Natural and Agricultural Sciences
Annual Report
2014

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Natural and Agricultural Sciences

Annual Report

2014

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Preface: Message from the Dean

Prof. Neil Heideman, Dean

Foreword

I am grateful to all staff and students for once again making our Faculty a great place to work and study, and for bringing accolades to the University through their achievements as highlighted in the departmental reports that follow.

This year (2015) being my final year as Dean, I wish to use this opportunity to provide a brief overview of our main achievements and challenges over the past five years. It has been a collective effort with exciting initiatives and projects driven with the support of various role players – on whose experience, wisdom, and commitment I could readily draw.

Staff

In 2010, a total of 132 out of the 209 full-time C1 staff members on the Bloemfontein Campus held doctorates (63%), compared to 159 out of 250 C1 staff members in 2015 (64%). For the QwaQwa Campus, the figure was ten out of 36 in 2010 (28%), and is currently 18 out of 42 (42%). The number of staff with an NRF rating increased from 57 to 64 over the five-year period, which would have been higher if not for several retirements. Significant about this growth is having a staff member with an A-rating after many years.

In eight departments on the Bloemfontein Campus, twelve black C1 staff members were appointed for the first time. In a further eight departments, eight additional black C1 staff members were appointed; giving a total of 20 black appointments over the five-year period. Apart from this, several black C2 staff members were also appointed. In six of the 22 departments (27%), female Academic Departmental Heads were appointed for the first time – two black and four white. At the QwaQwa Campus, one white and two black Subject Heads were appointed for the first time in its seven departments (43%). The position of Assistant Dean was created on the campus with the first incumbent being black.

Strategic Initiatives

Strategic plans that were developed include a general Faculty Strategic Plan, a Research Strategic Plan, a Postgraduate Strategic Plan, and a Broad-based Strategic Plan for improving our performance and stature with respect to agricultural training and research. A number of workshops, which will culminate in a Teaching and Learning Strategic Plan, has also been undertaken.

Apart from these initiatives, business plans were also developed for erecting two additional hothouses – of which one is nearing completion. A business plan for developing a part of the West Campus into a practical facility for mainly undergraduate practical training in agriculture has also been developed. A fully costed plan for the introduction of a Bachelor of Engineering in Agriculture degree is also nearing completion. One for introducing undergraduate training in agriculture at the QwaQwa Campus in 2016 is also currently being developed. A draft proposal for reconfiguring the Faculty into several Schools to better harness synergies, reduce routine administrative tasks for academic staff, and therefore improve performance, has been developed.

Undergraduate Student Access

Our Manager: Teaching and Learning must be credited with increasing the number of foundation programmes from three to six over the past five years; providing underperforming matriculants with potential a variety of well-structured and aligned programmes for gaining access to our agricultural and natural science main streams.

The matriculation subject level requirements for students to enter the mainstream of our degree programmes were also increased for mathematics, life sciences, and physical sciences. This has not only resulted in an improvement in the pass rate in most modules, but also in higher quality passes as more students achieved within the higher percentage intervals. The downside to this was a 9% decrease in enrolments, which was not substantial and is being addressed through aggressive marketing initiatives.

A meaningful recurriculation process took place, driven by the then Vice-Dean and the Manager: Teaching and Learning. The main outcomes were more coherent curricula, a reduction in the number of learning programmes, fundamental restructuring of programmes such as BSc Agric. and BSc Consumer Science, and the condensing of five Rule Books into one user-friendly document.

The average module success rates increased consistently from year to year; from 66.9% in 2010 to 81.3% in 2014 – in line with the benchmark set by the DHET. In terms of graduation rates, the 2010/2014 figures for the Bloemfontein Campus are as follows: professional

three-year bachelor's degrees: 81/114; professional four-year bachelor's degrees: 85/78; and general academic bachelor's degrees: 372/470. For the QwaQwa Campus, the figures for general academic bachelor's degrees are 48/49.

In general the undergraduate enrolments decreased over the past five years; requiring substantially better enrolment planning and marketing, as well as identifying new growth points to reverse the trend. The 2010/2015 figures are as follows: professional three-year bachelor's degrees: 383/492; professional four-year bachelor's degrees: 485/418; and general academic bachelor's degrees: 2306/2247. For the QwaQwa Campus, the figures for general academic bachelor's degrees are 384/424.

Recent introductions, which are already making an impact in enrolments, include behavioural genetics, forensic science – which is a very strong growth point, and a BSc with Physics and Engineering subjects. Once officially approved, the Advanced Diploma in Actuarial Science will also have a positive impact.

Postgraduate Student Performance

In many departments, the entrance requirements for the honours degree were raised to 65%. In terms of graduation rates, the 2010/2014 figures for the Bloemfontein Campus were 353/470, and for the QwaQwa Campus 16/15. At the master's and doctoral levels, the figures were 198/230 and 38/42 respectively.

In general the postgraduate enrolments also declined over the reporting period, requiring special attention. The 2010/2015 figures are 609/535 (honours), 952/759 (master's) and 235/242 (doctoral). Two actuaries were appointed in the Department of Mathematical Statistics and Actuarial Science; bringing the total for the first time to three. This makes it possible to offer master's degree training, which will assist in reversing the negative trend. The newly approved MSc in Mineral Resource Management will also make a difference. In terms of diversifying our postgraduate cohort, a total of 249 students from 20 different countries were enrolled in 2014.

In terms of FTEs, the 2010/2013 comparative figures for undergraduates and postgraduates collectively are 5269.4/5188.5.

Research Performance

The research unit output of the Faculty for 2010/2014 was 189.08/241.62, which represented a contribution of 35.9%/38.5% of the total output of the University. Our leading departments for this period were Physics, followed by Chemistry, and Soil, Crop and Climate Sciences. The appointment of a science writer helped to substantially boost our outputs as underperforming departments were assisted in improving their performance. The practice of having published papers by the time master's and doctoral degrees are awarded, is growing steadily and helps to improve our output. The utilisation of postdoctoral research fellows to strengthen capacity and increase outputs is much higher now than five years ago. State-of-the-art research equipment in various departments and divisions continue to grow – significantly boosting our capacity for cutting-edge research.

The Faculty was awarded its first Research Chair under the DST/NRF SARChI initiative. It is located in the Physics Department and focuses on Solid State Luminescent and Advanced Materials. Another major development has been the placement of the SADC Water Research Regional Office in our Institute for Groundwater Studies. Work by staff members at the QwaQwa Campus and the Directorate for Research Development towards developing a Montane Research Unit as key research driver at the campus is also underway.

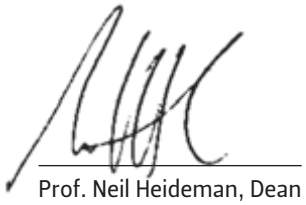
Finally, although strong and highly productive research teams already exist in the Faculty, an initiative was started to strengthen these further by way of research chairs which could grow into multidisciplinary/cross-faculty/cross-institutional Centres of Excellence. To this end, concept notes on a variety of highly relevant and leading-edge themes were developed. In the natural sciences, these include mine water management and multi-frequency astrophysics of high energy cosmic sources. Agricultural themes include the agriculture water footprint and crop improvement and protection, and in the building sciences, sustainable human settlements/communities and comprehensive design.

Infrastructure Development

Various individuals played a pivotal role in expanding the infrastructure of the Faculty for teaching and research. At the Bloemfontein Campus, new wings were added to the Physics and Biotechnology buildings, while Genetics now has a building of its own. The former building of Technology Education has been revamped and now houses the BSc with Physics and Engineering subjects' project, referred to a Project *Ensci*, the predecessor of the eventual introduction of the Bachelor of Engineering in Agriculture. One of two new glasshouses is also nearing completion. At the QwaQwa Campus an additional office block was added at the back of the original science building, while one of its glasshouses was revamped. The major addition, however, was a new building with lecture halls, laboratories, and staff offices for Geography and Physics.

As I leave the office at the end of September 2015, I close a chapter which represents a major highlight of my academic career. I am grateful for the opportunity given to me to lead and manage one of the premier science faculties of our country and I sincerely thank all staff for their loyal support over the past five years. A special word of thanks must also go to the staff in my office, with whom I enjoyed working. It was an honour to be involved with staff and students committed to academic advancement and excellence.

I wish you well in your future endeavours.



Prof. Neil Heideman, Dean

Agricultural Sciences

Department of Agricultural Economics

Overview

The 2014 year was filled with achievements and new partnerships. The year was especially good for the Department in terms of postgraduate student numbers. Not only did the Department have a record number of 66 students in the honours group, but also the largest group in the Faculty.

The Department also worked closely with various companies within the agricultural sector. These companies did not only assist with bursaries and funding, but also assisted in terms of new research ideas and research opportunities. This is very important for our Department, mainly because we strive to work closer with producers and the industry.

In terms of research, the Department is privileged to have long-term partnerships with research fund donors such as the Water Research Commission, Red Meat Research and Development South Africa, the National Research Foundation, and the Protein Research Foundation. The Department really appreciates this support from industry and research institutes.

In Agricultural Economics the personnel work together as a team and a family, thereby ensuring that we teach internationally recognised research expertise to entrepreneurial students and farmers. This makes the Department a world-class department with world-class standards. We are confident that we will do even better in 2015; with future visions in e-learning, short courses, and international research collaboration in water and livestock industries.

Activities and Achievements

Dr DB Strydom came in second place in the Excellence in Teaching and Learning Innovation Awards in the category Engagement and Student Learning. Dr Strydom also received a Faculty Award for Teaching and Learning in the category 35 years and younger.

Mr Petso Kohatla was one of 11 fellows nominated from three African countries (South Africa, Kenya, and Uganda) to participate in an international exchange programme in the United States. The Professional Fellows Program is directed by faculty members of Oklahoma State University, Stillwater, USA. The full name of this Bureau of Educational and Cultural Affairs-sponsored project is 'Empowering Aspiring Entrepreneurs for Economic Success in Sub-Saharan Africa: A Professional Fellows Program for Kenya, South Africa, and Uganda'.

Achievements of Students

At the annual Faculty prize-giving ceremony, the Department of Agricultural Economics was very proud of Mr Willie de Jager, who won the prize for the best honours student in Agricultural Economics, and Mr Jason du Preez, who won the prize for the best final-year B.Agric. Student in Agricultural Management.

Mr Frikkie Maré obtained a second place for the best Agricultural Economics master's study from the Agricultural Economics Association of South Africa at the annual AEASA conference.

The Department also had a record year in terms of postgraduate students.

Special Achievements

An article written by Dr Jordaan (main author), 'Conceptual framework for value chain analysis for poverty alleviation', published in *Agrekon*, has been included in an online article collection featuring the most downloaded articles published in Routledge Social Sciences Journals in 2014. The collection features the top three most downloaded articles that were published and downloaded in 2014 in each Routledge Social Sciences journal.

An article written by Mr Owusu-Sekyere (main author), 'Consumer preferences and willingness to pay for beef food safety assurance labels in the Kumasi Metropolis and Sunyani Municipality of Ghana', received the second prize at the AEASA conference for the best paper published in a professional journal.

Dr Bahta's (main author) article, 'The role of agriculture in welfare, income distribution and economic development

of the Free State province of South Africa', also received a second place award at the AEASA conference for the best paper published in *Agrekon*.

Activities

AGBIZ Conference 2014

The 2014 AGBIZ Congress (Agricultural Business Chamber) was held from 28–29 August in Somerset West in the Western Cape. Students in the Department of Agricultural Economics participated in the Student Case Study, where Mr Manfred Venter was on the winning team. Mr Herman Lombard was a winner in the Best Teamwork Effort, and Mr Venter was one of four outstanding individual students based on his contribution to the teamwork effort. Students from the University of Pretoria, University of KwaZulu-Natal, North-West University, and Stellenbosch University participated.

E-Learning

Prof. Steve Taylor, an Executive Director of the Centre of Distance Education from Mississippi State University, visited the Department of Agricultural Economics in July 2014. Prof. Taylor met with heads of departments of Economics, the Business School, Sociology, Economic Management, Centre for Sustainable Agriculture, Centre for Disaster Management, Environmental Management, and Mathematical Statistics, as well as the Dean of the Faculty, the Vice-Rector of Research, and the Dean of Humanities.

Prof. Taylor assisted the Department with a strategy to develop e-learning within the Department.

Following Prof. Taylor's visit, Mr Manfred Venter was invited to visit Mississippi State University in September 2014 in order to complete his master's studies and obtain assistance from colleagues at Mississippi State University.

IFAMA Conference 2014

Students from the Department participated in the International Food and Agribusiness Management Association conference. Five students were selected and were sponsored by Monsanto to compete in an international student case study competition. These students not only did the University proud, but also South Africa. They were runners-up in their division and just missed making it to the final round.

Students from Agricultural Economics participated in the IFAMA Conference held in Cape Town, 15–19 June 2014. From left: Manfred Venter, Morné Scheepers, Marcil Venter, Phillip Oosthuizen, and Willie de Jager.

Community Service

SAFEX courses are presented by Dr Dirk Strydom twice a year on campus and at the request of agribusiness off campus as well. Prof. Johan Willemse also hosts a quarterly market workshop where industry and farmers participate in order to evaluate new trends and developments within agricultural markets. The Department also assisted various agricultural schools within the Free State with the development of business plans in order to generate their own income.

Water Footprint Symposium held on 3 September 2014. From left: Drs Michael van der Laan, Brad Ridoutt, Ashok Chapagain, Gerhard Backeberg, Ms S. Munro, Dr Mark Gush, Ms B. le Roux, and Dr Henry Jordaan.

National and International Collaboration

Water Footprint Symposium 2014

The Water Footprint symposium was hosted by Dr Henry Jordaan on the main campus of the University of the Free State on 3 September 2014. The symposium was a collaborative initiative between the UFS, Water Research Commission (WRC), Red Meat Research and Development South Africa (RMRDSA), and the National Research Foundation (NRF). Two international experts, Dr Ashok Chapagain from the Water Footprint Network in the Netherlands and Dr Brad Ridoutt from CSIRO-Australia, presented overviews of the work they have done on water footprint assessments internationally to highlight the relevance of water footprint assessments in informing sustainable water use. Other scientists from South Africa involved in water footprint assessments were also invited to present the work they have done on the topic.

International Agri-Benchmark

The Department is in partnership with the International Agri-Benchmark network, specifically beef and sheep. In this programme, countries all over the world are compared according to their beef and sheep enterprises. Mr Walter van Niekerk, Mr Janus Henning, and Dr Dirk Strydom attended the annual conference in Italy. The research and data collection are conducted in collaboration with industry members such as Cape Wools, Red Meat Research and Development South Africa (RMRDSA), and the National Agricultural Marketing Council (NAMC).

Senwes Young Farmer Future Focus Day

At the Senwes Young Farmer Future Focus Day held at NAMPO Park, the Department invited Prof. Hamish Gow from Massey University to do a presentation on how farmers must approach the value chain from a consumer perspective. Dr Dirk Strydom and Prof. Hamish Gow were also invited to do a similar presentation to the management board of Senwes.

SANCID Symposium

The 21st SANCID symposium was held from 18–20 November 2014. This symposium of the South African Committee on Irrigation and Drainage celebrated its 21st year in the ICID family, and was attended by Dr Henry Jordaan, Prof. Bennie Grové, Dr Nicky Matthews, Messrs Berhande Haile, Morné Scheepers, Frikkie Maré, and Ms Marcil Venter.

Agricultural Economic Association of South Africa

The Annual AEASA conference was attended by Dr Dirk Strydom, Dr Yonas Bahta, Mr Moses Lubinga, and Mr Emmanuel Donkor from 28 September 2014 to 1 October 2014, where they all presented papers.

Postgraduate Students

The Department had 14 master's students, 66 honours students, and two PhD candidates in 2014.

Bursary Students for 2014

Agricultural Economics was in the fortunate position to have 13 postgraduate students sponsored by agribusinesses during 2014. Institutions that sponsored these students were BKB, Itau Milling, Veeplaas, RPO, ABSA, Beefmaster, and Silostrat. This sponsorship was launched by Prof. Johan Willemse in October 2009 and this programme has grown with many students working at the sponsoring companies during their academic breaks to gain experience.

Current projects in the Department:

Project Leader	Team Members	Project	Duration
Mr HN van Niekerk	Mr J Henning Dr D Strydom Mr F Maré Dr AC Geyer	AGRIBENCHMARK	RMRDSA (Cattle): 2013–2015 NAMC (Total project): 2013–2015
Dr AC Geyer	Prof. BJ Willemse Dr E Kotze Mr A vd Linde Mr J Stassen Mr P Mokhatla Mr I Staats Mr C Oberholzer Mr JL Venter	The establishment of economic farmer support programmes unlocking red meat potential for cattle, sheep, and goats.	RMRDSA: 2013–2015
Prof. B Grové	Miss M Venter Mr BO Haile July Hayward Ms P Madende Isabel vd Stoep Pieter van Heerden	The optimisation of electricity and water use for sustainable management of irrigation farming systems.	WRC: 2013–2017
Mr WA Lombard	Dr AC Geyer Mr HN van Niekerk	Financial implications of methods used to control livestock theft.	RMRDSA: 2014–2016
Mr HN van Niekerk	Mr J Henning Dr D Strydom Mr F Maré Dr AC Geyer	AGRIBENCHMARK	Cape Wools SA (Sheep): 2014–2016
Dr H Jordaan	Dr JH Barnard Dr MM Mekonnen Prof. LD van Rensburg Mr F Maré Dr G Scholtz Mr M Scheepers	Determining the water footprints of selected field and forage crops towards sustainable use of freshwater.	WRC: 2014–2019
Dr D Strydom	Dr J Batha Dr A Ogundeji Prof. J Willemse	KZN Agro Processing	University of Pretoria: 2014–2015
Mr H Lombard	Mr F Maré Dr A Ogundeji	Price transmission in the red meat value chain – The case of Bloemfontein, South Africa.	RMRDSA: 2014–2015

Delegates attending the 12th Agri Benchmark Beef and Sheep conference in Torino, Italy, 5–12 June 2014. Dr Dirk Strydom, Walter van Niekerk and Janus Henning represented the Department of Agricultural Economics.

Staff Matters

A previous postdoctoral student from the Department, Dr Yonas Bahta, was appointed as a full-time researcher. Dr Bahta made a noticeable contribution to the Department in terms of research in 2014.

Research Outputs

Research Articles

Bahta, Y.T. 2014. The impact of international oil price increases on the economy of the Free State province of South Africa. *International Journal of Food and Agricultural Economics* 21: 41-50.

Bahta, Y.T., Willemse, B.J. & Grové, B. 2014. The role of agriculture in welfare, income distribution and economic development of the Free State province of South Africa. *Agrekon* 53(1): 46-74.

Donkor, E., Ogundeji, A., Willemse, B.J. & Fadeyi, O. 2014. Effects of land tenure systems on resource-use productivity and efficiency in Ghana's rice industry. *African Journal of Agricultural and Resource Economics* 9(4): 286-299.

El Chami, D. 2014. Equity for an integrated water resource management of irrigation systems in the Mediterranean: The case study of South Lebanon. *New Medit* 13(4): 39-45.

Fadeyi, O.A., Bahta, Y.T., Ogundeji, A.A. & Willemse, B.J. 2014. The impact of the SADC free trade agreement on South African agricultural trade. *Outlook on Agriculture* 43(1): 53-59.

Fadeyi, O.A., Ogundeji, A.A. & Willemse, B.J. 2014. Establishing the linkages between South African agricultural trade balance and macroeconomic indicators. *Agrekon* 53(4): 92-105.

Jirgi, A.J., Grové, B., Jordaan, H, Viljoen, M.F. & Nmadu, J.N. 2014. Estimating Technical Efficiency and the Metatechnology ratio using the metafrontier approach for cropping systems in Kebbi State, Nigeria. *International Journal of Development and Sustainability* 3(2): 1538-1548.

Jordaan, H. & Grové, B. 2014. Conceptual framework for value chain analysis for poverty alleviation among smallholder farmers. *Agrekon* 53(1): 1-25.

Jordaan, H., Ogundeji, A. & Lubinga, M. 2014. East African community's trade potential and performance with European Union: A perspective of selected fruit and vegetable commodities. *European Scientific Journal* 1: 430-443.

Owusu-Sekyere, E. & Jordaan, H. 2014. Consumer preferences and willingness to pay for beef food safety assurance labels in the Kumasi Metropolis and Sunyani Municipality of Ghana. *Food Control* 46: 152-159.

Strydom, D.B., Van Zyl, H. & Willemse, B.J. 2014. Characteristics of potato contract producers in the South African potato processing industry. *Agrekon* 53(2): 65-82.

Staff

Professors: Profs BJ Willemse and B Grové.

Senior Lecturers: Drs AC Geyer, H Jordaan, DB Strydom, A Ogundeji, and Mr JJ van Staden.

Lecturers: Dr N Matthews, Messrs JIF Henning, P Mokhatla, HN van Niekerk, and FA Maré.

Junior Lecturers: Ms M Venter and Mr WA Lombaard.

Researcher: Dr YT Bahta.

Secretary: Mrs LP Hoffman.

Officers: Professional Services: Mrs C van der Merwe and Ms CS Combrinck.

Contact Details

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Department of

Animal, Wildlife and Grassland Sciences

Overview

The Department of Animal, Wildlife and Grassland Sciences experienced a year filled with challenges. The highlights focus on the postgraduate students graduating, the contributions to research, and community service delivered.

By focusing on the different disciplines and the efficient utilisation of the natural resources, alternative feed sources, the improvement of reproduction efficiency, and the acceleration of genetic progress in farm animals, the sustainable supply of quality animal production can be ensured. With droughts, escalating production costs, and the changing environment, the challenges facing animal production in Africa are ever increasing and subsequently, so too challenges to the Department.

To satisfy the national needs, the Department, with its high levels of expertise, is geared to meet the challenges. From the community Nguni projects in the Northern Cape and Free State to the sophisticated digestibility analyses in sheep and chickens, the Department was recognised by the livestock sector in South Africa during 2014.

Activities and Achievements

Several mega-farmers' days and trials were sponsored and presentations were made nationally in conjunction with the livestock industry (Voermol, the National Lucerne Trust, Supreme Chickens, Molatek, Nutri Feeds, the Department of Agriculture, etc.). The Department was intimately involved as judges in the Voermol National Cattle and Sheep Farmer of the Year competition (Profs J Greyling and H Snyman) and the National Stud Cattle Breeder of the Year competition in conjunction with Breed Plan (Prof. F Neser). A film crew from National Geographic and Discovery visited Mr F Deacon's PhD giraffe project – an indication of the international interest this project has generated.

Of the staff, five are NRF rated, while another four staff members are in an advanced stage of finalising their PhD studies and are thus potential rated researchers.

Achievements of Students

For 2014, 18 students obtained postgraduate degrees (12 BSc Hons, four MSc, and two Phd).

Activities

Short courses (sheep and cattle AI courses), as well as information (pig, cattle) and farmers' days were presented on campus, the experimental farm, and on private farms for students and farmers. The international Grassland Society of South Africa (GSSA) congress was organised by the Grassland section (Mr P Malan and Dr B Janecke) and held at the Phillip Saunders Resort at Maselspoort near Bloemfontein. This congress was attended by 150 delegates. Several workshops were also attended by the Animal Breeding Working Group in Pretoria (coordinated by the Agricultural Research Council).

Community Service

Three community projects are supervised by Prof. HO de Waal. The first is the Nguni project (Northern Cape and Free State province) in conjunction with the International Development Corporation (IDC) and respective provincial agricultural government departments, which has been effective in the training of black farmers for the past eight years. This project involves 90 farmers and approximately 1 000 animals (cows and bulls). The recognition received has been very positive.

Similarly, the use of *Opuntia* (cactus pear) as a potential animal feed is also being investigated. A national information day was held in 2014, and 52 hectares of prickly pear orchards have been established on 26 farms to investigate its use as an alternative feed source and also to help resource-poor farmers.

The third community project that is currently (from 2012 to present) being conducted is research into the impact of predators (jackal and caracal) on the livestock industry in the Free State. This problem is estimated to cost the livestock industry in South Africa more than R2 000 million annually. An MSc student (Agricultural Economics)

graduated in 2014 using the data generated from this project. Furthermore, Prof. H Snyman was actively involved in the community with surveys regarding the encroacher bush *Seriphium plumosum* (Slangbos, Vaalbos, or Bankrupt bush) and the impact of fire on the plant's productivity in arid and semi-arid grasslands. He enjoys international recognition for this research.

National and International Collaboration

Cooperation was maintained nationally with the Agricultural Research Council (ARC) (Irene, Glen, Grootfontein, Elsenburg) and the Department of Agriculture; while cooperation was also extended to the different breed societies, AI stations, and different feed manufacturing companies – especially by the Animal Science component of the Department. Most of the researchers were also involved as reviewers of local and international scientific articles. Prof. J Greyling served internationally as the Editor-in-Chief for an American research journal – an indication of the recognition that the Department enjoys internationally. Profs J van Wyk and F Neser have established linkages with French researchers in the field of Animal Breeding.

Postgraduate Students

Barring the postgraduate students who graduated, there are approximately 25 registered postgraduate students (MSc and PhD) in the different disciplines (Animal Nutrition, Animal Physiology, Animal Breeding, Grassland Science, and Wildlife Management) who are in various stages of progress; most research in the Department is driven by the postgraduate students. All research is basically focused on applied research as identified by the industry.

An Animal Physiology postgraduate student cleaning the sheep pens to ensure a healthy housing environment for the experimental animals.

Research

Most of Animal Science is focused on improving the reproduction efficiency (synchronisation, AI, in vitro fertilisation, and semen freezing in sheep, cattle, and chickens). The effect of different dietary levels of saturated and unsaturated fatty acids in the diets of sheep and chickens are being researched, as well as the effect of different quality (grades) of lucerne on the milk production levels of dairy cows (Dr G Scholtz).

Research Outputs

Research Articles

Banga, C.B., Neser, F.W.C. & Garrick, D. 2014. Breeding objectives for Holstein cattle in South Africa. *South African Journal of Animal Science* 44: 199-214.

Banga, C.B., Neser, F.W.C. & Garrick, D. 2014. The economic value of somatic cell count in South African Holstein and Jersey cattle. *South African Journal of Animal Science* 44(2): 173-177.

Bock, F., Fennessy, J., Bidon, T., Tutchings, A., Marais, A., Deacon, F. & Janke, A. 2014. Mitochondrial sequences reveal a clear separation between Angolan and South African giraffe along a cryptic rift valley. *BMC Evolutionary Biology* 14(219): 1-12.

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International Cactus Pear Workshop held at the UFS.

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International Cactus Pear Workshop held at the UFS.

Staff

Professors: Profs JPC Greyling, HO de Waal, FWC Neser, HA Snyman, GN Smit, and JB van Wyk.

Senior Lecturer: Dr AM Jooste.

Lecturers: Drs MD Fair, GDJ Scholtz, Messrs F Deacon, FH de Witt, OB Einkamerer, and PJ Malan.

Junior Lecturer: Mr MB Raito.

Junior Researcher: Dr BB Janecke.

Affiliated/Associate Professors: Profs M MacNeil, AZ van der Zijpp, Drs A Maiwashe, TL Nedambale, and MM Scholtz.

Technician: Mrs JAM van der Merwe.

Main Officer: Mr WJ Combrinck.

Officer: Professional Services: Mr G Janse van Rensburg.

Senior Officers: Mrs HMF Linde and Mrs EJC Nel.

Senior Assistant Officer: Mrs ML Palmer.

Technical Assistants: Messrs NK Long and SA Rowles.

Messenger: Mrs MV Moses.

Cleaner: Mrs NM Mokoallo.

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Department of

Plant Sciences

Overview

The Department of Plant Sciences is divided into three disciplines; Botany, Plant Breeding, and Plant Pathology. All three disciplines offer both undergraduate (BSc and BSc Agric) and postgraduate training up to postdoctoral level. In 2014, staff and students of the Department showed commitment, determination, and the will to work hard in the fields of research, teaching and learning, and community engagement. Research of a high standard was published in national and international peer-reviewed journals. The Department hosted 93 postgraduate students (20 honours, 33 master's, and 40 doctoral) during 2014, of which 14 obtained their degrees in 2014 (three honours, six master's, and five doctoral students).

Research Activities and Achievements

Botany: Plant Physiology / Biochemistry and Molecular Biology

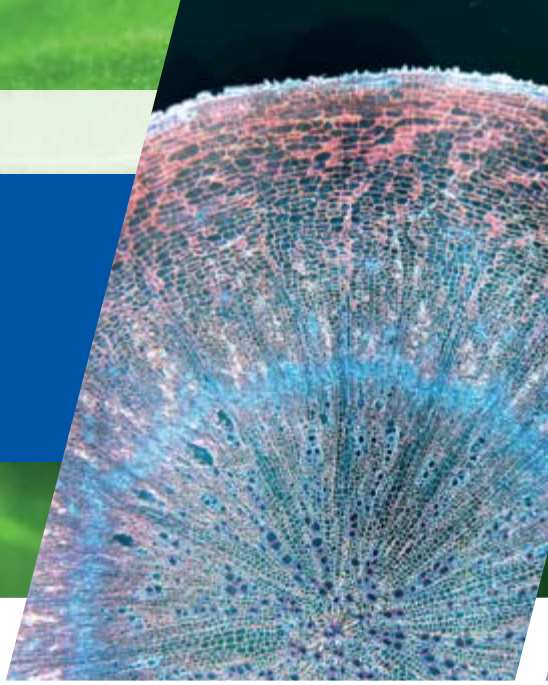
Research emphasis within this section is on molecular and physiological aspects of plant disease resistance and enhanced plant growth. Dr Botma Visser leads a research team that works on pathogenic fungi that cause rust diseases of wheat. Accompanied by Prof. Zakkie Pretorius, Dr Visser attended the annual Borlaug Global Rust Initiative (BGRI) Technical Workshop in Ciudad Obregón, Mexico. At the meeting, the 100th birthday of Dr Norman Borlaug, a Nobel Peace Prize recipient for his work on disease-resistant wheat breeding, was celebrated. A total of four contributions were made. Later in the year, Dr Visser visited the laboratory of Dr RF Park at the Plant Breeding Institute, University of Sydney, Australia. During the visit, he worked on a collaborative project that aims to confirm the earlier movement of stem rust urediospores from Africa to Australia across the Indian Ocean. This is achieved by DNA genotyping both current South African and Australian races, as well as herbarium specimens.

Dr Riana Viljoen is a postdoctoral student within this group who specialises in bio-stimulants. Bio-stimulants are used in agriculture to enhance crop yield and control disease by activating the plant's defence response. The bio-stimulatory ability of a *Lupinus albus* L. cv. Betsuhana White's seed suspension (SS) is currently being studied. The benefits of SS treatment include the recovery of photosynthesis after heat stress, a significant decrease in electrolyte leakage, and possible improved membrane stability.

Dr Lintle Mohase and her research group continued their work on plant defence mechanisms in wheat-to-insect (aphid) infestations. She collaborates with entomologists from the UFS (Prof. S vdM Louw) and the Agricultural Research Council Small Grain Institute (ARC-SGI) in Bethlehem (Dr A Jankielsohn). Her study focuses on the effect of commercial plant activators on priming plants for enhanced resistance to the Russian wheat aphid (*Duiraphis noxia*).

Dr Marieta Cawood's research focuses on extraction, identification, and utilisation of plant secondary metabolites to enhance growth and development, as well as disease resistance to pests and pathogens in plants. She collaborates with various national and international scientists, including Drs J Alleman (Soil, Crop and Climate Sciences, UFS), A Jankielsohn (ARC-SGI), S Bonnet (Chemistry, UFS), W Janse van Rensburg (Haematology and Cell Biology, UFS), and Profs ZA Pretorius (Plant Pathology, UFS) and B Moerschbacher (Westfälische Wilhelms-Universität Münster, Germany).

Dr Gerhard Potgieter continued his research in the fields of seed physiology and hydroponic cultivation of plants. His continued research on the control of reserve mobilisation during germination and early seedling establishment of lipid-rich seeds contributed to a better understanding of the 'oxygen sensing' mechanism(s) plants use to control cellular respiration, as well as the lipid-degrading process in these seeds. He is also involved in both the theoretical and practical aspects of the hydroponic cultivation of crops, which is specifically used as a tool to investigate the bio-catalytic potential of natural compounds from different organisms. The bio-catalytic potential of the secondary metabolites excreted by the symbiotic soil fungus *Trichoderma* is currently being evaluated on hydroponically grown tomato and spinach plants.



Botany: Plant Taxonomy and Molecular Systematics

The Plant Taxonomy Research Group is headed by Drs Lize Joubert and Mariëtte Jackson. Research in the Plant Molecular Systematics Group is currently focused on the phylogenetic relationships between certain groups or genera within the family Asteraceae. Within the Senecioneae tribe, relationships within the genus *Curio* were defined and a full taxonomic revision, that includes micro and macro-morphological data, contributed to the delimitation of the genus from its original genus, *Senecio*.

Botany: Paleobotany and Ecology

Due to his life-long interest, commitment, and contributions to the field of paleo-botany, Prof. Louis Scott was honoured by the National Museum, the UFS, and the Palaeontological Scientific Trust (PAST); all of which sponsored a conference with the title 'From Past to Present: Changing Climates, Ecosystems and Environments of Arid Southern Africa. A Tribute to Louis Scott'. The conference was held in Bloemfontein from 7–11 July 2014. It was followed by a two-day excursion to several sites in the Free State and Northern Cape province, including archaeological sites like the Wonderwerk Cave and Kathu Pan. Around 90 delegates, including at least 30 international delegates, attended.

Prof. Scott also attended the General Assembly of the European Geosciences Union held in Vienna, Austria, to present a multi-disciplinary paper on behalf of 13 co-authors. In July 2014, Dr K Sniderman, an Australian Research Council fellow at the School of Earth Sciences, University of Melbourne, visited the Department and Prof. Scott. Dr Sniderman is a palynologist who specialises in fossil pollen research and whose research focuses on vegetation and environmental change in the Late Cenozoic (the last 20 million years) period of the Southern Hemisphere.

Prof. Johann du Preez's research continued to focus on vegetation science with emphasis on the classification of the plant communities in the grassland, Nama Karoo, and savannah biomes of the interior of South Africa. Another aspect of this research is to update the vegetation map of the Free State province. This project forms part of the vegetation map of South Africa and will have a significant impact on the knowledge and management of the biodiversity of the interior of South Africa.

Mr Obed Mwenye (PhD student) studies soybean drought tolerance.

Plant Breeding: Molecular Plant Breeding

Prof. Liezel Herselman's research continued to focus on the introgression of different rust resistance genes and Fusarium head blight (FHB) resistance in South African wheat cultivars. Breeding for resistance is conducted using marker-assisted breeding combined with the application of the doubled haploid technique and biochemical screening of lines for good bread-making quality characteristics. A number of promising lines with a high number of rust or FHB resistance genes / quantitative trait loci (QTL), including resistance to new virulent race Ug99 (TTKSK) and related derivatives, have been developed and lines with improved FHB resistance were made available to three breeding companies in South Africa (ARC-Small Grain Institute, Pannar, and Sensako) for incorporation in their breeding programmes.

Dr Adré Minnaar-Ontong finalised her research project entitled 'The evaluation of wheat cultivars under irrigation for mycotoxin levels and FHB resistance'. She has started with a research project on the population genetics of *Sclerotinia sclerotiorum* on different hosts. This research serves as an initiative to develop a breeding programme for resistance against this pathogen in economically important crops like sunflowers and soybeans.

Plant Breeding: Wheat Quality and Crop Nutritional Value Research

Prof. Maryke Labuschagne continued with her research on wheat quality and the influence of environmental conditions and abiotic stress on gluten proteins. With the help of postdoctoral fellow, Dr Joyce Moloi, they have made good progress in the analysis of gluten proteins using different methods of analysis. During the year, Dr Angeline van Biljon conducted research on the baking quality of wheat and the nutritional value of wheat cultivars in South Africa. Dr Van Biljon initiated a laboratory in the Department for the analysis of beta-carotene for staple crops such as maize and cassava after receiving training at the International Maize and Wheat Improvement Center (CIMMYT) in Mexico.

2014 University of Johannesburg symposium delegation.

Prof. Labuschagne and Dr Van Biljon visited the University of Tuscia in Viterbo, Italy, for proteomics training. They characterised wheat storage proteins stressed with heat, drought, and low temperature using two-dimensional polyacrylamide gel electrophoresis analyses. The work was done in the Laboratories of Profs D Lafiandra and S Masci in the Department of Agriculture, Forests, Nature and Energy.

Dr Rouxléne van der Merwe continued her research on the newly initiated breeding programme on soybeans for human consumption, called Edamame, in collaboration with Dr M Smit of the Edamame Development Project in Durban.

Plant Pathology: Cereal Rust Diseases

During 2014, Prof. Zakkie Pretorius and his group continued their greenhouse and field studies on the three primary rust diseases of wheat. Projects included genetic mapping of stripe rust and stem rust resistance, remote sensing techniques to optimise phenotyping of field plots, assessment of rust response in recombinant lines with resistance derived from *Aegilops* and *Thinopyrum* spp., evaluation of South African and Australian wheat and triticale germplasm to Ug99 stem rust, and inheritance studies of stem rust resistance in local varieties. These projects were conducted in collaboration with CenGen, ARC-SGI, Sensako, Pannar and Stellenbosch University, CIMMYT (Mexico), the National Institute of Agricultural Biology (UK), Tel Aviv University (Israel), University of Minnesota (UM) and ARS-USDA (USA), and The University of Sydney (US) (Australia). Prof. Pretorius attended scientific meetings in Mexico (with Dr Visser), Turkey, and Brazil, where he presented results from research on some of the above topics. Dr B Steffenson (UM), Prof. R Park, and Dr D Singh (US) visited his programme in November.

Plant Pathology: Mycology

Dr Gert Marais leads the mycology group that focuses mainly on the biodiversity of fungi and their possible application and economic exploitation. During 2014, studies to understand the ability of *Trichoderma* species to enhance plant growth and the mechanisms by which these fungi are beneficial to the overall health of plants, were continued. A project in collaboration with the South African Pecan Producers Association (SAPPA) was initiated at the beginning of 2014 to monitor plant pathogenic fungi in pecan orchards over a three-year period in the Vaalharts and Prieska areas in order to identify the possible threats they pose to pecan production in South Africa. Studies are also being conducted on *Penicillium* species associated with the maize-milling process to understand the possible production of mycotoxins and how levels of these fungi and their toxins can be controlled. A project was also launched, in collaboration with Mr Du Toit Schabort from the Department of Microbiology, Biochemistry, and Food

Postgraduate students Lisa Coetzee and Danelle van Rooyen van Heerden inspecting sorghum research plots in Limpopo with project manager Mr Randy Bow (Texas AgriLife).

Biotechnology at the UFS, to screen *Penicillium* species from South African environments for their ability to produce flavours and fragrances, as well as pigments.

Dr Marieka Gryzenhout continued her research on disease and mycotoxin-producing fungi of the *Fusarium* and *Alternaria* genera in plants. Her focus is on the diagnostics of these various species, and she is developing identification schemes to rapidly identify these groups. She convened and co-organised the African Mycology Symposium with Prof. D Massebo (Cameroon) held during the XXth Association for the Taxonomic Study of the Flora of Tropical Africa (AETFAT) congress during January 2014 in Stellenbosch. This meeting also constituted the 6th General Assembly of the African Mycological Association, of which she was president at the time.

Plant Pathology: Epidemiology

The Field Crops Epidemiology Programme is led by Prof. Neal McLaren. Recent emphasis in this programme has been on the pathology of field crops in association with the Norman Borlaug Institute for International Agriculture and Texas A&M AgriLife Research in international collaborative projects seated in the Limpopo province. The two primary focus groups include cowpea/legumes and sorghum with Prof. McLaren and his team from the UFS as the primary collaborator on both projects. Further research support was received from the Sorghum Trust, with emphasis on sorghum plant and grain characteristics and their relationship with root and grain colonisation by mycotoxigenic *Fusarium* spp. and resultant mycotoxin levels. The stability of these relationships and the expression of the anti-fungal effects are being related to genotype x environment interactions and disease prediction modelling. Legume studies include crop rotation permutations with cowpea, soybean, and dry bean and associated disease suppressions and soil health. Evaluation of the dry bean and soybean National Cultivar Trials for disease susceptibility and risk analysis is also included, with emphasis on Sclerotium rot caused by *Sclerotium rolfsii*. During the season, collaborators from Texas A&M were received at trial sites and at the UFS. These included Dr J Foster (principle investigator (PI) for cow pea), Dr BB Singh (cowpea breeder), Dr F Workneh (plant pathologist), Dr G Peterson (PI sorghum programme and sorghum breeder), and members of their team. Dr M Chisi (ZamSeeds sorghum breeder) from Zambia is also a collaborator and regular visitor to the UFS and trial sites.

Community Service

Dr Botma Visser attended the annual Rotary Club Careers Day that was presented at Eunice High School for Grade 11 learners from various Bloemfontein schools. During three short presentations, he highlighted the career opportunities within Biotechnology to interested learners.

Special Achievements

Dr Botma Visser was awarded the first prize in the category Assessment Practices of the Excellence in Teaching and Learning Innovation Awards that were presented by the Centre for Teaching and Learning (CTL) at the UFS.

Dr Lize Joubert received the EM van Zinderen-Bakker prize for the best PhD in Botany.

Prof. Zakkie Pretorius obtained a B1-NRF rating.

Student Achievements

After attending the global 4-H Youth Ag-Summit (YAS) in Canada in 2013, the YAS primary sponsor, Bayer CropScience, invited Ms Lisa Coetzee in 2014 as a keynote

speaker at the South African National Seed Organisation's 25th anniversary congress as a youth representative. Her address greatly impressed the agricultural media, and in the weeks that followed, three articles were published: two in *Landbouweekblad* and one in *Famer's Weekly*. These articles highlighted the challenges in the agricultural sector and the lack of interest of the youth in agri-science as a whole. However, they also emphasised opportunities that these challenges present to the youth.

Mrs Ansori Maré received the Faculty's S_2A_3 medal for original research at master's level.

Ms Gerna Maree received the Faculty award for the best BSc Agric student, while Ms Anita da Costa, Mr Stefan Kassier, and Ms Marizelle van der Merwe received awards for the best final-year students in their specific disciplines, and Mr Pumzile Saba received the award for the best honours student in Botany.

A delegation of two lecturers and five postgraduate students from the Department attended the annual postgraduate symposium of the Department of Botany and Plant Biotechnology at the University of Johannesburg on 28 October 2014. Mr Stephan Kassier, a BSc Agric Hons student in Plant Breeding, received the prize for the best honours presentation during the symposium.

Mr Howard Castelyn, a doctoral student of Prof. Zakkie Pretorius and Dr Botma Visser, received the third prize in the category Best Student Poster at the annual BGRI Technical Workshop that was held in Ciudad Obregón, Mexico.

Ms Marcele Vermeulen, a doctoral student in Dr Marieka Gryzenhout's laboratory, attended the 10th International Mycological congress in Bangkok, Thailand.

Ms Joan Adendorff, a doctoral student of Dr Lintle Mohase, visited the NULANDIS Company in Gauteng where she presented her research findings to highlight the effect of plant activators (Alexin™) on plant defence responses.

Ms Ingrid Allemann, a master's student in Botany, received the prize for the best MSc presentation during the Kovsies' 3-Minute Thesis Competition held on 31 October 2014.

Ms Mardé Booyse, Mr Fred Philippou, Mrs Zelda Bijzet, Mrs Benhilda Masuka, and Mr Scott Sydenham obtained their doctoral degrees.

Mr Teboho Pitso (QwaQwa Campus), Mrs Maseka Malebana, Mrs Katleho Senoko, Ms Noncebo Mkhatywa, and Mrs Yolandi Muller obtained their master's degrees.

The Department hosted two postdoctoral students in 2014; Drs Joyce Moloi and Riana Viljoen.

Research Outputs

Research Articles

Agenbag, G.M., Pretorius, Z.A., Boyd, L.A., Bender, C.M., MacCormack, R. & Prins, R. 2014. High-resolution mapping and new marker development for adult plant stripe rust resistance QTL in the wheat cultivar Kariega. *Molecular Breeding* 34: 2005-2020.

Backwell, L.R., McCarthy, T.S., Wadley, L., Henderson, Z., Steininger, C.M., De Klerk, B., Barr, M., Lamothe, M., Chase, B.M., Woodborne, S., Susino, G.J., Bamford, M.K., Sievers, C., Brink, J.S., Rossouw, L., Pollarolo, L., Trower, G., Scott, L. & d'Errico, F. 2014. Multiproxy record of late Quaternary climate change and Middle Stone Age human occupation at Wonderkrater, South Africa. *Quaternary Science Reviews* 99: 42-59.

Crous, P.W. & Swart, W.J. 2014. Fungal plant descriptions sheets: *Phyllosticta mimusopisicola*. *Persoonia* 33: 222-223.

Figlan, S., Le Roux, C., Terefe, T., Botes, W., Visser, B., Shimelis, H. & Tsilo, T.J. 2014. Wheat stem rust in South Africa: Current status and future research directions. *African Journal of Biotechnology* 13: 4188-4199.

Gerrano, A.S., Labuschagne, M.T., Van Biljon, A. & Shargie, N.G. 2014. Genetic diversity assessment in sorghum accessions using qualitative morphological and amplified fragment length polymorphism markers. *Scientia Agricola* 71: 394-401.

Gerrano, A.S., Labuschagne, M.T., Van Biljon, A. & Shargie, N.G. 2014. Genetic variability among sorghum accessions for seed starch and stalk total sugar content. *Scientia Agricola* 71: 472-479.

Gil-Romera, G., Neumann, F.H., Scott, L., Sevilla-Callejo, M. & Fernández-Jalvo, Y. 2014. Pollen taphonomy from hyena scats and coprolites: Preservation and quantitative differences. *Journal of Archaeological Science* 46: 89-95.

Keet, J-H., Visser, B., Du Preez, P.J. & Cindi, D. 2014. Barberry Pirates. Two species of *Berberis* could become problem invaders in South Africa. *Veld & Flora* December 2014: 174-175.

Labuschagne, M.T., Mkhatywa, N., Wentzel, B., Johansson, E. & Van Biljon, A. 2014. Tocochromanol content, and protein and baking quality of white flour of South African wheat cultivars. *Journal of Food Composition and Analysis* 33: 127-131.

Labuschagne, M.T., Phalafala, L.T., Osthoff, G. & Van Biljon, A. 2014. The influence of storage conditions on starch and amylose content of South African quality protein maize and normal maize hybrids. *Journal of Stored Products Research* 56: 16-20.

Marsberg, A., Slippers, B., Wingfield, M.J. & Gryzenhout, M. 2014. Endophyte isolations from *Syzygium cordatum* and a *Eucalyptus* clone (Myrtaceae) reveal new host and geographical reports for the Mycosphaerellaceae and Teratosphaeriaceae. *Australasian Plant Pathology* 43: 67-77.

Metwally, A.A., Scott, L., Neumann, F.H., Bamford, M.K. & Oberhänsli, H. 2014. Holocene palynology and palaeoenvironments in the Savanna Biome at Tswaing Crater, central South Africa. *Palaogeography, Palaoclimatology, Palaeoecology* 402: 125-135.

Miles, C.W., Van Biljon, A., Otto, W.M. & Labuschagne, M.T. 2014. The relationship between selected mixogram parameters and rheological and baking characteristics in hard red bread wheat. *Journal of Cereal Science* 59: 219-223.

Moloi, M.J. & Van der Westhuizen, A.J. 2014. Involvement of nitric oxide in the Russian wheat aphid resistance response of wheat. *Cereal Research Communications* 42: 119-125.

Morojele, M.E. & Labuschagne, M.T. 2014. Prediction of bread-making quality using size exclusion high performance liquid chromatography. *African Crop Science Journal* 22: 31-43.

Mpofu, L.T. & McLaren, N.W. 2014. Ergosterol concentration and variability in genotypebypathogen interaction for grain mold resistance in sorghum. *Planta* 240: 239-250.

Ndhlela, T., Herselman, L., Magorokosho, C., Setimela, P., Mutimaamba, C. & Labuschagne, M.T. 2014. Genotype by environment interaction and stability analysis for grain yield of single cross

hybrids using GGE biplots. *Crop Science* 54: 1992-1999.

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Staff

Distinguished Professor: Prof. ZA Pretorius.

Professors: Profs MT Labuschagne, NW McLaren, and WJ Swart.

Associate Professors: Profs PJ du Preez and L Herselman.

Professor Extraordinary (contract): Prof. PW Crous.

Affiliated Associate Professors: Profs R Prins, M van der Bank, JJ van Rensburg, and M Zhou.

Affiliated Researchers: Drs L Rossouw and T Tsilo.

Lecturers: Drs ME Cawood, M Gryzenhout, M Jackson, GJ Marais, A Minnaar-Ontong, L Mohase, GP Potgieter, A van Biljon, R van der Merwe, B Visser, L Joubert, and Ms M Westcott.

Contract Staff: Profs JU Grobbelaar, L Scott, AJ van der Westhuizen, JHT Venter, and Dr A Venter.

Technical and Support Staff: Mmes CM Bender, NH Dlamini, LHA Molale, S Geldenhuys, N Janse van Rensburg, RI Rademeyer, C Steyn, Z van der Linde, Ms M Pienaar, Messrs D Jansen, G Moshodi, and HP Pretorius.

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Department of Soil, Crop and Climate Sciences

Overview

The Department of Soil, Crop and Climate Sciences specialises in the disciplines of Agrometeorology, Agronomy, and Soil Science; contributing to the agricultural programme of the Faculty of Natural and Agricultural Sciences of the University of the Free State. In addition to undergraduate and postgraduate teaching in the four disciplines, the Department also contributes to teaching at the Centre for Sustainable Agriculture, Rural Development and Extension, the Centre for Environmental Management, the Centre for 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 2014, an average of 40 postgraduate students were enrolled. Approximately 40% of these students come from Botswana, Eritrea, Ethiopia, Germany, Kenya, Lesotho, Malawi, Mauritius, Nigeria, Swaziland, the United States of America, Zambia, and Zimbabwe. We had six master's and five doctoral students who obtained their degrees.

Research in the Department is aimed at various aspects of the soil-crop-atmosphere system. Approximately R5 million was spent on research in 2014, 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), Kumba Iron Ore, SAB Miller, Bayer, Monsanto, Syngenta, Omnia Fertilizer Ltd., Potatoes SA, and Agraforum. Research findings were published in scientific journals as outlined in the Research Outputs. Furthermore, a wide range of oral and poster presentations were made; amounting to 24 at seven national conferences and eight at five international conferences.

Activities and Achievements

Agrometeorology

Dr Linus Franke joined this section as a senior lecturer from Wageningen University in the Netherlands. He attracted new research funding by participating in two WRC project proposals on nitrogen and phosphorus leaching in irrigated crop farming (led by the University of Pretoria), and the management of salt in irrigated systems (led by the UFS). Both proposals have a strong modelling focus and include funding for postgraduate research. The projects have been approved by the WRC and will run from 2015 until 2019. Moreover, funding has been attracted from Potatoes SA to study the impact of climate change on potato production in different regions of South Africa. This project is carried out in collaboration with the University of Pretoria (UP) and includes a position for a master's student.

Through the above-mentioned new projects, the collaboration with the Department of Plant Production and Soil Science at UP has been considerably strengthened. Moreover, collaborations between Agrometeorology and Wageningen University have been intensified through the joint supervision of doctoral students and a series of research articles jointly published or being developed. This is primarily through the efforts of Dr Franke.

Recurriculation gave rise to the inception of two new Agrometeorology modules. The module 'Agrometeorology for farming systems' is a fundamental course for undergraduate students in Agrometeorology and has a strong focus on the interactions between climate and agricultural production, albeit crop or animal production. The course is led by Ms Linda de Wet, with contributions from Dr Laszlo Lakatos.

The module 'Simulating biophysical interactions' is a key course for postgraduate students in Agrometeorology and has a strong focus on quantitative methods to model

Example of a continuous soil water measuring instrument installed at one of ten rangeland ecotopes in the Kolomela mine at Postmasburg.

weather-crop relationships, and includes the development and use of different crop models. The course is led by Dr Franke, with contributions from Mr Pieter van Heerden (doctoral student in Agrometeorology).

Dr Franke was invited as an expert to a technical meeting in Malawi to advise the country's government on adjusting the Farm Input Subsidy Programme – a programme providing subsidised inputs to millions of smallholder farmers. The meeting was organised by the Alliance for a Green Revolution in Africa (AGRA).

Ms De Wet and Dr Franke accompanied the Agro-meteorology interns and honours students to the 30th Annual Meeting of the South African Society for Atmospheric Sciences (SASAS), which took place at the Potchefstroom campus of the North-West University. The theme of the conference was 'Modelling and observing the atmosphere'. Ms De Wet, Dr Franke and, Ms Cassia Mlangeni (honours student) presented oral papers, while Ms Tumi Phatudi-Mphahlele (honours student) presented a poster.

Mr Stephan Steyn aided in organising the 48th Annual Conference of the Grassland Society of Southern Africa (GSSA), which took place at the Philip Sanders Resort and Conference Centre outside Bloemfontein.

Mr Phumudzo Tharaga (master's student) received an award as member of the best debating team at the DST/NRF Global Change Conference in Port Elizabeth.

The South African team consisting of Douw Bodenstein, Ian Smuts, Prof. Cornie van Huyssteen (coach), George van Zijl, and Darren Bouwer; attending the first International Soil Judging Contest.

Agronomy

Prof. Seef Pretorius, a leading light in the section and leader of the new crop development programme, retired at the end of 2014 after many years of service to the section. Dr Elmarie van der Watt was appointed to the section to fill this vacant position. Dr James Allemann was elected onto the board of the Southern African Weed Science Society.

Three members of staff, Mss Lize Henning, Anri de Vos, and Elzette le Roux, were awarded their master's degrees during the year.

Dr Gesine Coetzer was instrumental in establishing a tissue culture laboratory in the section to provide services mainly to the pecan industry, although a far wider application of the service is envisaged in the future. Dr Allemann conducted research for the potato industry; investigating suitable systemic herbicides for the control of volunteer potato plants, as well as writing a series of articles for the industry magazine (CHIPS) on the control of these problem plants. Dr Johan Barnard was involved in collaborative research with the Department of Agricultural Economics of the UFS, as well as the UP regarding water quality and use in the agricultural industry.

The specialty research areas in the section presently involve crop production systems with emphasis on plant nutrition and weed control, as well as the effect of salinity on crop water uptake and yield. Research is also being conducted on the effect of plant extracts as potential pesticides, and the use of plant growth stimulants for their potential in the alleviation of herbicide damage to plants.

Soil Science

The hydropedology research team of Prof. Pieter le Roux finalised research on 'The Hydrology of South African Soils and Hillslopes'. The project produced several products which are now applied by different institutions. The hydropedology leg, driven by Dr Johan van Tol, developed a hydrological hillslope classification system for South Africa, which has already been applied in hydrological research. Hydropedology is now applied in hydrology, urban hydrology, ecohydrology, and forestry. The digital soil mapping leg, led by Dr George van Zijl, has developed a protocol for the application of this technique. As in hydropedology, about five institutions are now applying the products.

Four students (Messrs Darren Bouwer, Douw Bodenstein, George van Zijl, and Ian Smuts), with Prof. Cornie van Huyssteen as coach, attended the First International Soil Judging Competition in South Korea, where they competed with participants from all over the globe. The competition was eventually won by a team from the USA – something that was to be expected because they have a long and proud history of soil judging. After the competition, all five presented papers at the 20th World Congress of Soil Science, which was also held in South Korea. Funding by the NRF to attend the Soil Judging Competition and the World Congress of Soil Science was critical, for which the team is infinitely grateful.

The research group of Prof. Leon van Rensburg consists of Dr Johan Barnard, Dr Sabelo Mavimbela, Dr Zaid Bello, Dr Mussie Zerisghy, Dr Andries Gouws (Barari Forest, UAE), Ms Andri van Aardt, and Prof. Rianto van Antwerpen (SASRI), as well as a number of master's and doctoral students. Dr Sabello leads the research on the hydro-physical properties of selected ecotopes at the Kolomela iron mine near Postmasburg; aiming to provide answers on how rainfall is partitioned between runoff, drainage, evaporation, transpiration, and deep drainage, since farmers are complaining that the dewatering of the mine has negative impacts on the groundwater supply and hence on their farming activities. Drs Zerisghy and Gouws have developed a computer model to manage the irrigation of trees using poor-quality water in arid parts of Abu Dhabi. Barari Forest Management is responsible for the management of about 140 000 ha trees in the Abu Dhabi Emirate. Dr Bello focuses on the water footprint of beer in a project sponsored by the Winter Cereal Trust and SAB Miller. This project focuses on the irrigation scheduling of barley and consists of glasshouse and field studies.

The research project entitled 'Vulnerability and resilience of soils under different rangeland use', financed by the Research Foundation of Germany (RFG), is in its second phase. This project is under the leadership of Profs Wulf Amelung and Chris du Preez, with Ms Elmarie Kotze as a team member in the final stages of her doctoral

Kirsten Unger, Elmarie Kotze, Palo Loke, and Alexandra Sandhage-Hoffman collecting soil samples in the Kuruman savannah.

studies related to this project. Soil sampling took place in the savannah biome near Kuruman and the samples were transported to Germany for analysing carbon and nitrogen isotopes.

Under the supervision of Profs Du Preez, Snyman (Animal, Wildlife and Grassland Sciences), and Ms Kotze, a master's student (Ms Portia Phohlo, employed by Woodland Dairies in Humansdorp), and a doctoral student (Mr Pieter Swanepoel, employed by the Western Cape Department of Agriculture in George) are investigating the soil quality of cultivated pasture in the Eastern and Southern Cape regions. Cultivated pastures in these regions form the base of dairy production, and the research is therefore funded in a joint effort by the public and private sector.

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

Research Outputs

Research Articles

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Staff

Professors: Profs CC du Preez, PAL le Roux, JC Pretorius, and LD van Rensburg.

Associate Professors: Prof. CW van Huyssteen.

Senior Lecturers: Drs J Allemann, GM Ceronio, GM Coetzer, L Lakatos, and E van der Watt.

Lecturers: Dr JH Barnard, Ms L de Wet, Ms E Kotze, and Mr AS Steyn.

Affiliate Professors: Profs CJ Stigter and S Walker.

Affiliate Associate Professors: Profs M Tsubo and R van Antwerpen.

Senior Officers: Professional Services: Mss YM Dessels and L Henning.

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Building Sciences

Department of Architecture

Overview

The year 2014 was a landmark year in the architectural community with the UIA (International Union of Architects) Architecture Otherwhere conference in Durban. It was the first time that such a conference was hosted on African soil, and provided several opportunities for the Department in terms of networking, education, marketing, and research.

This international event served as the platform for a special commemorative Sophia Gray exhibition celebrating the 25th year of this memorial lecture. Concurrently with the UIA exhibition, a catalogue was published as the first volume of a set focusing on 25 architects and their contribution to the South African and international built environment. Not only were the previous 25 years celebrated, but the 26th lecture was hosted in Bloemfontein as it has been done since 1989. This year's laureate, Mashabane Rose Architects, elegantly led in the next era of this proud tradition.

Achievements of Students

Once again, our students performed very well; receiving several national awards for design. In April 2014, Mr André Meyer was one of the three annual winners of the prestigious Carl and Emily Fuchs competition for architecture students in their third year of study, receiving R50 000 toward his studies.

Master's student Mr Marius du Plessis received the local first prize for his design of a National Geothermal Research and Education Centre in Johannesburg at the Regional Corobrik Student of the Year competition. Ms Anja Lareman received the second prize for her design for a psychiatric unit for the deaf in Worcester, and the third prize went to Ms Mariska Peel for a laboratory in the Post-oil Epoch in Durban. Mr Valentino Moutzouris received the Corobrik Award for the best use of clay masonry in his performing arts centre design for Wynberg, Cape Town. Third-year students designed a new parcade for the UFS main campus. This project was exhibited in the Architecture building, and two students were awarded prizes for their designs by Prof. Jonathan Jansen.

Activities

The Annual Winter School was once again a success. Grade 11 and 12 learners attended the two-day course designed to expose potential students to the architectural profession. The Department, in association with the Free State Institute of Architects (FSIA), hosted the first Bloembuild Expo in the Callie Human Centre. Students, professionals, and leading role players in the construction industry had the opportunity to attend CPD lectures, exhibitions, and compete in design competitions.

Staff members Messrs Jan-Hendrik Nel, Zack Wessels, Henry Pretorius, and Jako Olivier were the curators of exhibitions of architectural significance. The first exhibition, on the Sophia Gray memorial lectures of the last 25 years, took place at the UIA Architecture Otherwhere conference in Durban where students from all levels of study participated in building models. This exhibition was received very well on this international platform. At the second exhibition, during the 2014 Vryfees, student work was exhibited at the Department and an installation designed by Mr Jan-Hendrik Nel, called *Faces*, that also featured at the AfrikaBurn festival, was exhibited at the Department. Mr Kobus du Preez, in association with Mashabane Rose Architects, curated the 26th Sophia Gray memorial lecture exhibition at Oliewenhuis.

Third-year History of Architecture students had an exhibition of models of historic buildings at the War Museum that opened on Heritage Day.

Mr Jako Olivier also served on the scientific committee of the UIA Architecture Otherwhere conference, and Mr Jan Ras served on the organising committee. Messrs Jan-Hendrik Nel and Gerhard Bosman received an award for the best paper delivered in one of five categories at the CIAV 2013 conference in Portugal. The proceedings were published in 2014.

Community Service

Mr Hein Raubenheimer received a grant as part of the interdisciplinary research grants of the UFS for his project

Bloembuild 2014, Callie Human Centre.

with Ms Lizette Erasmus: Construction of a dwelling made from environmentally friendly 'cement'. The project is in the initial phase with completion expected in 2016. The house that will be constructed will be the future residence of Ms Mohatlane, who is the messenger of the Department.

National and International Collaboration

Several new collaborative efforts were launched close to home as well as abroad. A new association with the Department of Quantity Surveying ensures that architecture students are exposed to the impacts of the budget in large building projects at an earlier stage of their education. In turn, QS students are exposed to the way architects design projects and can gain an understanding into the need for specific elements that may impact on the management of building costs. An association with the Department of Art History and Visual Culture was also established on postgraduate level. Prof. Suzanne Human was involved in the redesign of the honours level Theory of Architecture course and students were introduced to multidisciplinary approaches in studio-based design.

On a professional level, a memorandum of understanding was signed with the Free State Institute of Architects (FSIA), ensuring future mutual collaboration between the two main role players in the architectural profession in the Free State. The Bloembuild Expo is jointly hosted by the Department and FSIA.

On an international level, the Department has begun a discourse with noted international architect, David Adjaye OBE, whose award-winning expertise will be introduced to the students in the future.

Models built by students for the UIA Sophia Gray exhibition in Durban. Messrs Henry Pretorius and Jan Ras (green hardhat) organising the set-up.

Postgraduate Students

The continuation of the weekly research seminars began in 2011 and has proven to be an insightful and productive activity. This year it took the form of an academic writing course. These seminars also provide staff members with the opportunity to give feedback on their studies, conferences they have attended, and assistance with aspects of higher degree study.

Staff Matters

Ms Wanda Verster received her BA (Hons) in Art History and Visual Culture cum laude at the autumn graduation.

Research Outputs

Research Articles

Bosman, G. & Van der Westhuizen, D. 2014. The effects of climatic conditions on attitudinal changes towards earth construction in South Africa. *Acta Structilia* 21(1): 117-141.

Bosman, G. & Van der Westhuizen, D. 2014. The impact of climate phenomena on attitudes toward traditional earth construction and decoration. *South African Journal of Art History* 29(3): 65-76.

Peters, W.H. 2014. Environmental management as a touchstone of modern identity: Hans Hallen's St Olav church, Berea, Durban, 1966 – 1968. *South African Journal of Art History* 29(3): 1-20.

Peters, W.H. & Du Preez, J.L. 2014. The "wall of flesh" of the Conquered territory: Farmhouses and towns established in defence of the eastern boundary of the Orange Free State beginning 1866. *South African Journal of Art History* 29(1): 201-223.

Verster, W. 2014. Observing the city: Imagining through faceless figures. *South African Journal of Art History* 29(1): 101-118.

Students during the group project to construct models for the Sophia Gray exhibition, taken in the Architecture Building. Mr Kobus du Preez is in the centre.

Chapters in Books

Du Preez, J.L. 2014. Introduction to Free State and Northern Cape and Department of Public Works building President Brand Street. In *Architectural Conservation in South Africa since 1994: 100+ projects*, edited by A. Heroldt. Port Elizabeth: Dot Matrix Printers.

Peters, W.H. 2014. Introduction to KwaZulu-Natal and Court of Appeal extension, President Brand Street, Bloemfontein. In *Architectural Conservation in South Africa since 1994: 100+ projects*, edited by A. Heroldt. Port Elizabeth: Dot Matrix Printers.

Stoffberg, M. 2014. Three Churches, Adamshoop, Thaba Nchu and Bloemfontein and House van Rensburg, Philippolis. In *Architectural Conservation in South Africa since 1994: 100+ projects*, edited by A. Heroldt. Port Elizabeth: Dot Matrix Printers.

Staff

Department Chair: Mr HB Pretorius.

Professor: Prof. WH Peters.

Associate Professor: Prof. JD Smit.

Senior Lecturers: Mrs MM Bitzer, Ms PN Tumubweinee, Mr JL du Preez, and Ms A Wagener.

Lecturers: Messrs G Bosman, WR Bitzer, and JW Ras.

Junior Lecturers: Messrs JH Nel, JO Olivier, H Raubenheimer, HB Pretorius, Z Wessels, S Moffat, W Terry, Mss KNE Saltzmann-McDonald, and M Stoffberg.

Secretary: Ms Y Pretorius.

Officer: Professional Services: Ms W Verster.

Messenger: Ms J Mohatlane.

Assistant Officers: Ms Z Bronkhorst and Mr L Keswa.

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Department of Quantity Surveying and Construction Management

Overview

The year 2014 was a fresh start for the Department of Quantity Surveying and Construction Management with the appointment of a new HOD, Prof. K Kajimo-Shakantu, and a new Programme Director, Dr Zulch. A total of 128 degrees were awarded to students; namely 43 BSc Learning area Quantity Surveying, five BSc Learning area Construction Management, 73 BSc Hons Learning Area Quantity Surveying, and seven BSc Hons Learning Area Construction Management degrees. A total of four Master in Land and Property Development (Structured) degrees and one doctoral degree in Quantity Surveying were awarded.

The Department also continues to offer various short learning programmes (SLPs), mainly targeting people who are already employed and/or who ordinarily may not have entered the university. SLPs such as the Facilities Management Programme (FMP) and Intensive Project Management Programme (IPMP) are offered in partnership with the South African Property Owners' Association (SAPOA). The Department prides itself on its degree programmes being accredited by national and international professional bodies.

Highlights of the Year

Dr MS Ramabodu, a product of the Department's 'grow your own timber' initiative, obtained his PhD degree in 2014. He is also the first black South African to obtain a doctorate in Quantity Surveying at the University of the Free State.

The Department won four paper awards at the 7th Quantity Surveying Research Conference in Pretoria. The recipients included Prof. Kajimo-Shakantu (best paper on engineering projects), Dr Ramabodu (best academic paper), and Mr Oosthuizen (most innovative presenter and best presenter). In addition, Prof. JJ Verster was presented with a lifetime-achievement award by the South African Council for Quantity Surveying Professionals.

At an international level, Mr Justin Haselau (an honours student supervised by Prof. Kajimo-Shakantu) won the prestigious Kenneth Humphreys Award for outstanding student paper entitled 'Alternative construction methods for low-cost housing in South Africa' at the ICEC conference held in Milan, Italy. Four other honours student papers by Elana Malherbe, Tshego Matshwi, Matlakala Radebe, and Marique Kamperbeek each received a commendation.

A total of 12 prizes from sponsors were awarded to a number of outstanding undergraduate and honours students in the Department at the April 2015 faculty prize-giving ceremony.

Research Specialisation Areas of the Department

The specialisation research areas include building information modelling, building materials, communication, construction industry development, construction project management, cost planning and management, education, training and development, ethics, facilities management, green building, health and safety, infrastructure delivery, land and property development management, procurement and supply chain management, project management, quantity surveying, restoration, risk management, skills development, and sustainability.

Staff Matters

The Department bade farewell to Mr Hendrik van Vuuren, a lecturer in the Department for 28 years who specialised in Construction Management. He headed the Centre for Construction Entrepreneurs that offered programmes to many men and women in construction who never had the opportunity to obtain formal training. The Department also welcomed two new lecturers on board in the latter part of 2013, Dr Tim Froise and Mrs Tascha Bremer, and two Senior Assistant Officers for Finance and for Distance Learning in 2014, Mr Ole Litheko and Ms Gago Mosala respectively.

Prof. Kahilu Kajimo-Shakantu, Mr Pierre Oosthuizen, and Dr Stephan Ramabodu with fourth-year students at the SACQSP Research conference.

Farewell party for the BSc Hons QS and CM students (2014), with Mr Hendrik van Vuuren (in blue shirt).

Research Outputs

Books

Hauptfleisch, A.C. 2014. *Basic construction technology*. Pretoria, South Africa: Construction Economics Associates (Pty) Ltd.

Hauptfleisch, A.C. & Sigle, H. 2014. *Structure of the built environment in South Africa.* Lynnwood Ridge, South Africa: Construction Economics Associates (Pty) Ltd.

Staff

Academic Staff

Head of Department: Prof. K Kajimo-Shakantu.

Contract Professor: Prof. AC Hauptfleisch (Midrand).

Senior Lecturers: Drs BG Zulch and MS Ramabodu.

Lecturers: Dr T Froise, Messrs HJ van Vuuren, PM Oosthuizen, M Letsie, Mss M-M Els, T Bremer, and E Jacobs.

Research Fellow: Prof. JJP Verster.

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Department of Urban and Regional Planning

Overview

Mr Piet Potgieter retired at the end of June after serving the Department for 19 years. Up to his retirement, he acted as Academic Head of the Department because Prof. Verna Nel experienced some health problems. Since his retirement, Dr Maléne Campbell has taken over the position.

Students discussing urban layout. From left to right: Ms C du Preez, Mr O Melokwe, Ms E Ramaila, and Ms B Sithole.

Student Energy Summit: Ms K Tale and Mr A van Aswegen

Activities and Achievements

Green Shift Africa has collaborated with Student Energy Canada to host the 1st African Student Energy Summit in Cape Town, South Africa. The Africa Student Energy Summit (AfSES) is powered by the Student Energy movement, in partnership with Green Shift Africa. This is the first time when a summit, which directly targets young African leaders, addressed energy issues on African soil. During June 2014, the Department, together with the UFS, sent 14 full-time honours students to this summit.

Achievements of Students

The following students presented papers at the biannual conference of the South African Planning Institute (SAPI) in October 2014 in Durban: Mr Ashley Hay, Ms Louisa Erasmus, Mr Paul Thakanyane, and Ms Thato Rapelang. Thato Rapelang also presented a paper at the international conference of the South African Housing Foundation (SAHF) in September 2014 in Cape Town.

Community Service

The master's students researched the viability of a development axis along the N8 highway between Bloemfontein and Maseru for the Applied Regional Planning Project module. Their partners were town planners at the Mangaung Metropolitan Municipality and Maseru City Council.

International Collaboration

Dr Maléne Campbell visited the Global Urban Research Unit at Newcastle University as an EU-Saturn staff mobility grantee.

Staff Matters

Dr Lize Barclay resigned early in 2014 to start an NGO and in the middle of 2014, Ms Thulisile Mphambukeli, a full-time PhD student supervised by Prof. Verna Nel, and Mr Thomas Stewart were appointed as lecturers. Prof. Das Steÿn, the editor of the *Journal for Urban and Regional Planning*, was appointed as a research fellow, while Mr Stuart Denoon-Stevens and Mr Kgosi Mocwagae were appointed as junior lecturers. Ms Emma Ramaila was appointed as an NRF Intern.

Research Outputs

Research Articles

Donaldson, R., Campbel, M., Benn, J. & Jager, A.D. 2014. Reshaping urban space through studentification. *Urbani izziv* 25(s): S176-S188.

Rex, R., Campbel, M. & Visser, G. 2014. The on-going desegregation of residential property. *Urbani izziv* 25(s): S5-S23.

Chapters in Books

Denoon-Stevens, S. 2014. Using land use management to create transit-friendly cities. In *How to Build Transit-Oriented Cities*, edited by G. Bickford. Johannesburg: South African Cities Network. pp. 98-119.

Denoon-Stevens, S. 2014. The role of land management in shaping (or preventing) the creation of sustainable human settlements. In *From Housing to Human Settlements: Evolving Perspectives*. Johannesburg: South African Cities Network. pp. 123-148.

2014 Master's Graduation – Mr C Tjipetekera, Mr Z Khuzwayo, Prof. VJ Nel, Mr PM Botha, and Mr S Sekonyela.

Staff

Professor: Prof. VJ Nel.

Senior Lecturer: Dr MM Campbell.

Lecturers: Ms TN Mphambukeli and Mr TM Stewart.

Junior Lecturers: Messrs S Denoon-Stevens and KS Mocwagae.

NRF Intern: Ms ME Ramaila.

Research Associate: Prof. JJ Steÿn.

Secretary: Ms RM Hugo.

Senior Assistant Officer: Ms LA Nel.

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Natural Sciences

Department of Chemistry

Overview

The Department of Chemistry continued to focus on the strategic priorities of the UFS and the Faculty of Natural and Agricultural Sciences. The postgraduate core of Chemistry for 2014 on the main campus consisted of eight postdoctoral associates, 29 MSc, and 27 PhD students in different sub-disciplines; of whom five PhD and nine MSc students graduated during 2014. A significant and sustained research output for 2014 was maintained, as manifested by the 59 research articles published in internationally accredited journals and 79 presentations made at local and international conferences.

The enthusiasm and commitment of Chemistry's personnel and students were clearly illustrated by activities throughout 2014. The continued support of the Faculty and senior UFS management, and in particular all personnel from Chemistry on all levels, to achieve even higher levels of success, is gratefully acknowledged.

Structure of and Activities in Chemistry

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

The **Inorganic Chemistry** division focuses on Coordination Chemistry and the integrated investigation of Reaction Mechanisms through the use of crystallography, spectroscopy, computational chemistry, and reaction kinetics. Three sub-research thrusts probe the applications to medicine (radiopharmaceutical and chemotherapeutical), 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), supported by Prof. Deon Visser, Drs Johan Venter, Alice Brink (holder of a THUTHUKA research grant), Marietjie Schutte-Smith, and Ms Amanda-Lee Manicum. The group also had four postdoctoral associates, nine MSc, and 11 PhD students; of whom one PhD and four MSc students graduated during 2014. Both Drs Brink and Schutte-Smith are UFS prestige scholars.

Prof. Deon Visser delivered one keynote address, Prof. André Roodt delivered one plenary and two keynote addresses, and Drs Johan Venter and Alice Brink presented nine lectures at international conferences in Spain, Mauritius, Singapore, Italy, Japan, and South Africa.

Other highlights from the Inorganic Division include contributions to 21 research articles in international chemistry literature (ISI journals), and the presentation of 30 posters at six international conferences.

The **Organic and Process Chemistry** division is headed by Prof. Ben Bezuidenhoudt (NRF C3-rated) with Drs Susan Bonnet and Anke Wilhelm as lecturing staff, and Mr Rudi Swart as the technical officer. The groups produced ten papers in the international chemistry literature, while seven MSc and PhD students were studying towards higher degrees. Two graduated during 2014. Dr Johannes van Tonder is employed by PETSLabs Pharmaceuticals but has been seconded to the UFS as a lecturer until the end of 2016.

The division focuses on synthetic organic chemistry, isolation of natural products, and the industrial application of processes.

Drs Susan Bonnet and Anke Wilhelm-Mouton attended workshops and conducted a number of research visits to Europe as part of the MUTHI project and the International Research Staff Exchange Scheme (IRSES) to establish collaboration between the project partners as part of the Framework 7 hERG-screen project.

The **Physical Chemistry** section has four distinct and separate research groups which are independently headed by Profs Jannie Swarts and Jeanet Conradie, and Drs Ernie Langner and Lizette Erasmus. Prof. Swarts (C1), Prof. Conradie (C1), and Dr Erasmus (Y2) are NRF-rated researchers in the division and are supported by 11 postgraduate students and four postdoctoral associates.

Chemistry personnel and students: November 2014.

The Division published 19 publications in high-impact journals, attended nine conferences, and made seven oral presentations and seven poster contributions.

Profs Swarts and Conradie both hold two NRF research grants (Rated Researcher and Competitive Rated Researcher). Dr Erasmus holds a Rated Researcher NRF grant, while both Drs Langner and Müller are holders of NRF Thuthuka grants. The Swarts, Erasmus, and Langner groups were also funded by research grants from SASOL.

The Swarts Group focuses on synthetic and physical chemistry aspects of multinuclear metallocenes, and concentrates on porphyrin and phthalocyanine compounds bearing metallocene substituents such as titanocene, zirconocene, ferrocene, ruthenocene, and osmocene derivatives, especially in association with late transition metals; electrochemical, kinetic, and thermal analyses of these complexes; medicinal aspects of these complexes; and industrial studies on carboxylato complexes and heterogeneous catalysis of systems supported on two-dimensional matrices in collaboration with SASOL.

The research of the Conradie Group focuses on the characterisation of transition metal complexes and intermediates by synthetic and computational chemistry. Transition metal porphyrin and related compounds, O,O'-Chelated titanium complexes, beta-diketonato-carbonyl complexes of rhodium(I) and rhodium(III) and dithizonato compounds of transition metal complexes are currently also being investigated.

Dr Erasmus' group focuses on heterogeneous catalysis of especially model catalysts on flat surfaces and materials characterisation with XPS techniques. Conversely, Dr Langner studies Metal Organic Frameworks (MOFs), especially for catalysis, gas adsorption and desorption studies, and thermal analysis thereof.

Analytical Chemistry has Prof. Walter Purcell (NRF C3-rated) as the division head, with Drs Karel von Eschwege (NRF C3-rated) and Rebotsamang Shago. The Division was supported by two PhD and six MSc students.

The group focuses on a number of analytical and inorganic projects. The former concerns 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 quantify the different elements therein. These projects are conducted in collaboration with the Nuclear Energy Corporation of South Africa's (NECSA) Advanced Metals Initiative (AMI).

Serious discussion at BloemCrystSchool2 between MSc students. From left to right, Pennie Mokolokolo, Orbett Alexander, Tom Kama, and Daniel Marake.

Unveiling a special plaque in Poznan, Poland, as part of the festivities of the UNESCO International Year of Crystallography (2014) to commemorate the work of Max von Laue a century ago, are Profs André Roodt, president of the European Crystallographic Association, and Gautam Desiraju, president of the International Union of Crystallography.

Different advanced analytical techniques are employed, such as microwave and acid dissolution procedures, while Inductively Coupled Plasma (both Optical Electronic and Mass Spectroscopy, and OES and MS), Graphite Furnace Atomic Absorption Spectroscopy (GFAAS), and Infrared and UV/visible spectroscopy were used for the identification and quantification of the different elements – with ISO 17025 criteria as benchmark. Other techniques such as X-ray Diffraction and X-ray Fluorescence (XRD, XRF), Differential Scanning Calorimetry (DSC), and Thermal Gravimetric Analysis (TGA) are also utilised. Elements which are currently investigated are niobium, tantalum, zirconium, and rhodium. Numerous samples were analysed for private individuals, as well as local and national companies.

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

In yet another thrust, the group is involved in the investigation of photochromic reactions in different transition metal complexes, with potential applications in high-density optical molecular switching mechanisms. Techniques such as Pulsed Laser, UV/visible, IR, NMR, Cyclic-Voltammetry, Quantum Computational Chemistry (ADF & Gaussian), and X-ray Crystallography are employed. The Analytical section was responsible for the element analyses for other groups in the Department of Chemistry, Geology, Physics, and Microbiology.

Achievements of Students

Mr Renier Koen from Inorganic Chemistry won the prize for the best oral presentation by a student at the national conference of the Advanced Metals Initiative from the DST/NRF held in Gauteng in October 2014.

The Organic group of Prof. Bezuidenhoudt attended the Binational Organic Chemistry Conference (BOCC-14) in Stellenbosch and made three student oral and six poster presentations. The group received three student awards: Ms Tanya Pieterse won second prize for the best student oral presentation, Ms Maretha du Plessis was the runner-up for most popular student oral presentation, and Mr Johannes van Tonder and Ms Tanya Pieterse received a special mention for the quality of their poster presentations.

Special Achievements

Prof. Jeanet Conradie was ranked number one of the top ten researchers at the UFS in terms of published outputs per impact factor of journals, and number ten of the top ten researchers at the UFS in terms of the number of publication output units (POUs). She also made the

Part of the more than 100 delegates at the Pan African Conference and Summit of the International Year of Crystallography in Bloemfontein, and 18 African country signatories of the Declaration to promote Science in Africa via Crystallography.

front page with her publication in Inorganic Chemistry (2014, 53(11): 5405-5874). Prof. Conradie was also the 2014 runner-up for the South African Government's DST (Department of Science & Technology) South African Women in Science award, she was elected as member of the Academy of Science of South Africa (ASSAF), and was appointed as Physical Chemistry editor of the South African Journal of Chemistry.

Prof. André Roodt presented two keynote addresses and one plenary lecture in Spain (Santander and Oviedo) and Italy (Pavia). He also hosted and presented the Pan African Conference of the International Year of Crystallography, IYCr2014Africa, in Bloemfontein in October 2014. During this meeting, which was one of only three world summits commissioned by the International Union of Crystallography (IUCr) during 2014 as the UNESCO International Year of Crystallography, a declaration was signed by all delegates and signatories from 18 African countries to promote science in Africa via Crystallography. Prof. Roodt also hosted the 2nd International Workshop on Crystallography, BloemCrystSchool2, in Bloemfontein during August. Prof. Deon Visser, Drs Marietjie Schutte-Smith, Johan Venter, Alice Brink, and Truidie Venter formed part of the Organising Committees of these meetings. Prof. Roodt was awarded an honorary medal from the Moroccan Crystallographic Association for his work to expand science in Africa via crystallography.

Prof. Visser presented an invited lecture (Singapore) and a keynote lecture (Mauritius), while Dr Johan Venter presented two invited lectures in Singapore and Japan.

Prof. Roodt acted as the dean for the third time for the prestigious South African Young Scientist Summer School Programme (SA-YSSP) for the three-month period from 1 November 2014 to 31 January 2015. The SA-YSSP was

Honours at conferences for Profs Deon Visser (right) and André Roodt, with a scroll for producing the best student speaker for the year in a row, Renier Koen, at an AMI conference. An honorary medal from the Moroccan Crystallographic Association was awarded to Prof. Roodt at IYCr2014Africa and the best poster award was awarded to postdoctoral fellow, Marija Zibacnik, visiting from Croatia.

again hosted by the UFS under the auspices of the NRF and the International Institute for Applied Systems Analysis (IIASA) in Austria. It included 35 supervisors from 16 countries and hosted 27 international students (selected from over 70 applications) from 12 countries. Prof. Roodt also unveiled a commemorative plaque in Poznan, Poland, during April in honour of Max von Laue to acknowledge the ground-breaking work this scientist has produced in crystallography. Profs André Roodt and Deon Visser won a

special award at the Advanced Metals Initiative conference for having produced the winning oral student presentation for the past three consecutive years.

Activities

Prof. Roodt served on behalf of the ECA on the council (20 permanent organisation members) of the Initiative for Science in Europe, which includes more than 330 000 individual scientists as members. He was also a member of the international editorial board of the Journal of Coordination Chemistry. He was also invited to present the annual lecture on the occasion of the announcement of the Nobel Prize for Chemistry for 2014 at the Swedish Embassy in Pretoria. As president of the European Crystallographic Association (ECA), Prof. Roodt chaired the executive meetings of the ECA in Rovinj, Croatia, in February, and in Montreal, Canada, in August, as well as the council meetings of the ECA in Montreal during August.

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

Dr Linette Twigge, manager of the Nuclear Magnetic Resonance facility, assisted more than 20 postgraduate students from the different research groups with delicate and advanced multi-nuclear NMR experiments, while Prof. Conradie visited the University of Tromsø, Norway, to present research lectures and continue with research collaboration.

Community Service

Most lecturers were involved in continuous career guidance and laboratory demonstration sessions to individuals and school group learners, and contributed to the University's open and expo days.

Drs Karel von Eschwege and Rebotsamang Shago assisted different learners with Eskom Science Expo projects. Dr Von Eschewege presented an invited lecture at the 2014 National Science and Technology Workshop entitled 'The Global Energy Status, SA, and Solar Alternatives'. Based on this, he was also invited to present a faculty lecture, was involved to a radio talk show on this topic, and gave an invited presentation to the Department of Science and Industry in Cape Town.

Drs Johan Venter and Ernie Langner, assisted by Dr Blenner Buitendach, presented the Chemistry Magic Show on seven occasions at different Bloemfontein schools and other venues. This initiative illustrates different aspects of simple but exciting experiments in a tangible way to create awareness of chemistry and to inspire primary and secondary school learners' and teachers' interest in chemistry. It was also presented as part of the UFS first-year teaching initiative, UFS101, across all subject disciplines.

Mrs Ina Du Plessis assisted in organising a Minquiz session at the Department; Minquiz being one of the Faculty's five community service flagships. All colleagues from Physical Chemistry, with special efforts from Drs Ernie Langner and Buitendach, contributed to the success of this session.

Dr Erasmus was involved in a community project to build a house for an underprivileged staff member; she was responsible for research on producing a new type of cement for the house.

Prof. Conradie was the chairperson of the Interest group for High-Performance Computing (HPC) at the UFS, and the representative of HPC on the Academic IT Workgroup. Since many of the first-year Chemistry students experience problems with Physical Chemistry, in particular with the more mathematical topics, Prof. Jeanet Conradie wrote several computer-based question-and-answer quiz programs to help develop their skills in the first year Physical Chemistry curriculum. All these quiz items are incorporated in the ILEARN programme at the UFS, which also enables access for the students to test and examination papers and answers and results.

Dr Langner was secretary for the HPC group during 2014. He was also a judge at the Expo for Young Scientists, and assisted a learner from Eunice High School with a project for the National Expo.

A significant number of colleagues acted as external reviewers for different international chemistry journals and represented the UFS on international research councils. Prof. Swarts serves in this capacity for the Irish Health Board.

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

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

National and International Collaboration

Dr Von Eschwege collaborated with Prof. H Schwoerer at the National Laser Research Institute at Stellenbosch University, and also initiated a collaboration with the Crystallography division at the University of Pretoria, and with Prof. S Titinchi at the University of the Western Cape. The Purcell group has research collaboration with Dr Johann Nel from NECSA and Prof. Herman Potgieter from the Manchester Metropolitan University in the United Kingdom.

The group of Prof. Jannie Swarts collaborates with Prof. Mike Cook (University of East Anglia, Norwich, England, on phthalocyanines); Prof. Manuel Aquino (Saint Francis Xavier University, Antigonish, Canada, on metal carboxylates); Prof. Bill Geiger (University of Vermont, Vermont, USA, on electrochemistry); Prof. Henry Lang (Chemnitz Technical University, Germany, on metal carboxylates and electrochemistry); Prof. Hans Niemantsverdriet (the Schuit

Inorganic postgraduate students and young colleagues.

Institute of Catalysis Technical University, Eindhoven, The Netherlands, on heterogeneous catalysis); and Dr Daniela Bezuidenhout (University of Pretoria, on carbene electrochemistry). Prof. Niemantsverdriet visited Prof. Swarts in November 2014 to further existing collaboration in the field of heterogeneous catalysis.

The Conradie group has international collaboration with Prof. Abhik Ghosh and Dr Katherine Hopman (Department of Chemistry, University of Tromsø, Norway); Prof. Todd C Harrop (Department of Chemistry, University of Georgia, Athens, USA, on computational chemistry); Prof. Penny Brothers (Auckland, New Zealand); and Dr Marile Landman (University of Pretoria). Dr Lizette Erasmus collaborates with Prof. B Gates from the University of California at Davis, USA.

The Roodt Group's research on medical aspects of pharmaceutical model compounds, in collaboration with Dr Hendrik Engelbrecht from Precision Nuclear in Tennessee, USA, the University of Zürich, Switzerland (Prof. Roger Alberto), NECSA, under the Nuclear Technologies in Medicine and the Biosciences (NTeMBi) programme, and PETLabs Pharmaceuticals / Klydon Gas (Dr Gerdus Kemp), again showed good progress. The project 'Development of Novel Theranostic Pharmaceuticals' of Prof. Roodt with Prof. Roger Alberto (Zürich) sourced more than R1 million from the NRF and the Swiss National Science Foundation (NSF).

Prof. Deon Visser continued the research collaboration with Dr Fabio Zobi from the University of Fribourg, Switzerland, Prof. Demetrius Papadopoulus, from Athens, Greece, as well as with Dr Gregory Smith from the University of Cape Town.

The Roodt group's 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 (DST) continued and sourced over R600 000 for bursaries and project expenses for three PhD students. The project 'Organometallic Complexes of the Platinum Group Metals', in collaboration with Prof. Vadim Kukushkin from the St Petersburg State University in Russia, provided exchange funding for supervisors and four PhD students.

Dr Alice Brink spent four months in Prof. John Helliwell's group at the University of Manchester in the United Kingdom. Dr Alice Brink, Dr Truidie Venter, and Ms Carla Pretorius were invited to attend the special school in Split, Croatia, on 'Hot Topics in Contemporary Crystallography' in June.

The Organic Chemistry group (Drs Susan Bonnet and Anke Wilhelm) collaborates with the Medical Research Council (MRC) under the MUTHI project with the European Union (EU), initiated by the late Prof. Andrew Marston, as well as with Dr Merlin Wilcox from the University of Oxford and Dr DG Reid from Cambridge University.

Other international collaboration includes a project under Framework 7 of the EU with the Universities of Oslo, Bergen, Bamako, the Western Cape, Amsterdam, and the Makerere University. They also collaborate under the Framework 7 hERG-screen project with the University of Innsbruck, the National and Kapodistrian University of Athens, University of Basel, the Biomedical Research Foundation of the Academy of Athens, and the University of Vienna.

The Bezuidenhoudt group collaborates with Chemical Process Technologies (Pretoria), Wildlife Pharmaceuticals (Nelspruit), and with PETLabs Pharmaceuticals on the synthesis of compounds with medical applications.

Staff Matters

Mr Solomon Leroala retired from the Department after more than 47 years of dedicated service. The Department will dearly miss Solly, who was an inspiration to both junior and senior staff and students.

Research Outputs

Research Articles

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Staff

Distinguished Professor: Prof. André Roodt.

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

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

Associate Professors: Profs Robert Dennis and Deon Visser.

Senior Lecturers: Drs Susan Bonnet, Ernie Langner, Karel von Eschwege, Lizette Erasmus, and Johan Venter.

Lecturers: Drs Rebotsamang Shago, Eleanor Müller, Linette Twigge, Alice Brink, Marietjie Schutte-Smith, Charlene Marais, Anke Wilhelm-Mouton, and Mrs Amand-Lee Volmink-Manicum.

Subject Coordinators: Ms Rina Meintjes (Programme Director: Bloemfontein and South Campus), Dr Charlene Marais (Programme Director: South Campus), and Dr Johan Venter (Programme Director: Bloemfontein Campus).

Secretary: Mrs Alet van Rooyen.

Chief Officers: Professional Services: Mr Charles Smith, Mrs Tessa Swarts, Dr Truidie Venter, and Dr Marianne Conradie-Bekker.

Officers: Professional Services: Messrs Michael Coetzee and Rudi Swart.

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Department of Computer Science and Informatics

Overview

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

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

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

The Department also forms part of the new Engineering Sciences project at the UFS as we are responsible for presenting the programming modules for students following this programme.

Activities and Achievements

A two-day workshop for master's and doctoral students was held at the beginning of 2014 in an effort to assist them with academic writing. Topics such as plagiarism, bibliometric methods, writing a research proposal, the literature review, methodology aspects, and hypothesis formulation and testing were discussed.

A departmental writing retreat was held at Stone Safaris, Brandfort, in November. A large contingent of staff and postgraduate students participated in the intensive three-day retreat. Attendees worked on a variety of writing activities, ranging from article drafts to a dissertation or thesis chapter. The retreat was instrumental in the progress of research in the Department by providing attendees with a period of focused concentration and writing time without interruptions.

Our undergraduate laboratories on the Bloemfontein and South Campus were upgraded and new audio-visual equipment was installed. We have also completed a laboratory where our students can study using their laptops.

Achievements of Students

Ian van der Linde, one of our postgraduate students, presented his research at the South African Academy for Science and Arts Student symposium during November. The topic of the presentation was '*Uitdagings in verband met die hantering van groot datastelle*'. Current methods that are being used to take care of data are no longer suitable for future situations. The mass of data generated grows with approximately 28% per annum and presents huge challenges to companies that do not want to fall behind. Many technologies have been developed during the past few years to solve the problem, but many hidden challenges appear and these must be investigated in order to have systems in place that function effectively. This research specifically focused on handling Twitter data with the aid of specific databases, as well as high-performance computer environments. Ian received a third place at Session 3, as well as R1 000 prize money.

Activities

An eye-tracking study was conducted in collaboration with the Hebrew Department to investigate whether there is transference of reading skills between the Latin alphabet and Hebrew. Students who were enrolled for a Hebrew module were asked to participate in the study. Participants were required to read a short passage in their mother tongue followed by a short passage in Hebrew.

Ian van der Linde, one of our postgraduate students, who presented his research at the South African Academy for Art and Science Student symposium during October 2014.

Eye movements were captured using an eye-tracker while participants were reading the passage. The results of the study were presented at a linguistic conference and a chapter has been submitted for possible inclusion in a book about Hebrew studies.

Community Service

The Department has been presenting Python classes to secondary school learners for the past few years in an effort to promote computing and programming skills. A group of these learners took part in SACO (South African Computer Olympiad) that consists of three separate tests. The first test (Talent Search) is based on testing logic and problem-solving skills; the second test (Application Olympiad) focuses on testing insight, skill, and knowledge with regard to the MS Office package and HTML; and the third test (Prestige), which is the programming Olympiad, tests programming and problem-solving skills by coding in a high-level programming language.

Marthinus Schoombie, a Grade 11 learner, scored the highest mark (above 70%) in the Free State and received a provincial prize for this achievement. More than 40 countries took part in this year's online test, and the Python project obtained the best results of all the participants from the Free State.

As part of the curriculum, the Department offers a service learning module to second-year students in which they have to teach basic computer literacy skills to members of the community. Through this initiative, members of the community were awarded with certificates in computer literacy.

Marthinus Schoombie, one of the Python learners, who scored the highest mark of all the Free State participants in the Computer Olympiad.

Thlolohelo Nkalai, one of our postgraduate students, who conducted research on computer anxiety by using a sensor glove.

National and International Collaboration

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

Postgraduate Students

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

Mr Gavin Dollman conducted research on the interaction between humans and machines by manipulating a small Lego robot by brainwaves. A brain-computer interface (BCI) is a device that uses neurophysiological signals from the brain to activate external machinery. BCIs have traditionally been used to enhance the standard of living for severely disabled patients, but there has recently been a trend towards BCI research involving able users. Traditional input methods are being replaced or supplemented by alternative natural modes of interaction known as NUIs. To investigate the suitability of a BCI as an NUI, this study used the Emotiv headset to provide direct measurement of a participant's performance while performing tasks similar to wheelchair manipulation (in this case manipulating a Lego robot) in order to determine whether a participant's access to traditional input methods influences their performance. The results revealed that a participant's performance with a BCI (Emotiv) when navigating a robot is not affected by exposure to traditional input methods and is thus intuitive to use and suitable for use as an NUI.

Mr Silas Verkijika realised that South Africa currently faces a huge shortage of mathematics skills; a problem commonly referred to as the 'math crisis'. However, existing solutions to address the problem have overlooked the role of cognitive functions in improving mathematics aptitude. Consequently, he decided to conduct research with the primary objective of exploring the impact of a BCI-based mathematics educational game as a tool for facilitating the development of cognitive function that enhances mathematics skills in children.

It was established that a BCI-based mathematics educational game could be used to significantly enhance four basic cognitive functions (working memory, inhibitory control, math anxiety, and number sense). These four cognitive functions have been widely acknowledged as significant fundamental aspects of mathematics education. As such, adopting such a technological solution in South African schools can go a long way in addressing the current 'math crisis' by enabling educators and learners to address the issue of low cognitive functions.

Ms Thlolohelo Nkalai used a glove with electronic sensors to determine computer anxiety. Computer anxiety involves emotional fear or apprehension when interacting or anticipating interaction with computers. Subsequently, some individuals, especially those adults who have never used a computer before, avoid using computers altogether. This situation is undesirable as it excludes them from the workplace as many positions require computer competency. Using questionnaires exclusively to determine computer anxiety rely on the 'subjective' responses of the participants. This research study incorporated an additional instrument for measuring anxiety, namely the Emotion RECognition (EREC) system. It measures physiological signals (skin temperature, skin resistance, and heart rate) of a participant. From the findings it can be concluded that the sensor glove does not add value to measuring anxiety. Instead, the sensor glove may only add value when measuring stress. This means that although the EREC sensor glove measures skin conductance, changes in skin conductance may indicate changes in stress levels rather than anxiety levels. It can also be concluded (based on the results from the anxiety questionnaire and the sensor glove) that computer anxiety is not influenced by age, gender, computer experience, educational attainment, and ownership of a personal computer.

Research

The research focus of the Department falls within the following five areas:

- Data Warehousing
- Educational Technology
- Eye-tracking
- Human-Computer Interaction
- Natural User Interfaces

Staff Matters

One of our senior lecturers, Dr Liezel Nel, was promoted to adjunct professor.

Prof. Pieter Blignaut and his team were named as finalists in the esteemed NSTF-BHP Billiton Awards in the category Contributions to Science, Education and Technology for Research Leading to Innovation for developing an affordable eye tracker that provides high-quality data at a high frequency.

Research Outputs

Research Articles

Blignaut, P.J. 2014. Mapping the pupil-glint vector to gaze coordinates in a simple video-based eye tracker. *Journal of Eye Movement Research* 7(1): 1-11.

Blignaut, P.J. & Wium, D. 2014. Eye-tracking data quality as affected by ethnicity and experimental design. *Behaviour Research Methods* 46: 67-80.

Nel, W. & De Wet, L. 2014. Dubbelsinnige websoekstringe: 'n Vergelyking van soekenjins en gebruikersinteraksies. *South African Journal for Science and Technology* 33(1): 1.

Book

Nel, W. & Van Biljon, A. 2014. *Visual Basic for Applications: An introductory guide*. Hennenman, South Africa: RiDan.

Chapters in Books

Beelders, T.R. & Blignaut, P.J. 2014. Gaze and speech: Pointing device and text entry modality. In *Current Trends in Eye-tracking Research*, edited by M. Horsley, B.A. Knight, M. Eliot & R. Reilly. New York: Springer. pp. 51-75.

Berg, L. & Beelders, T.R. 2014. An eye-tracking account of reference points, cognitive affordance and multimodal metaphors. In *Multimodal Epistemologies: Towards an Integrated Framework*, edited by A. Maiorani & C. Christie. New York: Routledge. pp. 13-25.

Blignaut, P.J., Holmqvist, K., Nyström, M. & Dewhurst, R. 2014. Improving the accuracy of video-based eye tracking in real time through post-calibration regression. In *Current Trends in Eye-tracking Research*, edited by M. Horsley, B.A. Knight, M. Eliot & R. Reilly. New York: Springer. pp. 77-100.

De Wet, L. & Mabanza, N. 2014. Determining the usability effect of pedagogical interface agents on adult computer literacy training. In *E-learning Paradigms and Applications: Agent-based Approach*, edited by M. Ivanovic & L.C. Jain. New York: Springer. pp. 145-171.

Staff

Professor: Prof. PJ Blignaut.

Adjunct Professor: Prof. L Nel.

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

Lecturers: Messrs RB Brown, AJ Burger, W Nel, and Mrs EH Dednam.

Junior Lecturers: Messrs JL du Plessis, RF Fouché, WSJ Marais, DJ Wium, and Mrs MJF Botha.

Senior Officer: Ms GJJ Dippenaar.

Senior Assistant Officer: Mrs S Opperman.

Assistant Officer: Mrs S de Klerk.

Technical Assistants: Messrs V Grobler, D Marais, and CA Cilliers.

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Department of Consumer Science

Overview

The Department of Consumer Science seeks to equip undergraduate students with the knowledge to identify and understand the needs of individuals and families regarding food, clothing, and housing, and the skills 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 consumers can benefit in the field of textiles and foods. Regular revision of modules and module content is necessary in order to keep the qualification relevant.

The Department offers three undergraduate programmes and three postgraduate degrees. In the B. Consumer Science programme, 110 students were registered in 2014, and 15 in BSc Home Economics (Foods). Thirteen students were registered for the BSc Honours in Home Economics, two students registered in the MSc in Home Economics programme, and three students for a PhD.

Activities and Achievements

Dr Linus Franke joined this section as a senior lecturer from The Department managed and hosted the Consumer Studies Olympiad for Grade 11 and Grade 12 learners in 2014 for the first time. Mrs F van Tonder is the coordinator of the Olympiad. The Olympiad examination was written by 3 669 learners from all the provinces of South Africa in 2014.

Prof. HJH Steyn started a four-year term as vice-president of the International Federation of Home Economics in July 2014 at the council meeting of the International Federation for Home Economics (IFHE) in Canada.

Community Service

The Department continued with the Mamello Community Development Programme in the 'old milk shed' on the experimental farm of the UFS.

Collaboration

Prof. HJH Steyn participated in the efforts of the Programme Committee: Household Technology and Sustainability of the IFHE to compile 'best practices' for household activities. Prof. Steyn is responsible for best practices in hand laundering; it is published on the IFHE website.

Mrs JS van Zyl participated in the efforts of the Programme Committee: Household Technology and Sustainability of the IFHE to compile 'best practices' for household activities. Mrs Van Zyl and Dr C Bothma (Department of Biotechnology) are responsible for best practices in home food preservation, which is also published on the IFHE website.

Dr Jana Vermaas took part in the activities of the Programme Committee of the IFHE on Textiles.

Research

Research done in the Department in 2014 consisted mainly of projects:

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

The 2014 Consumer Studies Olympiad awards ceremony.

Research Outputs

Research Articles

Bothma, C., De Wit, M., Swart, P.Z., Frey, M. & Hugo, A. 2014. Thermal treatment, jelly processing and sensory evaluation of cactus pear fruit juice. *Journal of the Professional Association for Cactus Development* 16(1): 1-14.

Books

Cronje, N. & Steyn, H.J.H. 2014. *Evaluating Catholyte: Could it be an environmentally friendly alternative to conventional powder laundry detergents?* Germany, Saarbrucken: Lap Lambert Academic Publishing.

Staff

Associate Professor: Prof. HJH Steyn.

Lecturers: Dr JF Vermaas, Mss I van der Merwe and N Cronjé.

Junior Lecturers: Mss JS van Zyl, PZ Swart, and Ms N Tinta.

Part-Time Contract Lecturers: Mss F van Tonder and A du Toit.

Senior Officer: Professional Services: Mrs D Jacobs.

Officer: Professional Services: Ms C Denner.

Senior Assistant Officer: Mrs W van der Walt.

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Department of Genetics

Overview

2014 was an exciting year for the Department of Genetics. A highlight was the launch of the new BSc Forensic Sciences programme, the first of its kind in Africa, with 54 first-year students in January 2014. At the same time, training and research activities continued in a number of established fields. These areas include Molecular Systematics, Recombinant DNA Technology, Behavioural Genetics, Human Genetics, Conservation Genetics, Population Genetics, and Forensic Genetics. In recognition of the growth of the Department, a new building to house the Department was approved and construction commenced in 2014.

Finally, 2014 saw the departure of three valued colleagues, but also the arrival of one new colleague.

Activities and Achievements

The launch of the BSc Forensic Sciences programme was celebrated with an invitation to well-known independent forensic expert, Dr David Klatzow, who gave a presentation on the topic of changing paradigms in Forensic Science. Dr Karen Ehlers and Mrs Letecia Wessels were invited to give presentations at the 2nd National Forensic Services Conference hosted by SAPS in Pretoria. They were also invited by the DNA Project, an NGO promoting the use of DNA evidence in criminal investigations, to participate in the development of a forensic programme for law students.

Ms Zurika Odendaal was selected as one of 12 international Young Investigators to attend the XXIst World Meeting of the International Society for the Research on Aggression (ISRA) in Atlanta, USA. She also contributed an oral presentation at the conference. Prof. Antoinette Kotze was invited to deliver a keynote address at the 5th Congress of Scientific Research in Parks, Italy. Prof. Paul Grobler was elected as vice-president of the Southern African Wildlife Management Association (SAWMA), an organisation that brings together conservation scientists from universities, conservation departments, environmental NGOs, and the private sector. He also continues to serve as a subject editor for two journals; *Mammalian Biology* (Elsevier) and *African Journal of Aquatic Science* (Taylor & Francis).

National and International Collaboration

A number of active collaborations continued in 2014: (i) The Department again hosted Prof. Trudy Turner, an affiliated professor from the University of Milwaukee-Wisconsin, for collaborative work on the genetic structure and behaviour of natural populations of vervet monkeys; (ii) Prof. Grobler and Ms Bindeman continued to collaborate with Dr Romulus Abila and Dr James Barasa from Kenya on various aspects of catfish genetics. A joint paper on the genetic structure of Kenyan catfish populations appeared during 2014, with another manuscript (involving South African catfish) accepted during 2014 and due for publication in 2015. This collaboration also contributed significantly to the training of one of our MSc students, Ms Sinobongo Ndyogolo; (iii) Locally, the very strong linkage continued with our collaborators and affiliated members of staff, Prof. Antoinette Kotze and Dr Desire Dalton from the National Zoological Gardens in Pretoria. This collaboration enables us to be part of the strong programme in conservation genetics at the NZG and several outputs resulted from this link in 2014, as indicated elsewhere in this report; (iv) Lt Col Anton Lucassen from the South African Police Service (SAPS) Forensic Division has been associated with the Department for a number of years and is an affiliated lecturer in the Department. In 2014 he provided training to the Department's honours students on the statistics used at the SAPS forensic laboratories. This collaboration also resulted in a joint publication in 2014; (v). Prof. Johan Spies hosted Dr Diego Zappacosta from the Universidad Nacional del Sur in Bahia Blanca, Argentina, who shares an interest in the grasses of the Southern Hemisphere with Prof. Spies.

International Visits

Dr Paula Spies attended the International Science Foundation workshop on Biodiversity held in Benin. Prof. Johan Spies visited the Universidad Nacional del Sur in Bahia Blanca, Argentina, where he presented a workshop on cytotaxonomy. Dr Karen Ehlers visited the Institute of Legal

Mr Tinus Viljoen (left) and Ms Laura Heathfield (right) from the Department, with Dr David Klatzow (middle), during his visit to the Department.

Medicine Innsbruck, Medical University Innsbruck, Austria, to attend a workshop on next-generation sequencing for forensic applications. The workshop was hosted by Walter Parson, a renowned forensic scientist. As part of the workshop, the whole mtDNA genome of each participant was sequenced and analysed. Knowledge on the latest research and trends in forensic genetics were discussed among the participants from France, Switzerland, Turkey, UK, Libya, and South Africa.

Achievements of Students

Three Genetics students obtained their MSc degrees in 2014. Two of the 2014 honours students also qualified for special awards based on their overall good performance.

Mr Francois Venter received the Hofmeyer-Van Schaik Medal as the best BSc honours student in Genetics, while Ms Jacqui de Jong received the Astra-Zeneca Award (sponsored by the DNA Project) for her performance in Forensic Genetics.

Ms Zurika Odendaal at the XXI[st] World Meeting of the International Society for the Research on Aggression (ISRA), in Atlanta, USA.

Staff Matters

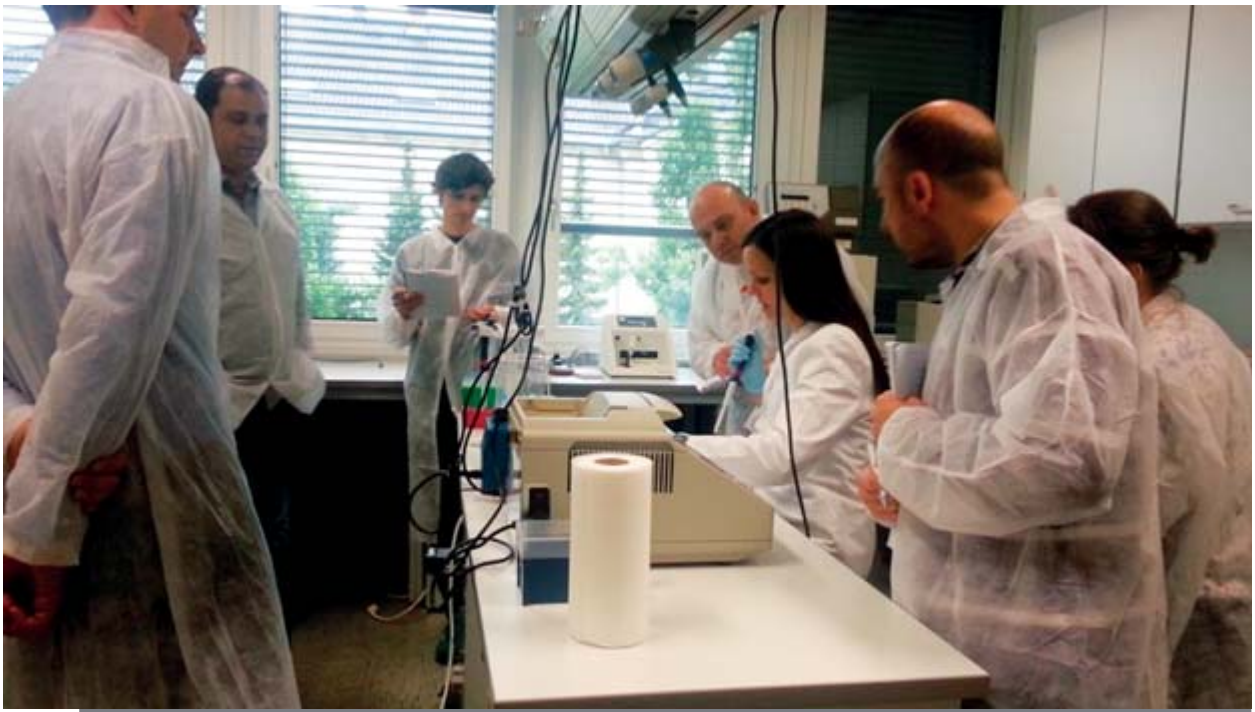
Prof. Johan Spies, long-time Academic Head, retired at the end of 2014. His passion for genetics will be missed by all. As a result of Prof. Spies' retirement and consequent move to Mossel Bay, we also lost the services of Dr Paula Spies. We wish them the very best for their future and will continue to use their expertise through their appointments as research fellows.

Mrs Letecia Wessels was promoted to the position of lecturer during 2014.

Prof. Paul Grobler, who was promoted some time ago, delivered his inaugural lecture on the topic of 'Intensive and selective breeding in the game industry' during May 2015.

Ms Laura Heathfield, who joined the BSc Forensic Science programme in the Department at the beginning of 2014, elected to continue her career at the University of Cape Town.

At the end of 2014 we welcomed Dr Ellen Mwenesongole as a lecturer specialising in Forensic Science. Dr Mwenesongole completed her MSc in Forensic Science at the University of Strathclyde in Glasgow (2007), attained an MSc in Chemistry at the University of Pretoria in 2009, and a PhD in Forensic Science & Chemistry at Anglia Ruskin University, Cambridge, UK, in 2014.



Participants at the next-generation sequencing for forensic applications workshop held at the Institute of Legal Medicine Innsbruck in Austria.

Research Outputs

Research Articles

Barasa, J.E., Abila, R., Grobler, J.P., Dangasuk, O.G., Njahira, M.N. & Kaunda-Arara, B. 2014. Genetic diversity and gene flow in *Clarias gariepinus* (Burchell 1822) from Lakes Victoria and Kanyaboli, Kenya. *African Journal of Aquatic Sciences* 39(3): 287-293.

Dalton, D.L., Tordiffe, A., Luther, I., Duran, A., Van Wyk, A.M., Brettschneider, H., Oosthuizen, A., Modiba, C. & Kotze, A. 2014. Interspecific hybridization between greater kudu and nyala. *Genetica* 142: 265-271.

De Vos, A., Spies, P. & Spies, J.J. 2014. Effective DNA barcoding regions in the genus *Lachenalia*. *Scripta Botanica Belgica* 52: 119.

Du Toit, Z., Grobler, J.P., Kotze, A., Jansen, R. & Dalton, D.L. 2014. The complete mitochondrial genome of Ground Pangolin (*Smutsia temminckii*) and the phylogenetic position of Pholidota. *Gene* 551: 49-54.

Kotze, A., Grobler, J.P., Van Marle-Köster, E., Jonker, T. & Dalton, D.L. 2014. The Tankwa Karoo National Park feral goat population: A unique genetic resource. *South African Journal of Animal Science* 44: 43-48.

Labuschagne, C., Kotze, A., Grobler, J.P. & Dalton, D.L. 2014. The complete sequence of the mitochondrial genome of the African penguin (*Spheniscus demersus*). *Gene* 534: 113-118.

Lucassen, A., Ehlers, K., Grobler, J.P. & Shezi, A.L. 2014. Allele frequency data of 15 autosomal STR loci in four major population groups of South Africa. *International Journal of Legal Medicine* 128(2): 275-276.

Pienaar, L., Grobler, J.P. Neser, F.W.C., Scholtz, M.M., Swart, H., Ehlers, K. & Marx, M. 2014. Genetic diversity in selected stud and commercial herds of the Afrikaner cattle breed. *South African Journal of Animal Science* 44: S80-S84.

Spies, J.J., Spies, P. & Grobler, J.P. 2014. Molecular identification of *Clivia* species. *Scripta Botanica Belgica* 52: 413.

Spies, P., Spies, J.J., De Vos, A. & Grobler, J.P. 2014. Phylogeography and genetic variation in the genus *Lachenalia*. *Scripta Botanica Belgica* 52: 414.

Staff

Professor: Prof. JP Grobler.

Lecturers: Drs K Ehlers, G Marx, E Mwenesongole, Mrs H Bindeman, Mr F Maleka, Ms Z Odendaal, Mrs S Schneider, Mr T Viljoen, and Mrs L Wessels.

Affiliated Professor: Prof. T Turner (University of Milwaukee-Wisconsin).

Affiliated Associate Professor: Prof. A Kotze (National Zoological Gardens).

Affiliated Lecturers: Dr DL Dalton (National Zoological Gardens) and Mr A Lucassen (South African Police Services – Forensic Division).

Assistant Officers: Mss B Henn and V Nuttall.

Chief Officer: Professional Services: Mrs S Reinecke.

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Department of Geography

Overview

At the Society of South African Geographer's (SSAG) biannual conference, Prof. Gustav Visser was made a Fellow of the Society. This is one of the top honours bestowed by the SSAG.

Dr Ruth Massey and Mrs Anneri Pretorius received a grant from the SSAG to run a project that would see ten Bloemfontein schools receive Geography teaching and learning support material (targeting the intermediate phase). The Green Box project will be rolled out into 2015.

Dr JJ le Roux joined the Bloemfontein Campus staff. Dr Le Roux brings with him a wealth of knowledge on Geomorphology (particularly erosion). Also joining the Department in QwaQwa is Mr Samuel Adelabu, also a physical geographer. Mr Adriaan van der Walt completed his master's degree.

Dr Ruth Massey was a visiting academic at the University of Cape Town's African Centre for Cities during July.

The Department's GIS modules were accredited by the South African Council for Professional and Technical Surveyors (PLATO). The UFS is now one of the few universities in South Africa to have PLATO-accredited GIS modules.

The Department also started a Geography Students' Forum which helps students with various elements of their studies; including writing, reading, and exam preparation.

Prof. Gustav Visser with his award. He was made a Fellow of the Society of South African Geographers.

Research and Teaching Specialisation Areas of the Department

- **First year:** Physical Geography, Human Geography, and Cartography.
- **Second year:** Urban Development, Environmental Studies, Process Geomorphology and Geomorphologic Hazards, and Geographic Information Systems (GIS).
- **Third year:** Applied Urban Development and Spatial Transformation, Environmental Management and Analysis, Environmental Geomorphology, and Geographic Information Systems (GIS).
- **Honours level:** Geomorphology, Rural Development, Urban Development, Philosophical Principles in Geography, GIS, and Environmental Management.

Research Outputs

Research Articles

Claassen, J.H.D., Mukwada G., Naidoo M. & Mahasa, P.S. 2014. Land reform and grain production: The case of emerging farmers in QwaQwa, South Africa. *Journal of Human Ecology* 46(2): 223-234.

Hay, E.A. & Visser, G.E. 2014. Socio-cultural and socio-economic features of second homes in Rosendal, South Africa. *Bulletin of Geography: Socio-economic Series* 26: 157-166.

Mahasa, P.S. & Ruhiiga, M. 2014. Medical waste management practices in north eastern Free State, South Africa. *Journal of Human Ecology* 43(3): 439-450.

Massey, R.T. 2014. Exploring counter-conduct in upgraded informal settlements: The case of women residents in Makhaza and New Rest (Cape Town), South Africa. *Habitat International* 44: 290-296.

Mukwada, G., Chingombe, W. & Taru, T. 2014. Why social acceptance in South African solar water heater projects should shape national energy policy: The case of Bluegumbosch. *Mediterranean Journal of Social Sciences* 5(16): 635-646.

Rex, R.S.R., Campbell, M.M. & Visser, G.E. 2014. The on-going desegregation of residential property ownership in South Africa: The case of Bloemfontein. *Urbani izziv* 25 (Supplement), Special Issue: S6-S24.

Rogerson, C. & Visser, G.E. 2014. A decade of progress in African urban tourism scholarship. *Urban Forum* 25: 407-417.

Taru, T., Chingombe, W., Mukwada, G. & Van Zyl, W.F. 2014. What is in a grave? Conflict between the Golden Gate Highlands National Park management and park inhabitants. *African Journal of Hospitality, Tourism, and Leisure* 3(2): 1-8.

Val, A., Taru, T. & Steininger, C. 2014. New taphonomic analysis of large-bodied primate assemblage from Cooper's D, Bloubank Valley, South Africa. *South African Archaeological Bulletin* 69(100): 49-58.

Visser, G.E. 2014. Urban tourism and the de-gaying of Cape Town's De Waterkant. *Urban Forum* 25: 469-482.

Visser, G.E. & Rogerson, C. 2014. Reflections on 25 years of Urban Forum. *Urban Forum* 25: 1-11.

Chapter in Book

Visser, G.E. 2014. Gay and lesbian tourism practices. In *The Wiley Blackwell Companion to Tourism* edited by A. Lew, C. Hall & A. Williams. United Kingdom, Sussex: John Wiley & Sons, Inc. pp. 435-443.

Staff

Professor: Prof. Gustav Visser.

Senior Lecturer: Drs Charles Barker and Jay le Roux.

Lecturers: Dr Ruth Massey, Ms Eldalize Kruger, and Mrs Tobeka Mehlomakulu.

Junior Lecturers: Mr Adriaan van der Walt, Mrs Anneri Pretorius, and Ms Mulalo Rabumbulu.

Administrators: Mrs Sandra Brits and Ms Nolene van Dyk.

Contact Details

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Department of Geology

Overview

A total of 85 degrees were conferred by the Department over the course of the year; with 49 students receiving BSc degrees, 29 honours degrees, three MSc degrees, and four MRTM degrees. Recurriculation resulted in the introduction of three new undergraduate programmes, with Geology and Chemistry, Physics, and Geography as majors. The Department was responsible for the presentation of six undergraduate and three honours programmes, as well as the master's degree in Mineral Resource Throughput Management (MRTM). The Department supervised a total of 11 MSc candidates and three PhD candidates.

Ms Huibrie Pretorius (Junior Lecturer: Mineralogy) resigned during the course of the year. Several new junior lecturers joined the Department in 2014; including Ms Thendo Mapholi, Ms Rinae Makhadi, and Mr Raimund Rentel. Prof. Marian Tredoux was retained on contract for 2014, and Ms Megan Purchase was appointed as Analytical Scientist – taking responsibility for the maintenance and operation of the Department's analytical infrastructure. Dr Robert Hansen joined the Department as an affiliated lecturer, Profs Leon Jacobson and Robert Schouwstra as affiliated associate professors, and Prof. Reyno Scheepers as an affiliated professor. Ms Justine Magson was nominated to replace Dr Hermann Praekelt as programme director, and served alongside Dr Praekelt in his capacity as programme director over the course of the year. Mr Adriaan Odenaal, our sedimentologist, was promoted to lecturer.

One of the highlights of the year was the outfitting of the Department's core storage facility with shelving capable of storing approximately 20 km of drill core material that will be used for training students in the important art and science of core logging. The official opening that took place in May was attended by Drs Dirk Harney (Anglo American) and Oupa Nkagisang (AngloGold Ashanti).

Activities and Achievements

It was a busy year as usual with undergraduate and honours students embarking on numerous field trips across the country and with staff members travelling both locally and abroad. Staff members and students presented their work at several conferences; including the 12th International Platinum symposium (Yekaterinburg, Russia), the 21st General Meeting of the International Mineralogical Association (Sandton Convention Centre), the Igneous and Metamorphic Studies Group Meeting (Rhodes University), and the European Geosciences Union General Assembly (Vienna). Profs Marian Tredoux and Christoph Gauert and Dr Freddie Roelofse attended a workshop organised by the International Continental Scientific Drilling Programme to discuss matters related to a potential drilling project in the Bushveld Complex.

The year also saw the birth of the Kovsie Geotalks series; a series of talks aimed at i) increasing academic discourse within the Department, ii) exposing students to the work of non-Kovsie researchers, academics, and industry professionals, and iii) allowing the broader public access to the wonders of geology. Speakers included Mr Felix Yebo Amoako (Friedrich-Schiller University), Prof. Duncan Miller (affiliated professor at the Department), Prof. Jan Kramers (University of Johannesburg), and Dr Gerrie van Aswegen (Institute of Mine Seismology). The Department also hosted Prof. Nic Beukes (University of Johannesburg) for the delivery of the 33rd Alex du Toit Memorial Lecture presented under the auspices of the Geological Society of South Africa. The year also saw the establishment of the Geological Student Association, which organised several social and academic events over the course of the year.

Prof. Christoph Gauert was awarded sabbatical leave between April and July to further his research on gold fingerprinting and the PGE mineralogy of the chromitite layers of the eastern Bushveld Complex, which he spent at the Museum für Naturkunde in Berlin. He also organised and led a pre-conference field trip for the 21st General Meeting of the International Mineralogical Association to the eastern Bushveld and Uitkomst complexes.

Dr Johann Claassen represented the Department and the Faculty of Natural and Agricultural Sciences at the 3rd Mining Lekgotla held at Gallagher Estate in August.

An exchange student from the Martin Luther University Halle-Wittenberg, Ms Melanie Krüger, visited the Department

Mr Adriaan Odendaal conducting fieldwork in the Sutherland district as part of his PhD study on the sedimentology of the Beaufort Group along the Great Escarpment (Salpeterkop visible in the distance).

for several months to conduct research on the metamorphic contact aureole of the Uitkomst Complex.

Twenty-four MRTM students attended the programme's annual Winter School hosted by the Department during the week of 14 July 2014. The school focused on the practical application of MRTM and flow principles to bring about positive change in the mining environment. Emphasis was placed on improving mining profitability through enhancing product payability. Guest speakers for this part of the school were Messrs PG Laurens and A Dunne. Other invited guest speakers were Prof. H Kotze and Dr P Mensah from the UFS Postgraduate School. Invaluable information and practical skills were transferred to assist MRTM students with the completion of their mini-dissertations. A review of the programme was initiated in October 2014 in

order to enhance the throughput rate for the programme and to transform it from a master's degree to a Master of Science course.

Achievements of Students

An MSc student of Dr Freddie Roelofse, Mr Mpho Mangwegape, was appointed as pre-doctoral fellow of the Carnegie Institution for Science and spent several weeks in the Department of Terrestrial Magnetism performing LA-ICP-MS Sr-isotopic determinations on plagioclase of the Bushveld Complex. Ms Jarlen Beukes (MSc student of Prof. Christoph Gauert) returned from a seven-month stay at the Karl-Frantzens University of Graz, Austria, which was funded by Erasmus Mundus.

Special Achievements

Dr Freddie Roelofse was elected as Fellow of the Gemmological Association of Great Britain following the successful completion of the association's Diploma in Gemmology. He also received generous funding from the Thuthuka funding instrument of the NRF to conduct research on mineral-scale disequilibrium within the Bushveld Complex and was appointed a visiting investigator at the Carnegie Institution for Science. He was appointed as chair of the Palaeoproterozoic Taskgroup of the South African Committee for Stratigraphy, and onto the editorial board of *Die Suid-Afrikaanse Tydskrif vir Natuurwetenskap en Tegnologie*.

Community Service

The Department once again hosted the Free State leg of the Minquiz National Science Competition, which was held on 15 May 2014. A total of 26 schools (mostly from the Free State), each represented by three learners, took part in the competition. The learners were also afforded the opportunity of visiting the departments of Chemistry, Physics, and Geology in order to see what these departments have on offer for prospective students. The Department was also involved in numerous other outreach activities, including the UFS Astrofair, the National Science Week launch, and the Eskom Expo for young scientists.

Core-shelving in the Department's core storage facility. The facility was officially opened in May 2014.

Research Outputs

Research Articles

Bindi, L., Tredoux, M., Zaccarini, F., Miller, D.E. & Garuti, G. 2014. Non-stoichiometric nickel arsenides in nature: The structure of orcelite, $Ni_{5-x}As_2$ (x=0.25), from the Bon Accord oxide body, South Africa. *Journal of Alloys and Compounds* 601: 175-178.

Colliston, W.P., Schoch, A.E. & Cole, J. 2014. The Grenvillian Namaqua-Natal fold belt adjacent to the Kaapvaal craton: 1. Distribution of Mesoproterozoic collisional terranes deduced from results of regional surveys and selected profiles in the western and southern parts of the fold belt. *Journal of African Earth Sciences* 100: 7-19.

Harris, C., Holngwane, W., Gule, N. & Scheepers, R. 2014. Origin of tanzanite and associated gemstone mineralization at Merelani, Tanzania. *South African Journal of Geology* 117: 15-30.

Killick, D. & Miller, D. 2014. Smelting of magnetite and magnetite-ilmenite iron ores in the northern Lowveld, South Africa, ca. 1000 CE to ca. 1880 CE. *Journal of Archaeological Science* 43: 239-255.

Mielke, C., Boesche, N.K., Rogass, C., Kaufmann, H., Gauert, C. & De Wit, M. 2014. Space-borne mine waste mineralogy monitoring in South Africa. Applications for modern push-broom missions: Hyperion/OLI and EnMap/Sentinel-2. *Remote Sensing* 6: 6790-6816.

Tredoux, M., Roelofse, F. & Shukolyukov, A. 2014. A Cr isotopic study of the Bon Accord NiO body in the Barberton greenstone belt, South Africa. *Chemical Geology* 390: 182-190.

Zaccarini, F., Tredoux, M., Miller, D.E., Garuti, G., Aiglsperger, T. & Proenza, J.A. 2014. The occurrence of platinum-group element and gold minerals in the Bon Accord Ni-oxide body, South Africa. *American Mineralogist* 99: 1774-1782.

Mr Mpho Mangwegape, MSc student at the Department and pre-doctoral fellow of the Carnegie Institution for Science, at the Smithsonian Institution National Museum of Natural History in Washington D.C., USA.

Staff

Professor: Prof. WA van der Westhuizen.

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

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

Junior Lecturers: Mmes J Magson, R Makhadi, T Mapholi, HCF Pretorius, Messrs AI Odendaal and R Rentel.

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

Secretary: Mrs PS Swart.

Administrative Officer: Mrs R Immelman.

Technical Support Staff: Messrs J Choane, A Felix, and 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. Our intake in the actuarial and statistical programmes both increased; showing the largest intake in actuarial science ever, with more than 70 first-year students, and our first magister students in Actuarial Science. The actuarial programme is accredited (Level 2) with the Actuarial Society of South Africa.

Activities and Achievements

The Department finished the year with a good record in publication outputs; with 7.99 publication units in scientific journals. We are working hard to grow publications, particularly among younger researchers in the Department.

Prof. Max Finkelstein, an international authority in the field of mathematical reliability, was recognised as such this year by receiving an A-rating at the NRF. This is a remarkable achievement for the Department and the UFS as well. Dr Andrehette Verster also did the Department proud by achieving a Y-rating from the NRF.

The actuarial programme was boosted by the employment of another actuary, Mr Jan Blomerus, who has several years of post-qualification experience. Mr Jan-Paul Venter was also appointed in March; he was formerly with Outsurance. Mr Venter needed one final exam to become a fully qualified actuary, and passed this exam at the end of 2014 to become our third fellow actuary. This saw our actuarial programme expand to a master's and PhD in Actuarial Science, with the first intakes already in 2014.

In December 2014, Mr Michael von Maltitz, lecturer in the Department, obtained his PhD from the UFS, with a thesis entitled 'Extending the reach of sequential regression multiple imputation'.

A third-year student, Ms Deidre Basson, was awarded the Dean's Medal for the best student in the Faculty of Natural and Agricultural Sciences for 2014.

Prof. Robert Schall stepped down as Head of the Department and is currently leading the Statistical Consultation Unit (SCU). The SCU was officially created on 1 March 2014 and recruitment of projects effectively started in April 2014. Therefore, in 2014 the SCU was operational for about nine months; during that time a total of 64 projects were handled by the SCU across all faculties. About two-thirds of the projects supported by the SCU were associated with research conducted towards a postgraduate degree.

With Prof. Robert Schall stepping down, Mr Frans Koning was elected as new HOD for a term of five years.

Profs Daan de Waal and Abrie van der Merwe stepped down from lecturing and became research fellows in the Department; focusing their efforts on research and supervision.

The Department held a very successful annual workshop on Applications of Statistics and Probability in Energy, Finance and Actuarial Science in February 2014.

The Department was also actively engaged in marketing by hosting our third actuarial and statistical information evening. This was attended by parents, teachers, and learners from the many schools that were invited from in and around the Free State.

Visitors to the Department

The Department received several national and international visitors; among which Mr Ian Bester (Coronation), Prof. Jan Dhaene (KUL), Prof. Jan Beirlant (KUL), Dr Liezel Alsemgeest (CFPL), Prof. Roelof Coetzer (SASOL), Prof. Igor Litvine (NMMU), and Mr Chris Prins (Anglo), who presented lectures at the annual Workshop on Applications of Statistics and Probability in Energy, Finance and Actuarial Science hosted by the Department in February 2014. The workshop was organised by Mr Frans Koning, leader of the Department's actuarial programme.

International Collaborative Research Projects

Prof. Max Finkelstein has several ongoing international research projects. He was involved in an ongoing project with Prof. Cha from Ewha Womans University, South Korea,

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

on Stochastic Modelling for Heterogeneous Populations; with Prof. Vaupel and Prof. Missov from the Max Planck Institute for Demographic Research, Germany, on Dynamic Modelling for Stationary and Stable Populations; with Dr Shaffie from Cranfield University, United Kingdom, on Optimal Maintenance; with Prof. Gertsbakh from Ben Gurion University, Israel, on Signatures and Maintenance; and with Prof. Stepanov and Dr Rozengaus from Elektropribor Institute and ITMO University, Saint Petersburg, Russia, on Reliability of Complex Systems.

Prof. Robert Schall is a statistical consultant to Quintiles, an international clinical contract research organisation; to Boehringer Ingelheim, an international pharmaceutical company; and to TB Alliance, an international non-governmental organisation dedicated to the development of new treatments for tuberculosis. The joint project with TB Alliance (Dr Carl Mendel) involves the 'statistical

Prof. Max Finkelstein was recognised by receiving an A-rating at the NRF.

characterisation of the early bactericidal activity of anti-tuberculosis drugs'.

Prof. Schall also collaborates with Dr Arne Ring of the University of Leicester, United Kingdom, in the area of 'bridging methods for bioequivalence studies'. During the year, Dr Ring was appointed as an affiliate professor at the UFS.

Research Outputs

Research Articles

Buschke, S., Ring, A., Friedrich, C., Metzmann, K. & Meinicke, T. 2014. Linagliptin fixed-dose combination with metformin is bioequivalent to co-administration of linagliptin and metformin as individual tablets. *International Journal of Clinical Pharmacology and Therapeutics* 52: 537-548.

Cha, J.H. & Finkelstein, M. 2014. Burn-in for eliminating weak items in heterogeneous populations. *Communications in Statistics – Theory and Methods* 43: 5115-5129.

Cha, J.H. & Finkelstein, M. 2014. On some conditional characteristics of hazard rate processes induced by external shocks. *Operation Research Letters* 42: 325-331.

Cha, J.H. & Finkelstein, M. 2014. Some notes on the unobserved parameters (frailties) in reliability modelling. *Reliability Engineering and System Safety* 123: 99-104.

Cha, J.H. & Finkelstein, M. 2014. Stochastic modelling for environmental stress screening. *Journal of Applied Probability* 51: 387-399.

Cha, J.H., Finkelstein, M. & Marais, F. 2014. Survival of systems with protection subject to two types of external attacks. *Annals of Operations Research* 212: 79-81.

De Waal, D.J. & Van der Merwe, S. 2014. Multiple discrimination between Dirichlet populations. *South African Statistical Journal* 48: 213-227.

Finkelstein, M. & Ludick, Z. 2014. On some steady-state characteristics of systems with gradual repair. *Reliability Engineering and System Safety* 128: 17-23.

Friedrich, C., Brand, T., Ring, A. & Meinicke, T. 2014. Bioequivalence of Glucophage (metformin) tablets from Europe and the United States tested in healthy volunteers. *Journal of Bioequivalence and Bioavailability* 6: 61-66.

Goegebeur, Y., Guillou, A. & Verster, A. 2014. Robust and asymptotically unbiased estimation of extreme quantiles for heavy tailed distributions. *Probability Letters* 87: 108-144.

Harvey, J. & Van der Merwe, A.J. 2014. Modelling occupational exposure using Random Effects Model. *South African Statistical Journal* 48: 61-71.

Krause, J., Agarwal, S., Bodicoat, D.H., Ring, A., Shepherd, D., Rogers, S., Wensing, M. & Baker, R. 2014. Evaluation of a tailored intervention to improve management of overweight and obesity in primary care: Study protocol of a cluster randomised controlled trial. *Trials* 15: 82-92.

Metzmann, K., Schnell, D., Jungnik, A., Ring, A., Theodor, R., Hohl, K., Meinicke, T. & Friedrich, C. 2014. Effect of food and tablet-dissolution characteristics on the bioavailability of linagliptin fixed-dose combination with metformin: Evidence from two randomized trials. *International Journal of Clinical Pharmacology and Therapeutics* 52: 549-563.

Raubenheimer, L. & Van der Merwe, A.J. 2014. Bayesian estimation for linear functions of poisson rates. *Communications in Statistics – Theory and Methods* 43: 4025-4045.

Raubenheimer, L. & Van der Merwe, A.J. 2014. Estimation of binomial proportions from pooled samples using an objective prior. *South African Statistical Journal* 48: 95-110.

Ring, A., Morris, T.B.S., Hohl, K. & Schall, R. 2014. Indirect bioequivalence assessment using network meta-analyses. *European Journal of Clinical Pharmacology* 70: 947-955.

Van Zyl, J.M. 2014. Testing normality in small samples of selected shape parameter estimators of a generalized Pareto distribution. *South African Statistic Journal* 48: 279-289.

Staff

Professor Extraordinaire: Prof. M Finkelstein.

Professors: Profs D de Waal, R Schall, and A van der Merwe.

Senior Lecturers: Drs L van der Merwe, A Verster, D Chikobvu, M van Zyl, and Mr F Koning.

Lecturers: Dr M Sjölander, Mss E Girmay, Z Ludick, W Oosthuizen, Messrs D Naudé, S van der Merwe, M von Maltitz, J Blomerus, and J-P Venter.

Part-time Lecturers: Dr A Neethling, Mrs L da Silva, Mrs T Strauss, and Messrs A Ngeuleu, T Makheta, and DB Fourie.

Secretary: Mrs E Mathee.

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

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

Activities and Achievements

Prof. JH Meyer continued his research by visiting a colleague in Tainan, Taiwan, where work on an open problem commenced and will hopefully be finalised in 2015. During this visit, he also presented an invited talk in the seminar series of the Department of Mathematics of the National Cheng Kung University. Prof. JH Meyer and his PhD student, Mr B-E de Klerk, attended the International Congress of Mathematicians in South Korea at the beginning of August, and delivered presentations. Furthermore, Prof. Meyer acted as the chair of the problem selection committee of the International Mathematical Olympiad held in Cape Town during July (for the first time ever in Africa). This formed part of his involvement (as in the past 20 odd years) with the training and setting of papers with regard to Mathematics Olympiads, nationally and internationally. He also reviewed several papers for *Zentralblatt Math* and *Math Reviews*.

Prof. TM Acho was appointed as external examiner for the Nelson Mandela Metropolitan University and also acted as external examiner for mathematics modules presented at the Central University of Technology. He also reviewed three papers for the *American Mathematical Society Math Review* database.

Prof. T Vetrik attended The Second Gdansk Workshop on Graph Theory in Poland in June 2014 and presented a talk on 'Directed Cayley graphs of given degree and diameter'. He gave seminar lectures at Qatar University (Doha, Qater) in November, and the Nelson Mandela Metropolitan University (Port Elizabeth) in April. He also served on the NRF panel to adjudicate applications for funding in the 'Competitive programme for rated researchers and competitive support for unrated researchers'.

Achievements of Students

Ms ECM Viljoen, a PhD student in Graph Theory, won the second prize for the presentation of her work at the annual conference of the South African Mathematical Society in November. She also chaired a session at this conference. Mr B-E de Klerk obtained his MSc degree and won the Dean's and Senate's Medal for the best master's student at the UFS. He also presented the results of his research work at the International Congress of Mathematicians in South Korea in August 2014.

Community Service

Prof. JH Meyer and Messrs C Venter, JB Smit, and B-E de Klerk continued to be deeply involved with Olympiad training amongst school learners from all over the country.

Staff Matters

Mrs C Faber of the QwaQwa campus won the Excellence 2013 Prestige Award as the winner of the Innovation Award: new and/or improved technology in the classroom.

Prof. TM Acho, preparing for his third-year class in Complex Analysis.

Mrs JS van Niekerk, undergraduate teacher.

Mrs SM Venter, administrative officer.

Research Outputs

Research Articles

Acho, T.M. 2014. Analysis of Sturm-Liouville Eigenproblem with interior singularities and a perturbation parameter. *Mathematical Problems in Engineering* 2014: Article ID 914527.

Broere, I. & Vetrik, T. 2014. Universal graphs for two graph properties. *Ars Combinatoria* 116: 257-262.

Childs, S.J. 2014. A model of teneral dehydration in *Glossina*. *Acta Tropica* 262: 214-229.

Dankelmann, P. & Vetrik, T. 2014. The degree-diameter problem for claw-free graphs and hypergraphs. *Journal of Graph Theory* 75: 105-123.

Fasondini, M. & Schoombie, S.W. 2014. Spurious resonance in semidiscrete methods for the Korteweg-de Vries equation. *SIAM Journal on Numerical Analysis* 52(6): 2863-2882.

Howell, K.-T. & Meyer, J.H. 2014. Near-vector spaces determined by finite fields. *Journal of Algebra* 398: 55-62.

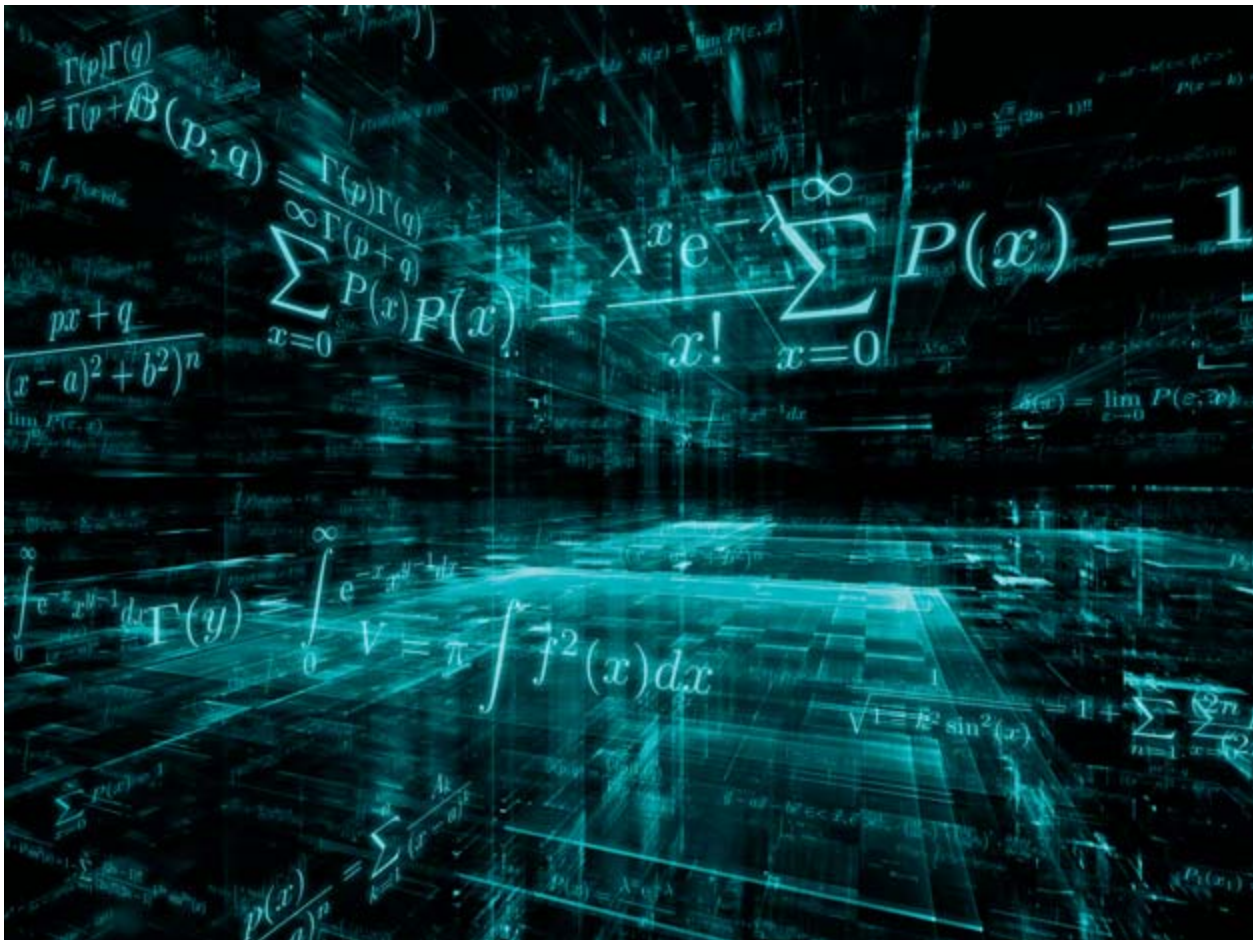
Mazorodze, J.P., Mukwembi, S. & Vetrik, T. 2014. On the Gutman index and minimum degree. *Discrete Applied Mathematics* 173: 77-82.

Mukwembi, S. & Vetrik, T. 2014. Wiener index of trees of given order and diameter at most 6. *Bulletin of the Australian Mathematical Society* 89: 379-396.

Oguoma, I.C. & Acho, T.M. 2014. Mathematical modelling of the spread and control of Onchocerciasis in tropical countries: Case study Nigeria. *Abstract and Applied Analysis* 2014: Article ID 631658.

Oguoma, I.C. & Acho, T.M. 2014. On the analysis of the treatment model for Onchocerciasis infected host in tropical countries. *Life Science Journal* 11(10): 263-268.

Vetrik, T. 2014. Abelian Cayley graphs of given degree and diameter 2 and 3. *Graphs and Combinatorics* 30: 1587-1591.



Staff

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

Associate Professors: Profs Thomas Acho, Tomas Vetrik, and Joachim Schröder (QwaQwa).

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

Lecturers: Mss Ansa Kleynhans, Anita Swart, Marina Botha, Messrs Christiaan Venter, Ben-Eben de Klerk, Marco Fasondini, and Patrick Mbambo (QwaQwa).

Junior Lecturer: Mrs Christa Faber (QwaQwa).

Temporary Lecturers: Prof. Dana Murray, Dr Hubertus Bargenda, Mss Elizabeth Viljoen, Hermina Oosthuizen, Karen Junqueira, Messrs Jon Smit, and Nallapan Sebastian (QwaQwa).

Postdoctoral Fellow: Dr Simon Childs.

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Department of Microbial, Biochemical and Food Biotechnology

Overview

The highlight of 2014 was undoubtedly when work for the refurbishment of the Biotechnology building commenced in June, which included the construction on the southern side of the existing building of a new wing comprising a large research laboratory with a seminar room and offices on the first floor. This project was funded by a R22 million grant from the Department of Higher Education, with the UFS contributing 25% of this amount. The work should be completed by mid-2015.

Academics from the Department received recognition and interacted with various organisations and institutions, both locally and abroad. The Department was also well represented nationally and internationally by staff and students attending various conferences and meetings. The Kovsie Microbrewers team of the Department excelled at the annual SAB Intervarsity Beer Brewing Challenge, where they not only won the bottle-labelling category, but also had the distinction of having all their beers placed in the top three in two of the three beer categories. Our pear cider received a third place in the category for ciders.

Activities and Achievements

Prof. Lodewyk Kock retained his NRF B1 rating. Prof. Rob Bragg was a keynote speaker on the control of infectious coryza at the 13th International Seminar of Avian Pathology and Production that took place in Athens, Georgia, USA, in March. Prof. Esta van Heerden was the keynote speaker and organiser of the session for deep subsurface research at the 10th International Congress on Extremophiles held in St Petersburg, Russia, during September. She was also an invited speaker at the opening session of the 24th biennial congress of the South African Society of Biochemistry and Molecular Biology that took place in Worcester, South Africa, in July. In addition, Prof. Van Heerden was appointed at the North-West University as a distinguished professor in the Unit for Environmental Sciences and Management. Dr Frans O'Neill was appointed to the NRF Health & Biotechnology Advisory Panel for the International Science and Technology Agreements: Germany/Italy/South Africa Research Cooperation Programme. Dr Trudi O'Neill was elected to the management board of the African Research Network for Neglected Tropical Diseases. In April, Prof. James du Preez attended a meeting of the Editors' Advisory Group of BioMed Central Publishers, combined with the Editors' Conference in Doha, Qatar, where he led a panel discussion. He was appointed as the external expert on the Biological Production Systems' grant evaluation panel of the Swedish Foundation for Strategic Research, and to the Applied Life Sciences and Non-Medical Biotechnology grant evaluation panel of the Scientific Council of the European Union Research Council. In August, he represented the American Society for Microbiology (ASM) in his capacity as ASM ambassador to South Africa at the Virtual Lecture Day of the ASM – National Health Laboratory Service Bio-Resource Centre in Johannesburg. He received an award (his second) for service to the faculty at the year-end function of the Faculty of Natural and Agricultural Sciences.

National and International Collaboration

Prof. Debabrata Mukhopadhyay from the Mayo Clinic in Rochester, USA, visited the Department to discuss collaboration regarding nanotechnology for tracking drug and chemotherapy treatment in human cells. He also delivered a Prestige Public Lecture hosted by the Faculty of Natural and Agricultural Sciences. In addition, a delegation from the Institute of Animal Husbandry and Veterinary Medicine, Beijing Academy of Agriculture and Forestry Science in China visited the Veterinary Biotechnology Research group with the aim of establishing closer ties.

Postgraduate Students

The number of postgraduate degrees conferred in 2014 were three PhD and 13 MSc degrees (four with distinction), while 24 students completed their BSc Hons degrees at the end of 2014.

Research

In the **Food Science Division**, the research of Prof. Celia Hugo on the microbial quality of food is ongoing;

The Kovsie Microbrewers team receiving awards at the SAB Intervarsity Beer Brewing Challenge. From left to right: Messrs Jan-G Vermeulen, Armand Bester, Bokang Mahlomaholo, Katlego Mthethwa, Prof. James du Preez, and Mr Errol Cason.

particularly on Chryseobacteria and their significance in food.

Prof. Arno Hugo and his postgraduate students continued with investigations into the importance of lipids in food and agricultural products. Current projects include 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; studies on the effect of dietary omega-3 fatty acid supplementation on the fertility of production animals and humans; and studies on the quality of plant oils for food and industrial applications.

In the sensory and product development laboratory, Dr Carina Bothma investigated the sensory profiling and nutritional values of novel food plants such as *Agave Americana*, lucerne, and cactus pear (*Opuntia ficus-indica* and *Opuntia robusta*) cladodes.

Dr Maryna de Wit's research also focused on investigating the cladodes of the cactus pears as a source of nutraceutical compounds.

The research of Prof. Garry Osthoff focuses on the milk of non-dairy animals and has provided new insights regarding milk synthesis and milk structure, as well as the sterol composition of milk from different animal species.

Dr Koos Myburgh and his students developed a chromatographic method to detect heat damage in milk. Another analytical problem that was solved is the detection of recombinant bovine somatotropin (rBST) in milk.

In the **Biochemistry Division**, the Extreme Biochemistry Group, where the TIA/UFS Metagenomics Platform is hosted, decided on a name change to incorporate a description of current activities. The new platform name will be SAENSE Platform (this is a Sotho word for 'science' but can be used as an elegant acronym to describe the research – Screening Applications and Novelty in Specialised Environments). The deep subsurface sampling, led by Prof. Esta van Heerden, continued. The research specifically addresses microbial carbon transformations in subsurface environments. Several water quality monitoring programmes and water purification projects were also established by the group. Dr Trudi O'Neill's Molecular Virology research group continued their research activities into the development of alternative rotavirus vaccines.

The research in Clinical Biochemistry, led by Dr Frans O'Neill, focuses on human cellular detoxification and sterol metabolism.

The aim of the Biocatalysis Group of Prof. Martie Smit and Dr Dirk Opperman is to develop excellent biocatalysts for the introduction of oxygen into molecules. The group focuses on the oxyfunctionalisation of various natural and petrochemical compounds, including monoterpenes, alkanes, and alkenes by cytochrome P450 monooxygenases, as well as the synthesis of esters and lactones from the corresponding ketones.

In the **Microbiology Division**, research of the Food Biotechnology research group, led by Prof. Bennie Viljoen, continued to focus partially on indigenous fermented foods and beverages, and a totally new direction based on mushrooms was established. These projects aim to improve the livelihoods and incomes of rural communities and small-scale processors through improved technologies for processing and developing fermented maize and dairy products that have the potential to be utilised as weaning and/or complementary foods for children. The Lipid Biotechnology Group has undergone a name change to the Pathogenic Yeast Research Group and currently comprises Profs Koos Albertyn and Carlien Pohl, and Drs Olihile Sebolai and Chantel Swart. They focus on metabolism and molecular mechanisms of bioactive lipids of pathogenic yeasts. In addition, research is conducted on novel imaging techniques such as Nano Scanning Auger Microscopy (NanoSAM) and Secondary Ion Mass Spectrometry – Time-of-Flight (SIMS-TOF) that can be

Prof. Esta van Heerden and her team at the launch of the Exxaro water purification pilot plant. From left to right: Prof. Esta van Heerden, Mr Julio Castillo, and Mr Rohan Posthumus.

applied in the search for novel cell inclusions and drugs. This is done in collaboration with Profs Hendrik Swart and Pieter van Wyk of the Department of Physics and Centre for Microscopy at the UFS. The applicability of NanoSAM to nanomedicine, specifically anticancer drugs, is researched in collaboration with the Mayo Clinic based in Rochester, USA. 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. The physiological role of five alcohol dehydrogenase (ADH) isozymes associated with ethanol metabolism in *Saccharomyces cerevisiae* was further investigated in collaboration with Prof. Koos Albertyn. Mr Schabort put a lot of effort into the development of bioinformatics software for the integration of multiple types of omics datasets. The Veterinary Biotechnology Research Group of Prof. Rob Bragg and Dr Charlotte Boucher was very fortunate to obtain three interdisciplinary research grants from the UFS. The first of these was for the continuation of work with Prof. Muriel Meiring of the Medical Faculty. The scope of this work was expanded and additional genes were successfully expressed, which has greatly assisted in the development of diagnostic tests, for which a patent has been submitted. A new cooperation with Prof. F Burt was also established during 2014, also based on the awarding of an interdisciplinary grant. The work involved the expression of selected genes from the Crimean Congo haemorrhagic fever virus. The third interdisciplinary project was with the Department of Zoology and Entomology (UFS), where the secretions of the secretory glands of *Amietophrynus* toad species were analysed for anti-microbial activity.

Staff Matters

Prof. James du Preez stepped down at the end of the year after serving 12 years as departmental chairperson, and Prof. Martie Smit was appointed academic departmental head from January 2015. Prof. Lodewyk Kock retired at the end of December, as did Mrs Leonie Myburgh and Mrs Andri van Wyk. We retained the services of the latter two ladies, who were appointed on contract for 2015 to facilitate the training of their successors.

Prof. James du Preez receiving a faculty award from the dean, Prof. Neil Heideman (right).

Research Outputs

Research Articles

Barbour, E.K., Ayyash, D.B., Shaib, H., Bragg, R.R., Azhar, E., Iyer, A., Harakeh, S., Kambris, Z. & Kumosani, T. 2014. Koch's postulate in reproduction of broiler coccidiosis by co-infection with eight most common Eimeria spp.: A model for future evaluation of new biologics. *International Journal of Applied Research in Veterinary Medicine* 12: 76-83.

Blanco, Y., Rivas, L.A., García-Moyano, A., Aguirre, J., Cruz-Gil, P., Palacín, A., Van Heerden, E. & Parro, V. 2014. Deciphering the prokaryotic community and metabolisms in South African deep-mine biofilms through antibody microarrays and graph theory. *PLoS ONE* 9(12): e114180.

Bothma, C., Hugo, A., Osthoff, G., Joubert, C.C., Swarts, J.C. & De Kock, H.L. 2014. Effect of dietary conjugated linoleic acid supplementation on the technological quality of backfat of pigs. *Meat Science* 97: 277-286.

Boucher, C.E., Theron, C., Jansen, A. & Bragg, R.R. 2014. Transcriptional profiling of chicken immunity-related genes during infection with *Avibacterium paragallinarum*. *Veterinary Immunology and Immunopathology* 15: 135-142.

Bragg, R.R., Jansen, A., Coetzee, M., Van der Westhuizen, W. & Boucher, C.E. 2014. Bacterial resistance to quaternary ammonium compounds (QAC) disinfectants. *Advances in Experimental Medicine and Biology* 808: 1-3.

Bragg, R.R., Van der Westhuizen, W., Lee, J-Y., Coetsee, E. & Boucher, C.E. 2014. Bacteriophages as potential treatment option for antibiotic resistant bacteria. *Advances in Experimental Medicine and Biology* 807: 97-110.

Brown, G.D., Meintjes, G., Kolls, J.K., Gray, C., Horsnell, W., Achan, B., Alber, G., Aloisi, M., Armstrong-James, D., Beale, M., Bicanic, T., Black, J., Bohjanen, P., Botes, A., Boulware, D.R., Bunjun, R., Carr, W., Casadevall, A., Chang, C., Chivero, E., Corcoran, C., Cross, A., Dawood, H., Day, J., De Bernardis, F., De Jager, V., De Repentigny, L., Denning, D., Eschke, M., Finkelman, M., Govender, N., Gow, N., Graham, L., Gryschek, R., Hammond-Aryee, K., Harrison, T., Heard, N., Hill, M., Hoving, J.C., Janoff, E., Jarvis, J., Kayuni, S., King, K., Kolls, J., Kullberg, B.J., Lalloo, D.G., Letang, E., Levitz, S., Limper, A., Longley, N., Machiridza, T.R., Mahabeer, Y., Martinsons, N., Meiring, S., Meya, D., Miller, R., Molloy, S., Morris, L., Mukaremera, L., Musubire, A.K., Muzoora, C., Nair, A., Nakiwala-Kimbowa, J., Netea, M., Nielsen, K., O'hern, J., Okurut, S., Parker, A., Patterson, T., Pennap, G., Perfect, J., Prinsloo, C., Rhein, J., Rolfes, M.A., Samuel, C., Schutz, C., Scriven, J., Sebolai, O.M., Sojane, K., Sriruttan, C., Stead, D., Steyn, A., Thawer, N.K., Thienemann, F., Von Hohenberg, M., Vreulink, J., Wessels, J., Wood, K. & Yang, Y-L. 2014. AIDS-related mycoses: The way forward. *Trends in Microbiology* 22: 107-109.

De Wit, M., Bothma, C., Swart, P., Frey, M. & Hugo, A. 2014. Thermal treatment, jelly processing and sensory evaluation of cactus pear fruit juice. *Journal of the Professional Association for Cactus Development* 16: 1-14.

Ells, R., Kilian, W., Hugo, A., Albertyn, J., Kock, J.L.F. & Pohl, C.H. 2014. Virulence of South African *Candida albicans* strains isolated from different clinical samples. *Medical Mycology* 52: 246-253.

Erasmus, M., Cason, E.D., Van Marwijk, J., Botes, E., Gericke, M. & Van Heerden, E. 2014. Gold nanoparticle synthesis using the thermophilic bacterium *Thermus scotoductus* SA-01 and the purification and characterization of its unusual gold reducing protein. *Gold Bulletin* 47: 245-253.

Ferroni, F.M., Smit, M.S. & Opperman, D.J. 2014. Functional divergence between closely related Baeyer-Villiger monooxygenases from *Aspergillus flavus*. *Journal of Molecular Catalysis B-Enzymatic* 107: 47-54.

Holtmann, D., Fraaije, M.W., Arends, I.W.C.E., Opperman, D.J. & Hollmann, F. 2014. The taming of oxygen: Biocatalytic oxyfunctionalization. *Chemical Communications* 50: 13180-13200.

Jere, K.C., O'Neill, H.G., Potgieter, A.C. & Van Dijk, A.A. 2014. Chimaeric virus-like particles derived from consensus genome sequences of human rotavirus strains co-circulating in Africa. *PLoS One* 9: e105167.

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Staff

Distinguished Professor: Prof. L Kock.

Professors: Profs J du Preez (chair), K Albertyn, R Bragg, S Kilian, H Patterton, M Smit, E van Heerden, B Viljoen, and G Osthoff.

Associate Professors: Profs A Hugo, C Hugo, and C Pohl-Albertyn.

Senior Lecturers: Drs F O'Neill, T O'Neill, D Opperman, M de Wit, and K Myburgh, and Mr N Bezuidenhout (part-time).

Lecturers: Drs O Sebolai and C Bothma.

Junior Lecturers: Dr C Boucher and Mr Du Toit Schabort.

Senior Researcher: Dr G Kemp.

Researchers: Dr C Swart and Ms L Steyn.

Affiliate Professor: Prof. M DeFlaun.

Affiliate Associate Professor: Prof. B Lodolo.

Research Associates: Prof. D Litthauer and Dr R Ells.

Secretaries: Mss M Cohen and I Auld.

Senior Officers: Professional Services: Mr S Marais and Ms N-M Agenbag.

Officers: Professional Services: Mss Y Makaum, C van Rooyen, D van den Berg, A van Wyk, E Roodt, Dr G Charimba.

Senior Officers: Mss L Myburgh and C Badenhorst.

Senior Assistant Officer: Ms E van den Heever.

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Department of Physics

Overview

The Department of Physics is recognised as one of the leading Physics departments in South Africa, as well as internationally, which is evident from strong international collaboration in the USA, Europe, and China. The main research areas in the Department are astrophysics, phosphor materials, and solid state physics (diffusion, segregation, thin films, and theatrical calculations). The Department is very well equipped; among others, it has a nano surface characterisation laboratory with a state-of-the-art AES nano-probe, XPS, ToF-SIMS, and an STM. The Department also has an observatory with six telescopes; the largest one being a 1.5 m telescope.

The undergraduate and graduate programmes are challenging and well balanced. The students who exit these programmes are highly trained and sought after in the industry. Most of our staff members are also involved with the Boyden Science Centre and Naval Hill Planetarium, which is actively involved with local, provincial, and national communities.

The Department produced 97 publications during 2014; the highest number published in a single year in the Department's lifespan (it started in 1904).

Activities and Achievements

It was another successful year for Physics. A new Physics building was erected, which will host four lecture halls that can accommodate 100 students each. The four lecture halls can be combined into a single lecture hall that can accommodate 400 students. Four new laboratories, several offices, and a video conference room also form part of the new building.

Prof. Hendrik Swart presented invited talks at the 1st International Symposium on Nanomaterials and Applications (ISN2A 2014) in Caparica (Lisbon, Portugal) in January, and at the PHI European User Meeting at Commundo Tagungshotel, Ismaning (Munich, Germany) in May. Prof. Swart and Prof. Martin Ntwaeaborwa presented keynote talks at the NanoAfrica 2014 international conference (Vanderbijlpark, South Africa) in April, and Prof. Swart also presented a keynote talk at the SETCOR International Conference on Smart Materials and Surfaces (SMS BANGKOK 2014) in Bangkok, Thailand, in August, where he was joined by two postdoctoral students, Dr Yousif Mohmmed and Dr Vijay Kumar. At this meeting, he received the IAAM Scientist Award for notable and outstanding research in Material Science and Technology. He was also invited to give a keynote talk at the 25th Catalysis Society of South Africa (CATSA) conference in November (St George Hotel, Johannesburg), and the 7th International Symposium on Macro and Supramolecular Architectures and Materials (MaM-14) in November in Johannesburg. In June, a group of phosphor students attended the 4th Workshop – between Linkoping, Sweden, and Port Elizabeth/Bloemfontein, South Africa – held at Karlskrona in Sweden. Very promising collaboration was established between Sweden and our group during this time. Prof. Swart, Prof. Dejene, Dr Vinod Kumar, and Mr Setumo Motloung presented their work at the 17th International Conference on Luminescence, held in Wroclaw, Poland, from 13–18 July.

Prof. Swart received the Research Excellence Award from the Faculty of Natural and Agricultural Science for the 80 papers that followed from the SARChI research chair with the strong phosphor research team. Profs Swart and Ntwaeaborwa won the prize for the most papers in the National Laser Centre (NLC) programme, and Prof. Swart also won the prize for the most successful PhD students.

Prof. Ted Kroon delivered presentations at the South African Powder Diffraction Conference at Wits in January, as well as at the 7th International Symposium on Macro and Supramolecular Architecture and Materials at Mintek in November, and at the 52nd conference of the Microscopy Society of Southern Africa at Stellenbosch in December. He was also invited to give a talk on 'Crystallography and Physics in the South African context' at the Pan-African Meeting of the International Year of Crystallography held at the UFS in October.

At the end of 2014, a team of scientists from the Department assisted an instrument engineer from the Oxford Instruments Omicron NanoScience Company to relocate a VT SPM (AES, LEED, and STM) system from the CSIR in Pretoria to the Department of Physics at the UFS.

The system was reassembled successfully. Continuous self-training is currently underway and the first atomic resolution images are expected mid-2015.

The UFS Astrophysics group hosted the 2014 High Energy Astrophysics in Southern Africa (HEASA 2014) workshop at the UFS-Boyden Observatory. This workshop has been an annual event since 2013 and is an initiative of SA-GAMMA, a high-energy research consortium between NWU, Wits, UFS, UJ, and SAAO. The workshop was attended by 35 researchers from across South Africa, with two world-renowned invited speakers from the US Naval Laboratory and Oxford University in attendance. The contributions will be published in *Memorie della Società Astronomica Italiana*. The UFS group made six contributions at this workshop.

Furthermore, Prof. PJ Meintjes, Dr B van Soelen, Mr J Maritz, and Ms A Odendaal received invitations to present research results at the Frontier Research in Astrophysics workshop held in Mondello (Palermo) between 25 May and 1 June 2014. These papers will be published in peer-reviewed conference proceedings. Furthermore, Dr Van Soelen and Ms Lizelke Klindt (MSc) made contributions at the SAIP conference hosted by the University of Johannesburg in July 2014, where two presentations were made.

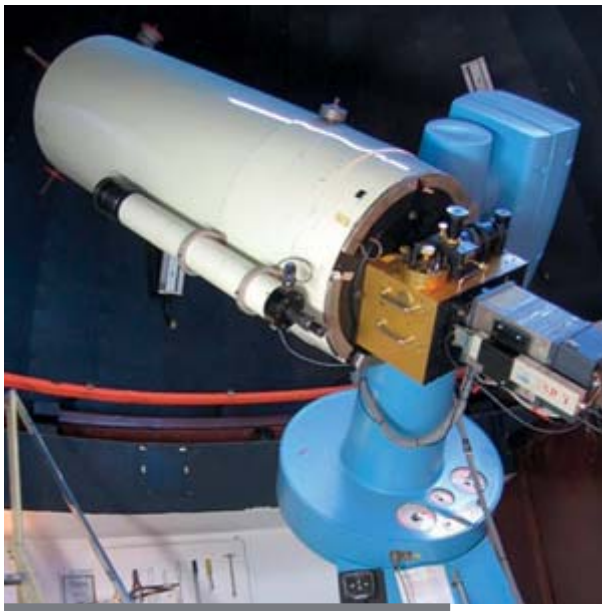
To boost the UFS observational capabilities of high-energy sources, Prof. PJ Meintjes wrote a proposal to host the decommissioned 0.5 m Boller and Chivens telescope of the South African Astronomical Observatory (SAAO), which is currently at the Sutherland site. The telescope has been allocated to the UFS and was installed at the UFS-Boyden Observatory between February and March 2015. The telescope is equipped with a photometer system that allows fast photometry of transient sources. This is an extremely valuable addition to our observational capabilities of rapid varying sources like the accretion-driven binaries, as well as to monitor the rapid variability that is observed in the jets of some classes of AGN, especially those with rich non-thermal multi-wavelength emission signatures.

Mr Cronje, Prof. Terblans, Prof. Kroon, and Mr Rautenbach reinstalling the VT SPM (AES, LEED, and STM) system that was donated by the CSIR in Pretoria to the Department of Physics.

Student Achievements

It was once again an excellent year for our postgraduate students at the annual conference of the South African Institute of Physics, where they won several prizes. The winners were:

- **Ms C van der Walt** won the prize for best PhD publication in Solid State (Supervisors: Profs JJ Terblans and HC Swart).
- **Mr STS Dlamini** won the prize for best MSc publication in Semiconductor Physics (Supervisors: Profs OM Ntwaeaborwa and HC Swart).
- **Mr TD Malevu** won the prize for best MSc oral presentation (Supervisor: Mr RO Ocaya).



The 0.5 m Boller and Chivens telescope at Sutherland that the South African Astronomical Observatory (SAAO) has donated to the Department.

Community Service

Two Observatories Project 2014

The Two Observatories Project at the UFS is an expansion of the project formerly known as the Boyden Observatory and Science Centre Project. The 'Two Observatories' are the Boyden Observatory (approximately 28 km from Bloemfontein), and the Lamont-Hussey Observatory on Naval Hill in the centre of Bloemfontein, which has been converted into a planetarium.

The planetarium has added another dimension to educational activities and programmes established through Boyden Observatory, and it has enhanced the reputation of the UFS (and Bloemfontein) as a centre that is at the forefront of astrophysics education in South Africa.

Planetarium: First Year of Operations

During its first year of operations (1 November 2013 to 31 October 2014), approximately 12 500 people attended 223 programmes at the planetarium.

Presentations at the planetarium start with an interactive, 'live' discussion on 'What's in the Sky this Month', and/or an exploration of our solar system. This part of the event involves a graduate student / volunteer / UFS staff member who addresses the audience as he or she 'flies' them through space. The audience then views one of the six pre-recorded shows that have been donated to the UFS, which includes a show from the University of Michigan ('Space Junk') and two shows from the American Museum of Natural History ('Passport to the Universe', and 'Search for Life: Are we Alone?').

Fifty-eight school groups visited the planetarium during this period. This included 385 teachers accompanying 2 870 learners. At least 1 960 learners were from disadvantaged schools and their expenses (transport and/or entrance) were partially or totally subsidised by the Two Observatories Project and DST/SAASTA. Some of the groups, especially those from rural areas, included a visit to Boyden Observatory as part of their itinerary.

Educational activities for the Two Observatories Project included the following high-impact events:

- The project team co-hosted a Space Science Outreach Programme on 1 March 2014 with DST/SAASTA. The event was part of an outreach programme to raise awareness about South Africa's advances in space science and technology, and how society benefits from these developments. The guest of honour was Mr Mandla Maseko – the first black South African scheduled to go into space in 2015. More than 600 learners attended the event.
- A total of seven special 'Science for the Future' planetarium programmes were presented to a total of 226 learners, 111 science teachers, and eight subject advisors.
- The National Astronomy Quiz for Grade 7 learners is a competition initiated by the South African Agency for Science and Technology Advancement (SAASTA), an agency of the National Research Foundation (NRF). The event was coordinated by the Two Observatories Project team in the Free State. One hundred and three schools from all over the Free State took part in the first official round on 3 June. These schools provided a very good geographic coverage of the Free State. Sixteen schools qualified for the second round; once again with a balanced geographic coverage of the province. All 64 learners who participated in the second round also attended a programme at the Planetarium. The third and final round was held at Boyden Observatory, and the winner this year was Henneman Primary School.
- The Department of Science and Technology (DST) invited the project team to co-host the launch of the 2014 National Science Week on 2 August. Dr Naledi Pandor (Minister of Science and Technology) delivered the keynote address at the event. She also attended a short programme at the planetarium.
- During the DST (Department of Science and Technology) National Science Week, held 2–8 August, a number of activities and programmes were presented and coordinated by the Two Observatories Project team. Ten special National Science Week planetarium programmes were presented to a total of 473 learners, 20 teachers, and 81 members of the public. This included 11 learners and two educators from the Soweto Science Centre.
- The project leader, Prof. Matie Hoffman, presented the module 'Are we Alone?' as part of the UFS 101 course to approximately 3 500 first-year UFS students.
- The UFS 101 Astronomy Fair took place on 30 August in Bloemfontein and on 6 September in QwaQwa.
- Prof. Hoffman attended the 7th Science Centre World Summit in Mechelen, Belgium, in March 2014. The Science Centre World Summit was organised by Technopolis, the Flemish Science Centre, in cooperation

Dr Coetsee-Hugo, Prof. Terblans, and Prof. Swart at the PHI European User Meeting, Commundo Tagungshotel, Ismaning, in Munich, Germany.

with the Royal Belgian Institute of Natural Sciences (Brussels). It was a high-level, global meeting point for representatives from different fields to discuss topics concerning all parties. Prof. Matie Hoffman spoke on 'Planetariums as seeds for science centre growth in Africa', with Mr Ayman el Sayad from Egypt, and Dr Jacob Ashong from Ghana.

National and International Collaboration

National

The Solid State Physics group is actively participating in a National Nanoscience Postgraduate Teaching Platform (NNPTP); a collaboration between three universities to train students in nanoscience. The students are selected from all over Africa.

The Astrophysics group is actively participating in a national programme for Astrophysics and Space Science (NASSP); a collaboration between ten universities to train top-class students in astrophysics and space science. The students are also selected from all over Africa.

International

Excellent collaboration was established between Linkoping University in Sweden (Profs Erik Janzén and Per-Olof Holtz) and our group during a research/workshop visit by Profs Swart and Terblans and Dr Duvenhage. It is foreseen that the Sweden group will visit the UFS in 2015.

Prof. Tiwari from Sweden and Prof. Swart with their postdoctoral students at the SETCOR International Conference on Smart Materials and Surfaces in Bangkok, Thailand.

Dr B van Soelen visited the University of Innsbruck (Innsbruck, Austria) to establish collaboration with Prof. Anita Reimer. The research visit consisted of two appointments; the first visit was from May to June, and the second visit from October to December 2014.

The Astrophysics group of the UFS is part of two major international research collaborations in High-Energy Astrophysics, namely the H.E.S.S. Collaboration, a partnership between 15 countries to study the highest energy sources in the universe. The telescopes are located in Namibia.

Postgraduate Students

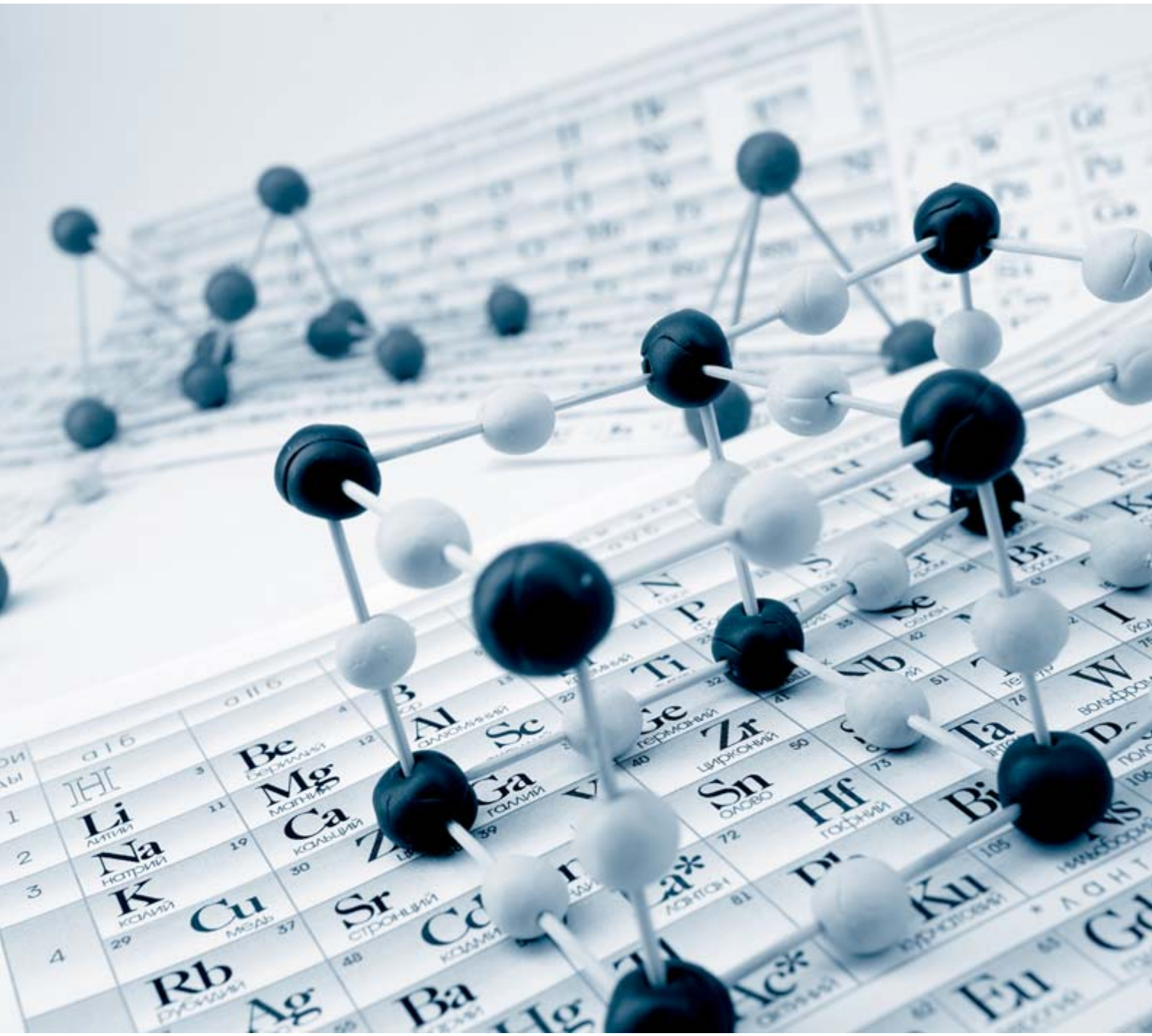
The following MSc students obtained their degrees: Messrs STS Dlamini, JM Maritz, LAL Wessels, and Ms PP Mokoena.

The following PhD students obtained their degrees: Mrs MM Duvenhage, Messrs LF Koao, AP Mohmmed, and W Tabaza.

Staff Matters

Dr RE Kroon was promoted to Associate Professor at the end of 2014.

Several staff members improved their NRF ratings during 2014: Profs HC Swart (B1), PJ Meintjes (B3), MO Ntwaeaborwa (C1), and RE Kroon (C3).



Research Outputs

Research Articles

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Adekoya, J.A., Dare, E.O., Mesubi, M.A., Nejo, A.A., Swart, H.C. & Revaprasadu, N. 2014. Synthesis of polyol based Ag/Pd nanocomposites for applications in catalysis. *Results in Physics* 4: 12-19.

Ali, A.G., Dejene, B.F. & Swart, H.C. 2014. Synthesis and characterization of Y_2O_3:Eu^{3+} phosphors using the Sol-Combustion method. *Physica B* 439: 181-184.

Ali, Y., Kumar, V., Sonkawade, R.G., Dhaliwa, A.S. & Swart, H.C. 2014. Gamma radiations induced modifications in Au-polypyrrole nanocomposites: Detailed Raman and X-ray studies. *Vacuum* 99: 265-271.

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Department of Zoology and Entomology

Overview

The Department comprises different research groups, each with its own objectives and specialised study areas. There is also a satellite department on the QwaQwa Campus.

Applied Agricultural Entomology

Mr De Villiers Fourie started collaborative work with the stinkbug research group and Nelspruit ARC. During 2014, Mr Fourie attended and presented talks at the National Macadamia Growers' Symposium and the National Avocado Growers' Symposium. Mr Petrus Roets completed his honours project on comparative population dynamics on several islands in the Vanderkloof Dam in the Northern Cape.

Aquatic Ecology

We concentrate mainly on fish parasites, but also on snails, crustaceans, and sometimes birds. Our focus is the biodiversity of fish parasites in natural environments. Members of Aquatic Ecology organised the annual conference of the Southern African Society of Aquatic Scientists at Black Mountain, Thaba Nchu (Bloemfontein), held 22–26 June 2014.

Arachnology

The 11th Colloquium of the African Arachnological Society was hosted by the UFS (C Haddad and J-A Neethling) and the National Museum (L Lotz) in Bloemfontein, and was held at the Amanzi Private Game Reserve in January 2014. The colloquium was attended by 28 people, including international delegates from Russia and Belgium. Mr J-H Neetlhing completed his MSc degree, to be awarded in 2015.

Dipterology and Environmental Entomology

Environmental Entomology reports on the intricate and dynamic ways in which insects interact with the biological, chemical, and physical aspects of their environment, with the focus on creating effective methods for environmental assessment by determining the biodiversity of insects in ecosystems.

Eco-Ethnology

We pursue basic research on behavioural biology and ecology, as well as anatomy, physiology, natural and evolutionary history, taxonomy, conservation, and the management and economics of animals. During July 2014, Mr H Butler, Mr P Olivier, and Ms N Jacobs presented talks, and Mr G Jonker presented a poster at the 49th annual congress of the Grassland Society of Southern Africa. A project on the spatial ecology of giraffes was also launched and the collaring of animals at Willem Pretorius Nature Reserve was filmed by an American film production crew. Collaboration with the Department of Economic Development, Tourism and Environmental Affairs was established, as well as collaboration with the Department of Medical Virology and the National Museum.

Forensic Entomology and Veterinary Entomology

Two studies in this field investigate various aspects of decomposition and arthropod succession in above and below ground (burial) scenarios. Research in Forensic Entomology primarily focuses on the succession patterns of calliphorids, sarcophagids, and the coleopterans in the past. The succession patterns of other arthropods are currently investigated in more detail. Two projects, shared with the Department of Genetics, investigate the extraction of viable DNA from the guts of maggots and gene expression in pupae as possible tools for fine-tuned post-mortem interval estimations. Two Veterinary Entomology projects are in progress, namely the use of the sterile male technique for the two species of tsetse fly prevalent in the KwaZulu-Natal area, and the investigation of natural insect and tick tolerance of purebred Brahman cattle due to certain physiological breed characteristics (skin thickness, tail length, hair structure, skin colour, and sebum production) when compared to Sussex cattle.

Ms E Allemann and Mr S Hoffman received their MSc degrees in 2014.

Herpetology

Since its reestablishment in 2013 by Prof. Neil Heideman and Ms Lindi Heyns, the Herpetology Research Unit has been active in research on our indigenous herpetofauna. We also have current projects in which affiliated postgraduate students deal with ecomorphological, phylogenetic, and baseline ecological questions, as well as the biochemical analysis of amphibian skin secretions.

One of the highlights of 2014 is the Interdisciplinary Research Grant (UFS) for collaboration with the Department of Microbial, Biochemical and Food Biotechnology that was received.

Postgraduate students at Soetdoring Nature Reserve.

Insects on New Crops Programme and Soil Ecology

Prof. Schalk Louw's research focuses on the biodiversity and ecology of soil mesofauna. Together with Mr De V Fourie and Mr I Cloete, papers were presented at the South

Lecturers and second-year and third-year Entomology students on visit to institutions in Pretoria.

African Avocado Growers' Association held in Tzaneen, and Starke Ayres Farmers' Day in Bloemfontein. From our research, chapters were contributed on amaranth, kenaf, and pistachio in *Insects of Cultivated Plants and Natural Pastures in Southern Africa* (published in 2015).

Members of HortGro Science Advisory Panel for Entomology reported on 25 projects at the Stellenbosch meeting in October. Prof. Louw is a member of the SubTrop Research Consortium in Mpumalanga for stinkbug management on avocado, litchi, mango, and macadamia.

Mr B Muller received his MSc and Mr V Swart received his PhD. The latter is to be awarded in July 2015.

Nematology

Ms Anneke Vermeulen (MSc) and Dr C Jansen van Rensburg attended the 6th International Conference on Nematology from 5–9 May 2014 in Cape Town, and presented a paper and poster respectively.

Research in this group is focused on plant-parasitic and free-living freshwater nematodes occurring in the Free State. Free-living nematodes belonging to the Dorylaimoidea are also studied at the Seekoeivlei Nature Reserve, near Memel in the Free State.

Tick Research Unit

The Tick Research Unit includes the Pesticide Resistance Testing Facility and is aimed at providing a service to producers and pharmaceutical companies by determining the presence and extent of tick resistance against chemical control in a specific area through conventional laboratory testing. Research includes evaluation of results from the entrepreneurial leg to indicate the spread of tick resistance, as well as collaboration with Dr C Maritz (UP) to correlate conventional testing with molecular expression of resistance. Plant extracts from different cultural remedies are also investigated in collaboration with Dr G Fouché (CSIR).

Staff Matters

Prof. Jo van As retired at the end of 2014 after being the Head of the Department since 1988.

SASAQS Conference held at Black Mountain (22–26 June). From left to right: President (Jeanne Adams), keynote speaker (John Mendelson), Lani Van Vuuren (Editor of Water Wheel), Prof. Jo van As, and Prof. Liesl van As.

Research Outputs

Research Articles

Grobbelaar, A., Van As, L.L., Butler, H.J.B. & Van As, J.G. 2014. Ecology of diplostomid (Trematoda: Digenea) infection in freshwater fish in Southern Africa. *African Zoology* 49: 222-232.

Haddad, C.R. 2014. A revision of the endemic South African sac spider genus Lessertina Lawrence, 1942 (Araneae: Eutichuridae). *Zootaxa* 3873: 82-92.

Louw, S. vd M., Wilson, J.R.U., Janion, C., Veldtman, R., Davies, S.J. & Addison, M. 2014. The unknown underworld: Understanding soil health in South Africa. *South African Journal of Science* 110(5/6): 2-5.

Ramírez, M.J., Grismado, C.J., Labarque, F.M., Izquierdo, M.A., Ledford, J.M., Miller, J.A., Haddad, C.R. & Griswold, C.E. 2014. The morphology and relationships of the walking mud spiders of the genus Cryptothele (Araneae: Zodariidae). *Zoologischer Anzeiger* 253: 382-393.

Wesołowska, W. & Haddad, C.R. 2014. An overview of the jumping spiders of Lesotho (Araneae: Salticidae), with descriptions of six new species. *African Invertebrates* 55: 229-268.

Book

Dippenaar-Schoeman, A.S. & Haddad, C.R. 2014. *Spiders of the Grassland Biome.* Plant Protection Research Institute Handbook No. 19. Pretoria: ARC, Plant Protection Research Institute.

Staff

Extraordinary Professors: Profs GL Prinsloo and LJ Fourie.

Professors: Profs JG van As, L Basson, and S vdM Louw.

Associate Professor: Prof. LL van As.

Senior Lecturer: Dr CR Haddad.

Lecturers: Dr S Brink, Mr HJB Butler, Mrs EMSP van Dalen, and Dr C Jansen van Rensburg.

Junior Lecturers: Messrs De V Fourie, VR Swart, and Ms L Heyns.

Research Associates: Drs J Botha and K Christison.

Research Fellow: Dr NA Rayner.

Officers: Professional Services: Mrs I Human and Mrs SAM Teele.

Senior Assistant Officer: Mrs I Erasmus.

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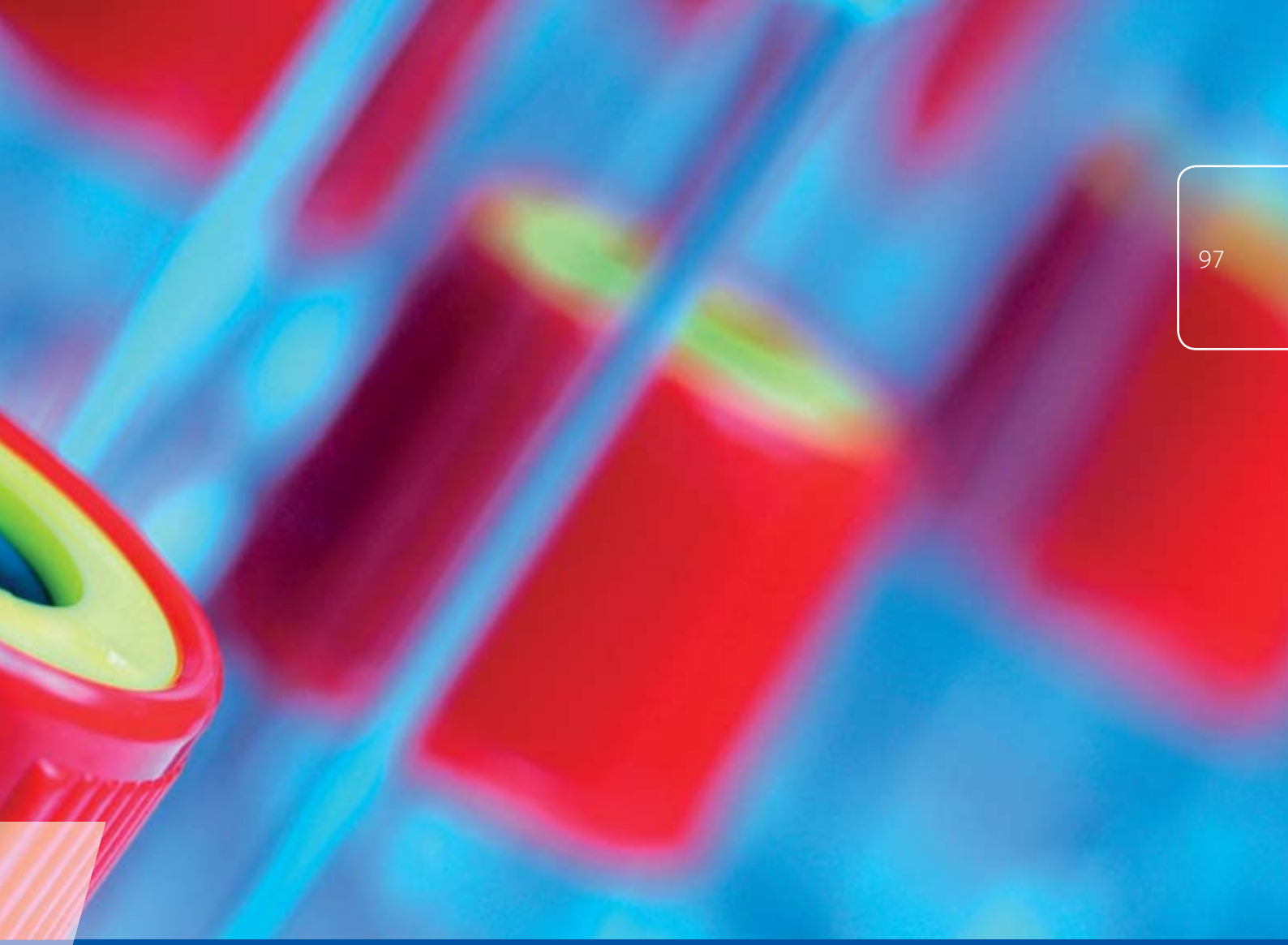

Academic Centres

Disaster Management Training and Education Centre for Africa

Overview

The year 2014 saw DiMTEC present at various international and national disaster-related activities, and concluded with the best results to date achieved by the first-year master's class during the 2014 November exams.

National and International Collaboration

Early in the year, Dr Jordaan, director at UFS-DiMTEC, conducted research visits to three African countries – Ghana, Kenya, and Tanzania – on invitation from different United Nations organisations. In November, Dr Jordaan also embarked on a very fruitful visit to the USA. He built relationships and initiated collaborations with the University of Nebraska-Lincoln and the Tulane University in New Orleans. As a result of his visits to Africa and the USA and close cooperation with institutions from these countries, Dr Jordaan laid the foundation for future collaboration.

Mr JA Belle visited Congo-Brazzaville in February 2014 as a follow-up on the UNU-EHS/UFS-DiMTEC collaboration to support master's students in Congo-Brazzaville. He also met with the director in charge of cooperation and international relations at the Marien Ngouabi University, Prof. Scholastique Dianzinga, laying the foundation for possible partnerships and research collaboration.

In June 2014, Mr Belle attended an international conference/workshop and the Global Training of Trainers on Ecosystem-based Disaster Risk Reduction and Climate Change Adaptation (Eco-DRR/CCA) in Bogor, Indonesia. He also participated in the Global Training of Trainers on the new master's degree course developed by the United Nations Environmental Programme (UNEP) on Ecosystem-based Disaster Risk Reduction and Climate Change Adaptation (Eco-DRR/CCA). Currently, 25 universities worldwide run this master's course and UFS-DiMTEC will follow suit.

Training Activities

This year's Block Course, in collaboration with the UNU-EHS, was held in Port Elizabeth. The 15 participants were from different backgrounds, sectors, and disciplines, allowing for interdisciplinary learning.

The Peace Relief Mission and Reconstruction Course, developed by Dr Jordaan, was presented in Pretoria at the War College to senior officers in the military, police, and correctional services. The course was designed to prepare officers to better understand disasters and the interaction with local people during peace operations.

Conferences

DiMTEC was prominent in several national and international conferences with presentations by staff in Europe, USA, and in Africa. The conference with the highest number of contributions from DiMTEC was the Southern Africa Society for Disaster Reduction (SASDiR) conference in Windhoek, Namibia. With no less than 18 papers from DiMTEC staff members and former and current students, the UFS boasted an extraordinary presence at this conference.

Research

Dr Jordaan completed research on drought risk in Karamoja in Uganda during July 2014. The main aim of this research was to provide insight into recurring droughts and their impact on famine in the region. DiMTEC's Water Research Commission project, *Vulnerability, adaptation to, and coping with drought: The case of commercial and subsistence rain-fed farming in the Eastern Cape,* also continued in 2014.

The newly registered PhD in Disaster Management promises to distinguish DiMTEC as a centre of excellence in research, with two staff members and six candidates registered for PhD study. In addition, 12 new candidates submitted proposals for registration in 2015.

From the left: Dr Jordaan, Prof. Luu, and Prof. Ferreira from the Tulane University in New Orleans.

Block Course attendees.

Student graduation.

Research Outputs

Research Articles

Belle, J.A. & Sikhakhane, M.M. 2014. Zonkizizwe Extension Six settlers' dolomite sinkhole risk awareness. *Disaster Advances* 7(10): 60-68.

Jordaan, A.J. 2014. Building resilience in Africa through transformation and a green economy: Challenges and opportunities. (Invited Author). *Rethinking Resilience. International Program for Environmental Innovators, Keio University, Japan.*

Jordaan, A.J., Jordaan, A.D. & Proctor, M. 2014. Wildfire risk assessment for the Northern Cape, South Africa. *Disaster Advances* March 2014.

Lukić, T., Marić, T., Hrnjak, I., Gavrilov, M.B., Mladjan, D., Milošević, Z., Marković, S.B., Sakulski, D., Jordaan, A.J. & Basarin, B. 2014. Forest fires – Guidelines for classification, legislation and fire management: A Serbian case study. *Acta Geographica Slovenica / Geografski Institut Antona Melika (Ljubljana) Anton Melk Geographical Institute of ZRC SAZU:* 1581-8314.

Mabela, B.M., Ncube, A. & Jordaan, A.J. 2014. Assessing the knowledge, attitudes and practices regarding cholera preparedness and prevention in Ga-Mampuru village, Limpopo, South Africa. *Disaster Advances* April, 2014.

Micic, T., Lukic, T., Dordevic, J., Basarin, B., Bjelajac, D., Hrnjak, I., Markovic, B.S., Sakulski, D., Dercan, B., Bubalo-Živkovic, M., Pavic, D. & Lazic, L. 2014. Determination of wind energy potential and its implementation concept for the electricity market in the Vojvodina Region (North Serbia): An Overview. *Geographica Pannonica* 18(1): 6-17.

Ndille, R. & Belle, J.A. 2014. Managing the Limbe Floods: Considerations for disaster risk reduction in Cameroon. *International Journal of Disaster Advances* 5: 147-156.

Siebrits, R.M., Winter, K., Barenes, J., Dent, M.C., Ekama, G., Ginster, M., Harrison, J., Jackson, G., Jacobs, I., Jordaan, A., Jordaan, A.J., Kasan, H.C., Kloppers, W., Le Roux, R., Maree, J., Momba, M.N.B., Munnik, A.V., O'keeffe, J., Schulze, R., Silberbauer, M., Still, D. & Van Zyl, D.E. 2014. Priority water research questions for South Africa developed through participatory processes. *Water SA* 40: 199-210.

Sokolovic, D.S., Höflinger, W., Šecerov Sokolovic, R.M., Sokolovic, S.M. & Sakulski, D. 2014. Experimental study of mist generated from metalworking fluids emulsions. *Journal of Aerosol Science* 61: 70-80.

Reports

Bussink, C., Jordaan, A.J., Armstrong, L.J., Liu, L., Ranera, F., Wei, W., Hagenlocher, M., Yesuf, G. & Dwyer, N. 2014. *Technical advisory report on the use of space-based information for disaster risk reduction and response in Kenia.* United Nations Space-based Technology for Disaster Risk Reduction and Response (UNSPIDER) Technical Advisory Mission to Kenia. Report submitted to National Disaster Operations Centre, Office of the Presidency, Government of Kenia, Nairobi, Kenia.

Csarant, L., Jordaan, A.J., Anderson, L.J., Macharia, D., Siwela, B., Mück, M. & Sibanze, P. 2014. *Technical advisory report on the use of space-based information for disaster risk reduction and response in Zambia.* United Nations Space Based Technology for Disaster Risk Reduction and Response (UNSPIDER) Technical Advisory Mission to Zambia. Report submitted to National Disaster Operations Centre, Office of the Presidency, Government of Zambia, Lusaka, Zambia.

Jordaan, A.J. 2014. Dro*ught risk assessment: Is drought the cause of chronic food insecurity in Karamoja, Uganda?* Drought risk assessment report submitted to International Rescue Committee, Kampala, Uganda.

Jordaan, A.J. & Sakulski, D. 2014. *Vulnerability, adaptation to and coping with drought: The case of commercial and subsistence rainfed farming in the Eastern Cape: Drought hazard assessment.* Report delivered to the WRC KSA4/Thrust4/P2, Contract 2280. Water Research Commission, Pretoria, South Africa.

Jordaan, A.J., Fumiso, F., Fadeyi, T. & Mdungela, M. 2014. *Vulnerability, adaptation to and coping with drought: The case of commercial and subsistence rainfed farming in the Eastern Cape: Vulnerability and resilience to drought.* Report delivered to the WRC KSA4/Thrust4/P2, Contract 2280. Water Research Commission, Pretoria, South Africa.

Staff

Director: Dr AJ Jordaan.

Professor: Prof. D Sakulski.

External Lecturers: Dr H Booysen, Dr E du Plessis, Prof. B Grové, Prof. R Bragg, Ms L de Wet, Dr H Booysen, Dr M. Schutte-Smith, Dr E du Plessis, Ms M M Joubert, Mr S Carstens, Mr A Kesten, Ms J Swanepoel, Ms L Nogabe, Ms A van Rooyen, Mr M Procter, Mr T Mudamburi T, and Mr WF Ellis.

Junior Lecturers: Mr J Belle, Ms O Kunguma, and Ms A Ncube.

Researcher Assistants: Mr C Mokete, Ms MM Motsumi, Mr RT Mayne, Ms R Rambau, and Ms NB Zwane.

Senior Assistant Officers: Mrs G van Coppenhagen and Ms A van Straten.

Researcher Assistants: Ms Muyambo and Mr Fenta.

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Centre for Environmental Management

Celebrating 20 years: Looking to the future

The Centre for Environmental Management (CEM) celebrated 20 years of existence in 2014. To commemorate this achievement, the CEM presented a series of events for staff, research associates, role players in the history of the CEM, and other specialists in the field of environmental management. The activities included a public lecture, a dinner, a colloquium, and a workshop on the topic of educational needs in the field of environmental management. A survey among almost 400 CEM graduates was used to inform the valuable discussions.

Since its establishment in 1994, the CEM has created a niche for itself in Southern Africa, based on three intertwined components; namely, the master's and doctoral programmes, a number of short courses, and a research and contract component. Through its research projects and teaching activities, the CEM has become known as an established centre of expertise in fields such as aquatic ecology.

The master's programme developed gradually around the themes of sustainable development, project management, environmental assessment, environmental management systems, and integrated environmental management, and is now a well-established and highly sought after qualification. Graduates are equipped with an interdisciplinary overview of the South African environment. They are in high demand at companies, consultants, government at various levels, and nature conservation bodies. Today, environmental management systems are required by even the smallest of businesses, and environmental assessment has become a highly sophisticated requirement for a variety of development activities. Water research is becoming more and more important in Africa as water resources dwindle.

Special Achievements

Louis Scott Tribute 7–11 July 2014

Prof. Maitland Seaman was instrumental in the organisation and presentation of a tribute to Prof. Louis Scott, who has retired from the Department of Plant Science, with the theme *From Past to Present: Changing Climates, Ecosystems and Environments of Arid Southern Africa*. This international gathering was attended by delegates from several countries.

Staff

Prof. Maitland Seaman, who had been instrumental in the establishment of the CEM and particularly instrumental in the success of its various activities over the 20 years of its existence, retired towards the end of 2014 after a successful career spanning 34 years at the UFS.

Students

At the 2014 winter graduation ceremony, 20 students graduated with master's degrees in Environmental Management, of which two graduated cum laude. The Maitland Seaman Prize for the best student and the CEM Prize for the best mini-dissertation in Environmental Management in 2013 were both awarded to Ms Ilse Botha. The Limpho Letsela Prize, in memory of a former CEM staff member, was awarded to Mr Don Muroua from Namibia for the best foreign African student.

At the spring graduation ceremony, one student received a master's degree in Environmental Management.

A PhD in Environmental Management was awarded to Mr Morgan Hauptfleisch for his dissertation entitled 'The use of ecosystem parameters in predicting the risk of aircraft-wildlife collisions at Namibian airports'.

Community Service

The ecological condition (water quality and algae) of Loch Logan, an urban impoundment at Bloemfontein's Waterfront development, has been intermittently monitored from 2000 to present. This ongoing project is used to train postgraduate students and the data collected are shared with the Mangaung Metropolitan Municipality and the owners of the Waterfront development for use in the management of the lake.

The CEM has been involved in collecting data (water quality, algae, fish, and macro-invertebrates) for the National Aquatic Ecosystem Health Monitoring Programme, specifically for the River Health Programme (a Department

of Water and Sanitation initiative), for the last 16 years. The data collected are shared with the Free State as well as the National Department of Water and Sanitation. The data are used to establish the present ecological condition of the sites monitored and has also been used to determine the resource quality objectives of sites on the Modder River and Riet River.

Representatives from the CEM serve on the Modder-Riet Catchment Management Forum (an Institutional Committee of the Department of Water and Sanitation), contributing data and knowledge for use in the management of the catchment.

Collaboration

One of the cornerstones of CEM's approach to education and research is cooperation. In addition to the contribution made by lecturers from outside the university, colleagues at other UFS departments are also involved in CEM activities. CEM staff and research associates reciprocate by contributing to programmes in other faculties.

Ms Marinda Avenant has been contributing to the master's programme in Development Studies, coordinated by the Centre for Development Studies, since 2008. She presents a module on climate change and development in Africa. For the honours programme in Africa Studies, coordinated by the Centre for Africa Studies, Prof. Maitland Seaman and Ms Marinda Avenant present a course on Africa's resources and environment.

For the past four years, two exchange students from the Technische Universität Dresden, (TUD) studying under Dr Dirk Jungmann, joined the CEM for two months to complete a practical project in aquatic ecology and ecotoxicology as part of their master's degrees. In 2014, Mr Stefan Lips and Mr Martin Bochman, who study Hydrobiology at the Technical University of Dresden, Germany, joined CEM and completed research projects on the hydrology and water quality of the Modder River catchment.

GIS Facility

Mr Frank Sokolic, a recognised GIS expert and consultant, spends a week each month in the Centre's offices. His collaboration involves supervision and assistance to students from the CEM and other faculties. He also provides maps and Internet web pages for current research projects at the CEM.

Two staff members of the CEM, Mr Pieta Hoffman and Ms Qawekazi Mkabile, monitoring the ecological condition (water quality and algae) of Loch Logan, Bloemfontein Waterfront.

Research

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

Based on perceived gaps in the knowledge on unconventional gas mining in South Africa and how this activity could impact on the biophysical and socio-economic environments, researchers at the CEM and the departments of Physics, Sociology, and Mathematical Statistics, in collaboration with researchers from the universities of Pretoria, Cape Town, and Fort Hare, and the Iziko South African Museum and Endangered Wildlife Trust,

prepared a report on the vulnerability of unconventional gas mining of specific themes (surface water, groundwater, vegetation, seismicity, and socioeconomics). The monitoring protocol that was developed can be used as a guideline for planning monitoring activities during the various phases of unconventional gas mining. The final Water Research Commission report was published in 2014.

Determining the factors that had an influence on the lifting of the moratorium on unconventional oil and gas extraction by means of hydraulic fracturing in South Africa. The aim of this study was to identify the key factors that influenced the decision-making process to lift the moratorium on unconventional oil and gas extraction in South Africa in 2012 before adequate regulations were in place. It was found that decision making may have been influenced by a desire to create jobs and to meet energy needs.

The prize for best student and the CEM Prize for best mini-dissertation in Environmental Management in 2014 were both awarded to Ms Ilse Botha. Mr Don Muroua from Namibia received the Limpho Letsela Prize as the best foreign African student. From left to right: Prof. Maitland Seaman, Ms Marinda Avenant, Ms Ilse Botha, and Mr Don Muroua.

In 2014 the CEM celebrated 20 years of successful activities. Prof. Maitland Seaman, one of the founders of the CEM, retired after 34 years' service at the UFS.

DAAD project – Alliance for Wetlands – Research and Restoration (AllWet RES)

Through the CEM, the UFS is one of the core partners of a German-South African research project on wetlands funded by DAAD (the German Academic Exchange Service). This project focuses on the improvement of knowledge about the possibilities and limitations of restoring degraded wetlands in the northern Maputaland area, South Africa.

Biomonitoring of the ecological status of Free State rivers

The Modder, Riet, and Caledon rivers are monitored three times a year (March, July, and November) by a team from the CEM. Data, focusing on water quality, algae, vegetation, fish, and macro-invertebrates, have been collected on these three rivers for the last 16 years at 11 sites. A yearly report is produced, which compares the trend in the ecological condition for the last three years.

Biodiversity monitoring at Kolomela Mine (Kumba Iron Ore), Postmasburg

The CEM, in collaboration with the National Museum and the UFS departments of Pasture Science, Soil Studies, and Zoology, has been conducting a biomonitoring programme at Kolomela Mine close to Postmasburg since 2010. The mine is situated on the Ghaap plateau, a unique area of very high plant diversity and endemic or near endemic plant species. Aspects that are being monitored include rangeland management and bush encroachment, vegetation diversity and rehabilitation, soil water balance, aquatic and terrestrial invertebrates, small mammals, reptiles, and amphibians. The aim of the monitoring programme is to determine the impact of dust and dewatering on the local biodiversity.

The enterprise architectures of South African towns

Dr Daan Toerien (research associate), in collaboration with Prof. Maitland Seaman, is investigating the nature of enterprises that occur in South African towns, as new ways are needed to improve our understanding of the enterprise dynamics of South African towns, especially after the Small Towns Regeneration Project was initiated. A strong and fully quantifiable relationship between enterprise richness (i.e. number of enterprise types) and the total number of enterprises in the towns was found in a recent study published in the *South African Journal of Science*.

Projects by Research Associates

Research associates are involved in various projects in the field of Archaeology (Drs James Brink and Daryl Codron), Ecology (Drs Nico Avenant, Hugo Bezuidenhout, Joh Henschel, Fred Kruger, and Pieter Zietsman), Wetlands (Drs Nacelle Collins, Piet Grundlingh, and Steve Mitchell), Water Resource Management (Prof. Tony Turton), and Sustainability (Drs Daan Toerien and Alex Weaver).

Research Outputs

Research Articles

Avenant, N.L. 2014. Rodent biology and management. *Navorsinge van die Nasionale Museum, Bloemfontein* 30(3): i-ii (Editorial).

Backwell, L.R., McCarthy, T.S., Wadley, L., Henderson, Z., Steininger, C.M., De Klerk, B., Barré, M., Lamothe, M., Chase, B.M., Woodborne, S., Susino, G.J., Bamford, M.K., Sievers, C., Brink, J.S., Rossouw, L., Pollarolo, L., Trower, G., Scott, L. & d'Errico, F. 2014. Multiproxy record of late quaternary climate change and Middle Stone Age human occupation at Wonderkrater, South Africa. *Quaternary Science Reviews* 99: 42-59.

Breed, W.G., Leigh, C.M., Aplin, K.P., Shahin, A.A. & Avenant, N.L. 2014. Morphological diversity and evolution of the spermatozoon in the mouse-related clade of rodents. *Journal of Morphology* 275: 540-547.

Buschke, F.T. & Seaman, M.T. 2014. Golden Gate Highlands National Park: Killing the goose laying the golden eggs? Comment on Tau *et al.* (2013). *South African Journal of Science* 110(7/8): 20-21.

Du, K., Marston, A., Van Vuuren, S.F., Van Zyl, R.L., Coleman, C., Zietsman, P.C., Bonnet, S.L., Ferreira, D. & Van der Westhuizen, J.H. 2014. Flavonolacyl glucosides from the aril of *Schotia brachypetala* Sond. and their antioxidant, antibacterial and antimalarial activities. *Phytochemistry Letters* 10: 123-127.

Esterhuyse, S. & Redelinghuys, N. 2014. Knowledge on unconventional gas mining among decision-makers in South Africa: Exploring the requirements for fact-based water policy development. *Water Policy* 16: 1155-1171.

Hempson, G.P., Archibald, S., Bond, W.J., Ellis, R.P., Grant, C.C., Kruger, F.J., Kruger, L.M., Moxley, C., Owen-Smith, N., Peel, M.J.S., Smit, I.P.J. & Vickers, K.J. 2014. Ecology of grazing lawns in Africa. *Biological Reviews* 90(3): 979-994.

Kneidinger, C.M., Van Heerden, H., MacFadyen, D., Van der Merwe, M., Avenant, N.L. & Van der Bank, H. 2014. Species identification, habitat preferences and population genetics of *Mastomys natalensis* and *Mastomys coucha* in an enclosed area, Kruger National Park, South Africa. *Navorsinge van die Nasionale Museum, Bloemfontein* 30(3): 31-45.

Toerien, D. 2014. 'n Eeu van orde in sakeonder-nemings in dorpe van die Oos-Kaapse Karoo. *Litnet Akademies* 11(1): 330-371.

Toerien, D. & Seaman, M.T. 2014. Enterprise richness as an important characteristic of South African towns. *South African Journal of Science* 110(11/12): 66-74.

Chapters in Books

Jacobs, I. & Turton, A.R. 2014. Transboundary water resource management. In *Handbook of Engineering Hydrology, Volume 3: Environmental Hydrology and Water Management*, edited by S. Eslamain. UK: CRC Press, Taylor and Francis. pp. 420-431.

Turton, A.R. 2014. Hydropolitics and transboundary river basin management nuances in the Southern African Development Community. In *New Approaches to Governance of Natural Resources*, edited by A. Grant, W.R.N. Compaoré & M.I. Mitchell. London: Insights from Africa, Palgrave Macmillan. pp. 224-246.

Turton, A.R. & Botha, F.S. 2014. Anthropocenic aquifer: New thinking. In: *Handbook of Engineering Hydrology, Volume 3: Environmental Hydrology and Water Management*, edited by S. Eslamain. UK: CRC Press, Taylor and Francis. pp. 2-17.

Staff

Professor and Director: Prof. MT Seaman.

Lecturer: Ms MF Avenant.

Affiliate Professor: Prof. A Turton.

Research Associates: Drs NL Avenant, H Bezuidenhout, JS Brink, D Codron, NB Collins, P Grundlingh, JR Henschel, FJ Kruger, SA Mitchell, DF Toerien, A Weaver, and PC Zietsman.

Course Coordinator: Ms H van Jaarsveld.

Chief Professional Officer: Ms M Watson.

Senior Professional Officer: Ms ME Kemp.

Professional Officers: Mss S Esterhuyse and HS Human.

Senior Assistant: Professional Officer: Ms TA Vos.

Assistant Professional Officer: Ms D Kolesky.

Assistant Researchers: Ms IS Ferreira (until 30 October 2014), Mr PA Hoffman, Ms Q Mkabile, Ms MW Naudé, Mr MAW Nell (until 28 February 2014), Mr C Odendaal (until 30 June 2014), Ms L Pretorius, and Ms HES Prinsloo (until 28 February 2014).

Messenger: Mr PS Thibiri.

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Centre for Microscopy

Overview

The Centre for Microscopy maintains its research support function and assists mostly researchers and students of the Faculty. Thirty-two research areas with 76 researchers and students conducted microscopic and nanotechnology-based research in 2014. Nearly all preparations, excluding those for four independent students, were undertaken by Centre personnel. The Centre supplies all chemicals needed by researchers. It is thus not necessary for departments to purchase very expensive chemicals in bulk that may expire before it can be utilised. The Centre has a confocal microscope (CLSM), two scanning electron microscopes (SEM), and a transmission electron microscope (TEM). A few external users from the private sector and a number of researchers from other local and international institutions have also visited the Centre for specimen analysis. Indicated below are the user numbers of the past four years:

2011	2012	2013	2014
48	64	72	76

The microscope usage by different users and departments is indicated in the following table. It is noticeable that preparation time involved 725 hours in the laboratory before actual microscope analysis commenced.

Department	Usage hours		
	CLSM	SEM	TEM
Cardiothoracic Surgery	-	68	14
Centre (image processing, support, training)	10	221	20
Chemistry	-	2	26
Engineering	-	21	-
Geography	-	11	-
Geology	-	30	-
Haematology	-	6	-
Institute for Groundwater Studies	-	6	-
Microbial, Biochemical and Food Biotechnology	2	109	49
Physics	-	332	25
Plant Sciences	35	79	-
Zoology and Entomology	3	48	-
External researchers/projects:			
Central University of Technology[1]	-	17	6
Gotha Pharmaceuticals[1,2]	26	5	-
Mayo Clinic, Rochester, USA	-	5	-
Total Usage	**76**	**960**	**140**

[1] Projects were facilitated by the Directorate for Research Development.

[2] Gotha Pharmaceuticals depended on fluorescence analysis of oils used in skin treatment medications for filing patent rights.

Research and Training Activities

A local researcher from the Central University of Technology, Dr Ntsoaki Malebo, now a regular visitor to the Centre (postdoctoral fellow, Unit of Applied Food Science and Biotechnology), performed ultrastructural research using scanning and transmission electron microscopy.

An international researcher, Prof. Debabrata Mukhopadhyay, from the Mayo Clinic in Rochester, USA, visited the Centre for sample preparation and analysis pertaining to the development of novel anticancer drugs. These samples were also prepared by the Centre for nanotechnology research.

Honours students from the departments of Zoology and Entomology (DRK/ENT614) and Microbial, Biochemical and Food Biotechnology (MKB/BOC614) attended practical presentations concerning the preparation of material and handling of equipment.

Second-year students from the Department of Zoology and Entomology and the Department of Plant Sciences attended demonstrations regarding microscopy research.

New JEOL Scanning Electron Microscope

The JEOL SEM was installed at the end of 2014. R10,1 million was allocated to Prof. Martin Ntwaeaborwa from the

Training on the new JEOL 7800 FEG-SEM presented by Dr Andy Yarwood. From left to right: Ms Puseletso Mokoena (SEM manager: Physics), Prof. Martin Ntwaeaborwa (who initiated the purchase of the microscope), Dr Yarwood, and Ms Hanlie Grobler (laboratory manager at the Centre).

Department of Physics by the NRF NNEP (National Nanotechnology Equipment) Programme. This apparatus is a high-resolution field-emission scanning electron microscope and structures as small as two nanometres can be resolved. It can also qualitatively analyse elements in any type of sample. Specialised software is used to quantify elements analysed. It is also equipped with a cathode luminescence detector to determine very specific wavelength emissions of luminescent particles. These analyses play an important part in physics and geological research fields.

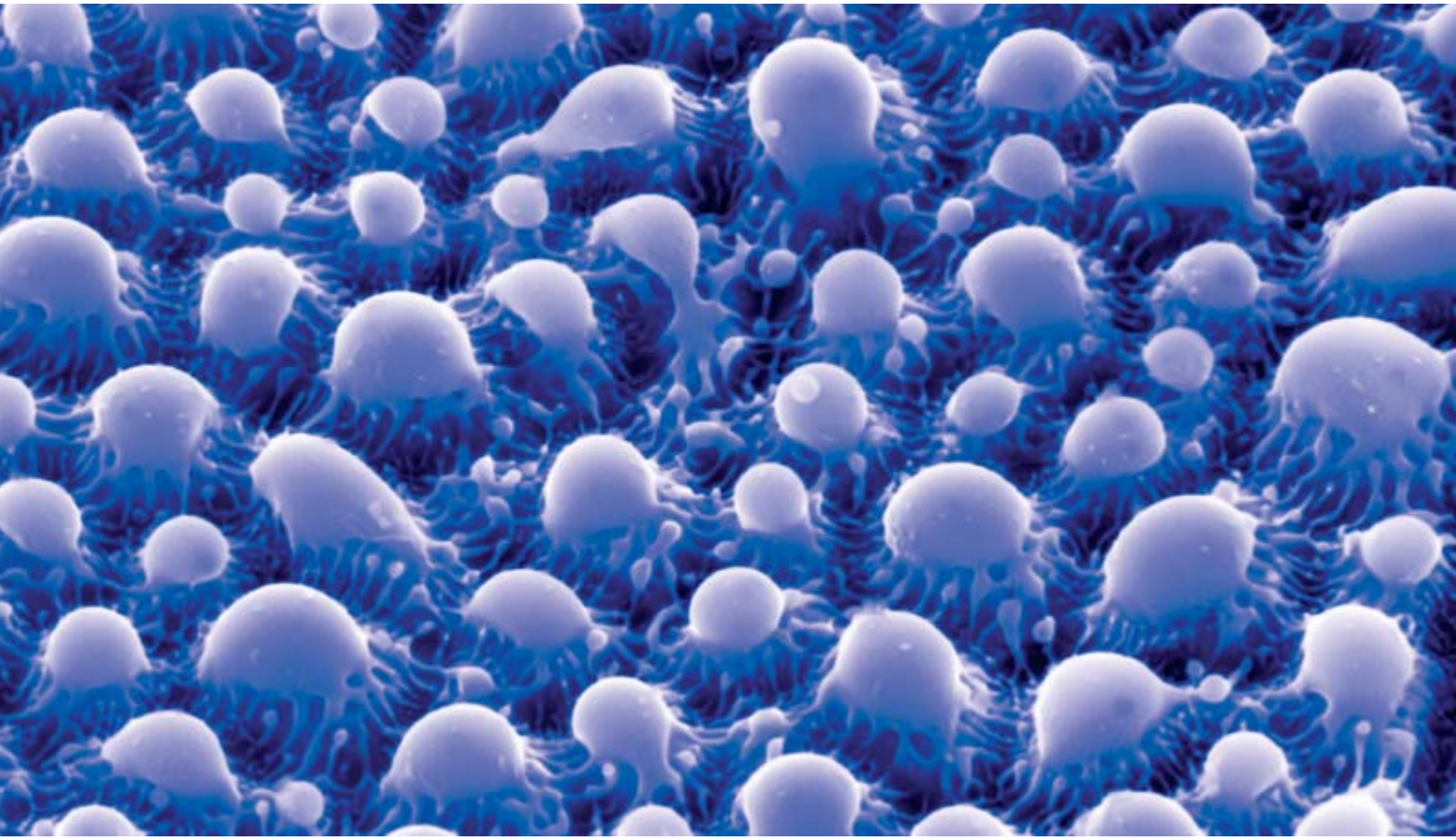
Prof. Pieter van Wyk presenting a poster at the XV International Conference on Electron Microscopy in Cracow, Poland.

Other Facilities

The histological and other light microscopy preparation technique laboratory became fully functional during 2014. Researchers from the Department of Zoology and Entomology and the Department of Plant Sciences utilised these facilities during the year.

Maintenance Aspects

The problematic state of the Shimadzu SEM remains unresolved since there is no longer a company available in South Africa that can attend to the electronic problems of this type of microscope. The replacement of this microscope with a scanning electron microscope more specific to biological applications needs to be attended to in the next few years. Prof. Van Wyk regularly does maintenance on the microscopes, which involves approximately 40 hours, with an estimated cost saving of R25 000.00 (based on rates that external companies quoted for similar maintenance on the microscopes).



Research Outputs

Research Articles

Duvenhage, M.M., Visser, H.G., Ntwaeaborwa, O.M. & Swart, H.C. 2014. The effect of electron donating and withdrawing groups on the morphology and optical properties of Alq3. *Physica B: Condensed Matter* 439: 46-49.

Kumar, V., Gohain, M., Kumar, V., Van Tonder, J.H., Bezuidenhoudt, B.C.B., Ntwaeaborwa, O.M. & Swart, H.C. 2014. Synthesis of yellow emitting bis-pyrimidine based purely organic phosphors. *Journal of Luminescence* 149: 61-68.

Kumar, V., Kumar, V., Som, S., Duvenhage, M.M., Ntwaeaborwa, O.M. & Swart, H.C. 2014. Effect of Eu doping on the photoluminescence properties of ZnO nanophosphors for red emission applications. *Applied Surface Science* 308: 419-430.

Kumar, V., Som, S., Kumar, V., Kumar, V., Ntwaeaborwa, O.M., Coetsee, E. & Swart, H.C. 2014. Tunable and white emission from ZnO: Tb3+ nanophosphors for solid state lighting applications. *Chemical Engineering Journal* 255: 541-552.

Mokhena, T.C. & Luyt, A.S. 2014. Investigation of polyethylene/sisal whiskers nanocomposites prepared under different conditions. *Polymer Composites* 35(11): 2221-2233.

Mokoena, P.P., Gohain, M., Kumar, V., Bezuidenhoudt, B.C.B., Swart, H.C. & Ntwaeaborwa, O.M. 2014. TOF SIMS analysis and enhanced UVB photoluminescence by energy transfer from Pr3+ to Gd3+ in Ca3(PO4) 2:Gd3+,Pr3+ phosphor prepared by urea assisted combustion. *Journal of Alloys and Compounds* 595: 33-38.

Som, S., Mitra, P., Kumar, V., Kumar, V., Terblans, J.J., Swart, H.C. & Sharma, S.K. 2014. The energy transfer phenomena and colour tunability in Y2O 2S:Eu3+/Dy3+ micro-fibres for white emission in solid state lighting applications. *Dalton Transactions* 43(26): 9860-9871.

Swart, C.W., Pohl, C.H. & Kock, J.L.F. 2014. Auger-architectomics: Introducing a new nanotechnology to infectious disease. *Advances in Experimental Medicine and Biology* 807: 1-8.

Wako, A.H., Dejene, B.F. & Swart, H.C. 2014. Roles of doping ions in afterglow properties of blue CaAl2O 4:Eu2+,Nd3+ phosphors. *Physica B: Condensed Matter* 439: 153-159.

Yousif, A., Jafer, R.M., Terblans, J.J., Ntwaeaborwa, O.M., Duvenhage, M.M., Kumar, V. & Swart, H.C. 2014. TOF SIMS induced artificial topographical effects on the Y 2(Al,Ga)5O12:Tb3+ thin films deposited on Si substrates by the pulsed laser deposition technique. *Applied Surface Science* 313: 524-531.

Yousif, A., Swart, H.C., Terblans, J.J., Jafer, R.M., Kumar, V., Kroon, R.E., Ntwaeaborwa, O.M. & Duvenhage, M.M. 2014. Structural and morphology analysis of annealed Y3(Al,Ga) 5O12:Tb thin films synthesized by pulsed laser deposition. *Applied Surface Science* 305: 732-739.

Staff

Professor: Prof. PWJ van Wyk.

Lecturer: Dr CW Swart-Pistor.

Assistant Officer: Ms H Grobler.

Contract Appointment (one year): Ms P Mokoena.

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Centre for Sustainable Agriculture, Rural Development and Extension

Overview

The year 2014 marked an important milestone for many South Africans for various reasons. As South Africa prepared to celebrate its 20th anniversary of democracy, the Centre for Sustainable Agriculture, Rural Development and Extension celebrated its 20th anniversary. The Centre is characterised by its unique focus on applied science (as opposed to basic science) and our emphasis is mainly on interdisciplinary research across traditional academic departmental boundaries. We continuously strive to educate the broader agriculturalist in finding the balance between the current and future agrarian and agri-business needs. In light of our core focus and measured by our noteworthy outputs, quality education and continuous innovative curriculum development ensured that we maintain both industry and market leadership in our niche approach to theoretical and practical teaching.

Achievements and Activities

During the 2014 academic year, 39 students registered for the two-year master's programme and in the same year 44 students graduated with their master's degrees in Sustainable Agriculture (MSA) – three with distinctions. An audit team consisting of experts in their relevant fields, Drs D Nkosi (ARC) and E Zwane (SASAE), was commissioned to ensure the quality of the research reports. This brings the total number of MSA degrees awarded, since inception of the Centre in 1994, to 412 graduates. In addition to the master's degrees, Dr Magdalena Blum, an agricultural extension specialist in Rome for the Food and Agriculture Organization (FAO), was awarded an honorary doctorate.

To uphold the Centre's commitment to educating and training extensionists from all spheres of life, the Centre partnered with the Department of Agriculture in the Eastern Cape and delivered 88 Advanced Diploma graduates during 2014. To date, more than 130 graduates have completed the Advanced Diploma degree with the Centre. This qualification aims to meet the needs of the Agricultural Extension and Advisory Service to assist their workforce in furthering their qualifications. This initiative is in line with the National Extension Recovery Plan (ERP) of 2014 and in accordance with the Norms and Standards Requirements pertaining to extensionists. Quality course structure and content ensure that our graduates are well-equipped to address all challenges in their fast-changing environments and the skills embedded in our Advanced Diploma programme ensured that this contract was renewed for the 2015 academic year.

Short learning programmes offered during 2014 were aimed at the development of extension officers and agricultural industry professionals, and include courses on a wide range of topics related to sustainable agriculture, including (but not limited to) Plant Production, and Livestock and Rural Development. Additional short learning programmes are currently being developed. To date, more than 200 people have received training and the demand for participation and delivery remains high.

The Centre seeks to maintain the status quo of offering quality education across various specialised areas and facilitating mobility between the different NQF levels. In line with the Faculty's strategic plan for 2014–2017 and in support of improving research and increasing the Centre's peer-reviewed journal articles, Dr Johan van Niekerk embarked on an extensive marketing campaign; hosting several PhD workshops across the country to increase PhD enrolments by the end of 2014. Since inception of the programme in 2004, seven PhD degrees have been awarded and, to date, 11 students applied for enrolment of their PhD degree in 2015.

The Centre played a crucial role in the organisation of the *Landbouweekblad* conference hosted on campus from 30–31 October 2014, where 286 attendees were addressed by experts in various fields of agriculture. The success of the conference, '*Vuisvoos vir Uitdagings*', means that it will be presented again in 2015.

International Linkages

The Centre actively collaborates internationally with the Food and Agriculture Organisation (FAO), the Global Forum for Rural Advisory Services (GFRAS), the University of Minnesota in the USA, and the National Department of

Agriculture; increasing the visibility of the Faculty and the Centre in the global arena.

International collaboration led to a seminar presentation for the master's students by Dr Debbie Cherney of Cornell University, entitled 'Forage sampling, fermentation, analysis and estimating harvest time'. She is an internationally acclaimed animal and pasture expert with over 70 published articles, more than 120 book or chapter contributions, and she has acted as a keynote speaker at numerous workshops and conferences, including several international television inserts.

The Centre gives thanks and recognition to the management of the UFS and the Faculty, the extraordinary professors and research fellows, and its own staff members for their continued support and commitment to CENSARDE.

Dr Magdalena Blum, an agricultural extension specialist for the Food and Agriculture Organization (FAO), was awarded an honorary doctorate.

Graduation ceremony 2014.

Research Outputs

Research Articles

Van Niekerk, J.A., Groenewald, I.B. & Zwane, E.M. 2014. Mentorship by commercial farmers in the land reform programme in the Free State. *South African Journal of Agricultural Extension* 42: 62-70.

Zwane, E.M. 2014. The role of extension as a profession is critical in delivering excellent services: An experience from Limpopo, South Africa. *Journal of Agricultural Science* 6(11): 1-7.

Zwane, E.M., Groenewald, I.B. & Van Niekerk, J.A. 2014. Critical factors influencing performance of extensionists in Limpopo Department of Agriculture in South Africa. *South African Journal of Agricultural Extension* 42: 49-61.

PhD workshop in KZN with Dr JA van Niekerk

Staff

Acting Director: Dr JA Van Niekerk (also senior lecturer in academic programme presentation)

Professors Extraordinary: Profs Edward Nesamuvuni and Alice Pell.

Research Associates: Prof. IB Groenewald, Drs Clifford Dlamini, Doughlas Nkosi, Fanie Terblanche, Elliot Zwane, and Kristin Davis.

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Paradys Experimental Farm

Overview

Paradys Experimental Farm is located 14 km from the main campus of the UFS. During the last year, the experimental farm downscaled to three agricultural branches; namely sheep and cattle farming, and lapa rental. The core function of Paradys Experimental Farm is to act as an extension of the Department of Animal, Wildlife and Grassland Sciences for research and practical application of theoretical knowledge in practice for undergraduate and postgraduate students. The experimental farm is also used for the empowerment of commercial and emerging farmers in livestock and crop cultivation.

Each year is started by welcoming the prospective Agriculture students and their parents on the experimental farm and taking them on a tour of each branch. In this way, good cooperation between Agriculture students is formed from an early stage and a foundation is laid for parents and students to feel at home at the UFS. One hundred and fifty parents and students were involved in this prestigious function. The day demonstrated the Faculty's dedication towards agricultural training and the workshop gave parents the opportunity to meet lecturers at the Faculty and ask them questions.

In 2014, Paradys Experimental Farm accommodated two students in the cattle branch as part of a farm management and theory internship. As such, these students were exposed to the practice and the challenge of the agricultural sector on the farming level. The internship system is designed to grant continuity to the management system and senior students are required to continuously mentor junior students in the respective business branches.

In 2014, Paradys especially focused on establishing sustainable farming practices on the experimental farm. The primary goal of establishing such practices is to stimulate the agricultural business and to expose students to all the trends in the agricultural sector. Structural changes were made in all the branches in order to succeed in this goal. The development of some of the non-sustainable branches is currently being attended to. The processes are already in a very advanced stage and will probably be completed in the next two years.

In 2014, 956 undergraduate students attended practical demonstrations on the experimental farm. The experimental farm offers especially students who don't come from farms the opportunity to better understand the experience of agricultural business and to apply it to their studies in a more relevant manner. The implemented methods stimulate their interest as well as their insight into the industry. During 2014, one MSA, six MSc, and one PhD student conducted their research on the experimental farm. Seven accredited publications and eight congress contributions came from the research outputs on the experimental farms.

Learners and staff from Lesotho visited the farm, where lectures and demonstrations were presented to stimulate their interest in agriculture.

The contribution of the experimental farm to the agricultural business and communities progressed significantly in the last year.

Sheep Branch

The sheep branch showed considerable growth during the period, where an accelerated mating frequency technique was implemented. This implies that three lambing seasons were possible in two years. The conception in the flock of 124 ewes was 94%, and the lambing percentage was 167%. The latter was due to the fact that 85% of the ewes had multiple births.

Synchronisation and AI were used to inseminate the ewes. Of all the lambs that were born, the mortality rate was only 3%, mainly due to bad weather. Various practical sessions about sheep physiology and management were presented to students from the main campus and schools as far as Lesotho. There are currently two studies being conducted on the flock. The studies are regarding fertility and hormone function during synchronisation and the period the ewes are in heat. The studies form part of the honours and master's degree dissertations. The flock currently consists

Farmers' Day.

of 128 ewes and 20 replacement ewes. Mr J Barnard is in charge of the day management of the flock

Beef Cattle Branch

The conception of the Afrikaner herd of cows was 75%. The stud animals currently consist of 129 breeding cows. In addition, a cross system was implemented with Simmentaler, of which 45 Afrikaner cows were mated with a Simmentaler bull. The cross system will be extended to a three-point cross; resulting in Afrisim. Various practical sessions were presented about the management and handling of cattle. The practical sessions were attended by students from the main campus and school learners. There was also close collaboration with the staff of the SAPD Stock Theft Unit and a course on branding and tattooing of animals was presented to prevent stock theft. The SAPD Stock Theft Unit trained on the Afrikaner herd to identify animals by their brand marks and ear tags, as well as the correct procedures to be followed when animals are branded and ear-tagged. The oxen of the Afrikaner herd form part of a feeding trial of Molatek. The intake, as well as the ADI (average daily intake) of animals are monitored in order to determine the growth from the field and the

potential growth of the animals. Mr J Barnard is in charge of the day management of the herd.

Lapa Branch

The lapa is a popular venue for weddings, farmers' days, fund-raising projects, and general functions. The lapa can accommodate 120 people for weddings and there is also room in the garden area. The garden and the surroundings are the perfect setting for photographs.

During farmers' days and workshops, the lapa can accommodate 180 people. We have also presented many workshops and year-end functions of the departments of the UFS.

JB Mokora Primary School hosts their annual prize-giving function at the lapa for Grade 7 learners who will attend high school the following year.

During the year, Senwes presented two farmers' days at the lapa; one with the latest technology for soil cultivation and the other with the latest medicine for internal parasites in sheep.

The experimental farm also hosts Top Pig's annual pig information day for students and farmers, during which the farmers can market their latest products.

The annual Game Congress was hosted to introduce the game trade to the public and to promote the production and marketing of products in the trade.

Municipalities from the Northern Cape presented workshops to their staff during June 2014.

School training days were also presented, where primary and secondary schools from Lesotho brought their learners to get them interested in agriculture.

A fun morning with breakfast and sing-alongs was presented for an old-age home where about 120 elderly people attended the function.

Various churches host their annual year-end function at the lapa with a picnic for all the members. On Sundays they also have country sport and public worship in the lapa and in the garden.

Mrs A Smith manages the lapa branch.

Lengau Agricultural Development Centre

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.

One of the three experimental farms of the UFS was earmarked for agricultural skills development and training of emerging farmers, farm workers, and entrepreneurs in agricultural business. The buildings, facilities, and a portion of the land of the Sydenham Experimental Farm were used for animal and crop production, and alternative natural and agricultural skills development opportunities in value-adding and marketing.

The UFS, Mangaung Metropolitan Municipality, the Free State Provincial Department of Agriculture, and the National African Farmers' Union embraced the programme as partners in agricultural transformation. An agreement was signed by the Mangaung Metropolitan Municipality, National African Farmers' Union, and the UFS in December 2004; whereby the local and provincial governments would fund the initiative. The Council of the Mangaung Metropolitan Municipality approved a contribution of R5 million in total 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 at 30 years. Unfortunately, due to no financial deliveries by 2011 by the Mangaung Metropolitan Municipality, the 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 basic and advanced food gardening. Lengau also serves as a centre for education of undergraduates and postgraduates, mentors, farmers, and black entrepreneurs in many aspects of livestock, crop farming, and agri-business. Almost R7.5 million was invested by the UFS over the past ten years to upgrade and manage the facility.

The original agreement stated that the UFS would provide the facilities and education at the Lengau Agri Centre and accommodate a limited number of emerging farmers to capacitate them to sustainable levels within two years. Afterwards they would be granted their own land by the government and the Lengau Agri Centre would mentor their enterprises. Eight farmers were successful in getting their own land. However, some of them left without being granted any land. No new candidates were allowed since the contract was terminated in 2011. However, seven farmers are still utilising the cattle, sheep, and pig facilities at the Lengau Agri Centre.

In an attempt to enhance the agricultural extension skills development of undergraduates, an internship was implemented during 2012. 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, as well as to analyse and reflect amongst themselves and with the farmers. Accommodation facilities were erected during 2011 on the premises to house the eight students during weekends for this purpose. Eight sessions were implemented in the second semester in 2012 during weekends and both students and farmers reflected positively and requested a continuation of this intervention. The internship was temporarily extended in 2013 and 2014 due to the full-scale implementation of the two learnership programmes by Umga Farmers' Training Group. Sixteen students and the two instructors utilised the accommodation facilities at Lengau Agri Centre and one of the houses at the Paradys Experimental Farm.

The lapa is a popular venue for weddings.

Staff

Farm Manager: Dr MC van der Westhuizen.

Administrative Manager: Ms Amanda Smith.

Assistant Officer: Mr Johan Barnard.

Student: Mr Jethro Parker.

Farm Workers: Mss A Sebonyane and Elisa Sebonyane, Messrs Thabo Khubeka, Paulus Somi, Samuel Motswari, Petrus Ramatekoane, Petrus Moriribela, Stephen Bavuma, and Albert Khumalo.

Security: Messrs Azael Khoele, Ernst Maqala, Esau Selepe, and Alfred Mkaka.

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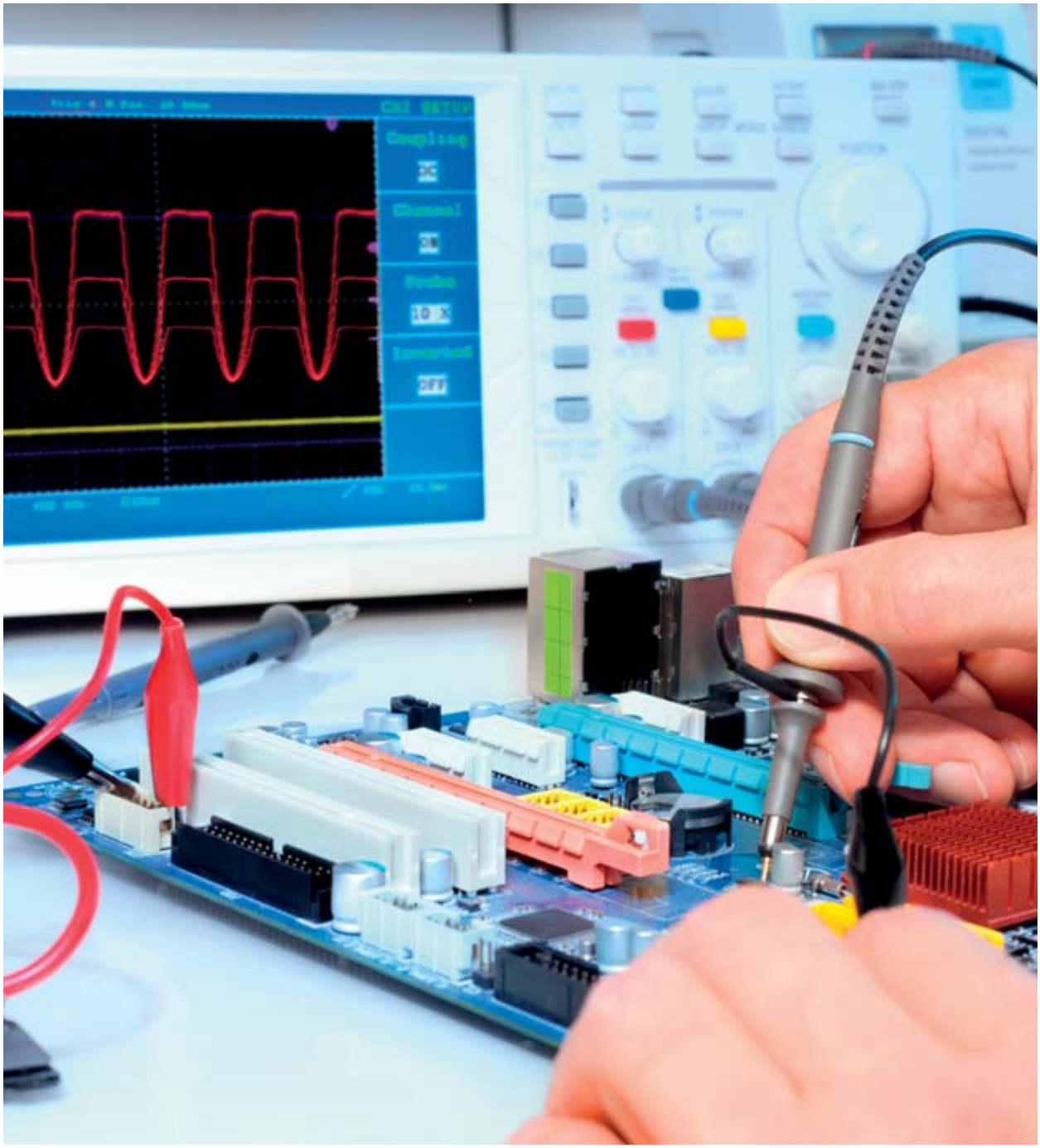
EnSci – Engineering Science



Overview

This programme in Engineering Sciences started in 2014 with an intake of 16 students. The degree, known as a BSc majoring in Physics and Engineering subjects, provides a foundation in physics with an additional focus on the required foundational skills in Engineering Sciences. This empowers the successful graduate with the flexibility to choose between several possibilities to suit his/her career interests, namely:

- enter the work environment;
- continue with postgraduate Physics studies; or
- pursue further discipline-specific engineering studies at another university acknowledging the UFS modules.

After successful completion of two years, an additional BEng degree can be obtained. Current possible disciplines are civil, mechanical, mechatronic, electrical, and electronic engineering.

Staff Matters

Engineering Sciences consists of two full-time staff, namely the project manager, Mr Louis Lagrange, and senior assistant officer, Ms Christine du Toit. Staff for developing and lecturing of the 29 new engineering-related modules consists of two part-time lecturers, Prof. Hendrik Marx and Mr Ben Swart, and nine temporary lecturers.

Staff

Professor: Prof HJM Marx.

Senior Lecturer: Mr LF Lagrange.

Lecturer: Mr BJ Swart.

Senior Assistant Officer: Ms C du Toit.

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Institute for Groundwater Studies (IGS)

Overview

The Institute for Groundwater Studies (IGS) continues to focus on the strategic priorities of the University of the Free State (UFS) and is proud to illustrate with this report the sustained quality and excellence in teaching and research. The IGS was founded in 1974 and celebrated its 40th anniversary in 2014. The Institute is currently under the directorship of Prof. Danie Vermeulen. The IGS is in the process of establishing a SADC Groundwater Management Institute, sponsored by the World Bank, which will be established during 2015. The UFS will act as the implementing agent and will be responsible for the management of the finances. The IGS will provide all academic and technical expertise.

The IGS is the leading groundwater research institute in Africa; focusing on aspects related to fractured rock aquifers, groundwater resources and governance, and contamination at industrial and mining sites. Our vision is to be the preeminent groundwater institution in Africa for academic training and relevant research.

Achievements of Students

Mrs Amy Allwright (Groundwater modelling lecturer and PhD student) has been given the opportunity to travel abroad to acquire new skills, which are important for capacity building in the IGS. She broadened her groundwater modelling skills by attending a groundwater modelling training course in the USA in June 2014. The course is both an introduction and advanced coverage of the groundwater modelling software Visual Modflow. The current course will be held in Las Vegas, Nevada, and is hosted by well-known groundwater expert, Prof. Robert Cleary. This will be Amy's third groundwater modelling course that she attends abroad and is part of our policy to further the skills of our staff. In October 2013 she also attended a groundwater modelling software course called FeFlow in Berlin, Germany.

Special Achievements

Prof. Jopie Fourie turned 75 on 28 February 2014. He is still doing research at the IGS.

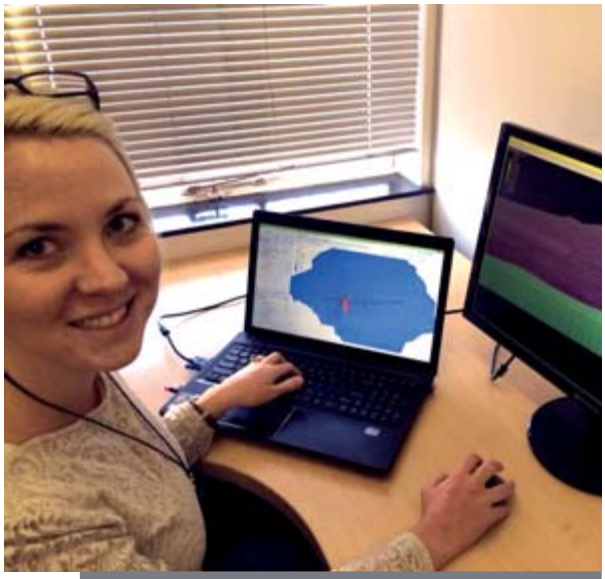
Activities

Dr Francesco Sindico from the University of Strathclyde Law School in Glasgow presented a special lecture on 'Managing Transboundary Aquifers: Linking Hydrogeology and International Law' on 22 May 2014 at the IGS. The goal of this seminar was to present the most recent developments in the field of transboundary aquifer law and policy; with special focus on the United Nations International Law Commission Draft Articles on the Law of Transboundary Aquifers. The seminar discussed the 'guiding role' that such draft articles may play in the future. What this guiding role may look like and how it can be operationalised was explored in the context of the Guarani Aquifer System in Latin America and transboundary aquifer systems throughout the Southern African Development Community region.

A five-day short learning programme on Water Management in a Mining Environment was offered at the Institute from 20–24 October 2014. The content of the short learning programme is based on groundwater fundamentals, and the application of these fundamentals to water management. The course focused on how to maximise the hydrogeological information that is available to them from consultancy work contracts from existing monitoring schemes. Experts within the field, Prof. Danie Vermeulen, Dr Francois Fourie, Dr Brent Usher (from Australia), Dr Johan van der Merwe, Mr Fanie de Lange, and Mr Eelco Lukas, presented different units of the short learning programme.

National and International Collaboration

Mr Paul Lourens and Dr Modreck Gomo attended the 5th International Field Workshop for Young Hydrogeologists at the University of Silesia in Sosnowiec, Poland, from 18–22 August 2014. The workshop focused on mining hydrogeology and groundwater quality and protection in areas subjected to intensive drainage by mines and well fields. Dr Modreck Gomo gave an oral presentation and Mr Paul Lourens presented a poster.



Amy Allwright (Groundwater modelling lecturer and PhD student).

From left: Dr Modreck Gomo, Mr Dejan Neskovic (from the Faculty of Mining and Geology, University of Belgrade), and M Paul Lourens during the 5th International Field Workshop for Young Hydrogeologists at the University of Silesia in Sosnowiec.

In collaboration with the International Mine Water Association and the Xuzhou Municipal Government, the 12th IMWA congress was hosted by the China University of Mining and Technology from 18–22 August 2014. About 40 experts from universities, research institutes, mining groups, and governments worldwide attended the forum and discussed issues related to mine water, such as groundwater inrush, environmental pollution, and mine closures. The participants recognised that the mine water issue is not a one-dimensional problem but has multiple facets in technology, the environment, society, economics, and ecology. Mr Sehai Mokhahlane (PhD student), Ms Nequita MacDonald (MSc student), Mr Eelco Lukas, Dr Francois Fourie, and Prof. Danie Vermeulen from the IGS attended the 12th IMWA congress.

Postgraduate Students

The IGS offers postgraduate studies at honours, master's, and PhD level. Top academic staff ensure that students are equipped with the necessary knowledge and skills to contribute to the knowledge base of the groundwater industry. The year 2014 was filled with excitement and new challenges. The year was especially good for the Institute due to increasing student numbers. The Institute had 26 enrolments for the BSc Honours in Geohydrology, 37 for the MSc, and ten who registered for the PhD. Geohydrology remains a popular choice for students.

The annual Winter School for the honours students is always a highlight for the students. It is important that the

Annual winter field school for honours students.

students at the IGS are exposed to the practical aspects of groundwater. A field trip is organised annually for the new students to visit at least two different sites.

Staff Matters

It was with a sense of disbelief that the Institute had to bid farewell to a beloved colleague and friend, Prof. Gerrit van Tonder, who passed away on 22 April 2014. He started working as lecturer and researcher at the Institute on 1 January 1976. He specialised in hydraulics and focused on the determination of aquifer parameters and groundwater modelling. In the last few years, he was the most senior professor at the IGS. In his career, he has supervised more than 60 master's and PhD students. His presence, insight, and innovative way of thinking will be missed by the Institute, staff, and students.

Mrs Amy Allwright, a PhD student in Geohydrology, was appointed as Numerical Groundwater Modeller at the Institute from 1 June 2014. Amy was awarded the prize for the best MSc student in 2013 and received her MSc (Geohydrology) cum laude in 2013.

The IGS Laboratory appointed Mrs Ntwaeaborwa Gaonkile as Officer from 9 May 2014.

Molly Gaonkile (left) and Ennie NciNci, demonstrating that samples for bacteriological analysis should be collected in pre-sterilised screw-cap glass bottles.

Conferences

Prof. Vermeulen delivered the keynote address at the Southern African Society of Aquatic Scientists (SASAQS) on 'Shale gas development and the environment of the Karoo – Can the two be compatible?' The conference was held at Black Mountain, Thaba Nchu, on 25 June 2014

Dr Atangana, post-doctorate researcher at IGS presented a paper entitled 'On the Stability and Convergence of the Time-Fractional Variable Order Telegraph Equation' at the 5th conference on Nonlinear Science and Complexity, held 4–9 August 2014, in Xi'an, China. The conference focused on the fundamental and frontier theories and techniques for nonlinear science and complexity.

Various members of the staff also gave talks to various organisations e.g. organised agriculture and the mining industry on a regular basis.

Research Outputs

Research Articles

Atangana, A., Bildink, N. & Noutchie, S. 2014. New iteration methods for time-fractional modified nonlinear Kawahare equation. *Abstract and Applied Analysis* 2014: 1-9.

Atangana, A. & Okonomi, S. 2014. On multi-Laplace transform for solving nonlinear partial differential equations with mixed derivatives. *Mathematical Problems in Engineering* 2014: 1-9.

Atangana, A. & Van Tonder, G.J. 2014. Stochastic risk and uncertainty analysis for shale gas extraction in the Karoo basin of South Africa. *Abstract and Applied Analysis* 2014: 1-10.

Atangana, A. & Vermeulen, P.D. 2014. Analytical solutions of a space-time fractional derivative of groundwater flow equation. *Abstract and Applied Analysis* 2014: 1-11.

Atangana, A. & Vermeulen, P.D. 2014. Modelling the aggregation process of cellular slime mold by the chemical attraction. *Biomed Research International* 2014: 1-9.

Vermeulen, P.D., Burger, M., Van Wyk, A. & Lukas, E. 2014. Using environmental isotopes in a coal mine and a gold mine to determine groundwater interaction. *Mine Water and the Environment* 33(1): 15-23.

Gomo, M. & Vermeulen, P.D. 2014. Hydrogeochemical characteristics of a flooded underground coal mine groundwater system. *Journal of African Earth Sciences* 92: 68-75.

Staff

Director: Prof. PD Vermeulen.

Affiliate Associate Professor: Prof. KT Witthüser.

Affiliated Researchers: Prof. JF Botha and Dr J van der Merwe.

Researchers/Geohydrologists: Drs FD Fourie, M Gomo, Messrs SS de Lange, and E Lukas.

Numeric Groundwater Modeller: Mrs A Allwright.

Postdoctorate Researcher: Dr A Atangana.

Research Assistant: Mr PJH Lourens.

Chief Scientist: Mrs L-M Deysel.

Chief Officer: Professional Services: Mrs E de Necker.

Assistant Analyst: Mrs H Human.

Senior Officer: Financial Manager: Mrs L Rust.

Officer: Professional Services: Mrs A Rossouw (from 1 November).

Officers: Mmes WC Geyer and Ntwaeaborwa Gaonkile (Laboratory).

Assistant Officers: Mmes DM du Plessis and J Smith.

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Academic Support Units

Workshop:

Electronics Division

Overview

The Electronics Division experienced a very busy year and we had to work hard not to fall behind schedule. We strive to serve our clients in the best possible way.

Mr Mark Jackson achieved his B.Tech degree in 2014 and we would like to congratulate him on this achievement.

The estimated saving for the Faculty of Natural Sciences for the past year is R3 964 100. This amount is calculated by taking the actual amount of working hours minus the internal administration hours multiplied by R700.

We repaired the following expensive apparatus: Versaprobe, Leco, XPS, ICP, SAM600, XRD, SAM700, IKA, Potensiostate, and numerous other instruments.

An estimated amount of R2 225 000 was saved while repairing the above apparatus. The total savings amount is therefore in the region of R6 189 100.

Work Activities

A total of 441 work requisitions were received the past year, representing 817 apparatus. Of this amount, 46 were for development projects. Some were new and others were extensions of existing systems, as well as the upgrading of older systems, as shown in Table 2 and Table 3.

Of a possible 6 266 working hours, 6 238 were actively used. Percentagewise, the active usage is calculated at 99.6%. The possible hours were calculated at 7.25 hours per day per person present.

Mark Jackson busy with the printed circuit cutting machine.

Table 1 lists the 35 departments and divisions that made use of the services of the Division of Electronics. This is shown according to department, total time spent, and percentage of total, with the total time needed for each project, the total time needed for each project, and the percentage of the total time it took to complete the project.

Table 1:

Department	Total time spent	Percentage
Physics	981.00	15.73%
Biotechnology	658.00	10.55%
Plant Sciences	596.00	9.55%
Chemistry	579.00	9.28%
Internal Administration	575.00	9.22%

Department	Total time spent	Percentage
Soil, Crop and Climate Sciences	521.00	8.35%
Animal, Wildlife and Grassland Sciences	389.00	6.24%
Agricultural Economics	333.00	5.34%
Institute for Groundwater Studies	304.00	4.87%
Computer Sciences and Informatics	224.00	3.59%
Electronics	147.00	2.36%
Geology	136.00	2.18%
Mathematics and Applied Mathematics	116.00	1.86%
Pharmacology	89.00	1.43%
Dean's Office	77.00	1.23%
Zoology and Entomology	60.00	0.96%
Physical Recourses	43.00	0.69%
National Control Laboratory	38.00	0.61%
Geography	37.00	0.59%
Urban and Regional Planning	31.00	0.50%
Economics an Management Sciences	31.00	0.50%
Genetics	28.00	0.45%
Virology	25.00	0.40%
Architecture	23.00	0.37%
Fine Arts	23.00	0.37%
Instrumentation	14.00	0.22%
Centre for Microscopy	9.00	0.14%
Exercise and Sport Science	8.00	0.13%
School of Nursing	5.00	0.08%
Library and Information Services	5.00	0.08%
Centre for Environmental Management	4.00	0.06%
Consumer Science	3.00	0.05%
Haematology and Cell Biology	3.00	0.05%
Centre for Sustainable Agriculture	2.00	0.03%
Outside Work	121.00	1.94%
Total	6238.00	100.00%

Table 2 lists completed projects for different departments.

Table 2:

Department	Apparatus
Chemistry	5 x Laboratory Temperature Controllers 3 x Mantle Temperature Controllers 2 x Access Control 2 x 30 Volt 5 Amp Power Supplies 2 x Electronic Heat Block Control 1 x Upgrading of Building Heating System
Biotechnology	2 x Access Control 1 x Washer Controller 1 x Incubator Control 1 x Electronic Heat Block Control
Physics	15 x Practicum Power Supplies 2 x Remote on/off for Lights 1 x Pressure Meter Control Unit 1 x Fan Control Unit
Plant Sciences	3 x Access Control 2 x SMS-80 Alarm System 2 x Growth Chamber Upgrade
Institute for Groundwater Studies	6 x Access Control 1 x Safety Switch for ICP 3 x Video Intercom System
Computer Sciences and Informatics	12 x Camera System 2 x Access Control 1 x USB Switch
Agricultural Economics	26 x Alarm System 7 x Access Control 3 x Video Intercom System
Animal, Wildlife and Grassland Sciences	9 x Access Control 1 x Dryer Temperature Control
Economics and Management Sciences	2 x Access Control
Mathematics and Applied Mathematics	1 x Aeroplane Alterations
Zoology and Entomology	1 x Solar Power Supply
Fine Arts	1 x Mine Lamp

Table 3 lists projects that are in progress.

Table 3:

Soil, Crop and Climate Sciences	Display Boards
Physics	New Physics Building Security
Biotechnology	New Biotechnology Building Access Control Micro Brewery

Table 4 shows the time spent on the different faculties.

Table 4:

Faculty	Total time spent	Percentage
Natural and Agricultural Sciences	5804.00	93.04%
Other	434.00	6.96%

A total of 1 932 hours was spent on development (59.81%), 3 731 hours on maintenance (30.97%), and 575 hours on administration (9.22%).

Henri Roodt, Adriaan Hugo, and Innes Basson.

Staff

Head of Department: Mr AB Hugo.

Control Technicians: Mr I Basson, Mr HJ Roodt, and Mr MH Jackson.

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Workshop:
Instrumentation Division

Overview

As a year that can only be described as an exacting one for Instrumentation, 2013 eventually succumbed to the promise of the New Year. It was a year with many developments; some positive, some negative – some choices made, others more forcibly and not always positively enforced, but everything contributed to the changes that had great impact on the workings of the Division.

Mr Japie Myburg was on sabbatical from the end of June until December; inclusive of his retirement as Head of Department at the end of December 2013. After 31 years of service, the most of those as Head of Department, he will be greatly missed. The staff of Instrumentation wishes to thank Mr Myburg for his selfless duty and wish him a happy and prosperous retirement.

Mr Johann Erasmus, assistant head of Instrumentation, experienced a difficult year due to illness. As a result of this he was forced to take a long leave of recuperation from work. This had a substantively negative effect on the productiveness of the Division.

Mr Pieter Botes was appointed as acting HOD until the end of December 2013. Further evaluation of prerequisites and other factors with regards to appointing a person to the position of line manager: Instrumentation will be done by the dean, Prof. Neil Heideman, in 2014.

In 2013, the Division therefore had to cope with only 60% of its staff. Taking that into consideration and all the other challenges the Division had to face, it is a great tribute to the remaining staff that they not only coped with the situation, but that their outputs to other departments in the Faculty, albeit with a slight delay in delivery time, continued.

Given the situation and circumstances in the Division, decisions were made regarding the strategy of service delivery that is currently being followed in the Division. This strategy will have to be re-evaluated in terms of the governing strategy relating to service delivery, delivery time, new products and requests relating to service delivery.

Work Overview

The outline below will show the work and number of orders, as well as the time taken to complete these orders, for the various departments both in and outside the Faculty of Natural and Agricultural Sciences. Annual and sick leave will also be indicated. The overview will also show the real time, as well as the time spent on projects in the Division. Only the large projects that were done for the various departments are indicated.

Table 1 shows the working hours spent on each of the departments inside the Faculty of Natural and Agricultural Science (internal departments).

Table 1:

Internal Departments	Number of work orders	Number of hours spent on the orders
Chemistry	34	681
Physics	30	749
Zoology and Entomology	13	98
Electronics	28	241
Geology	7	48
IGS	9	490
Plant Sciences / Genetics / Plant Cultivation	14	822
Soil and Harvest Sciences/Climatology	17	495
Zoology and Entomology	3	50
Animal, Wildlife and Grassland Sciences	3	53
Food Science	8	106
Pharmacology	2	18
Haematology	1	6
Biotechnology/Microbiology	39	2362
Medical Virology	3	24
Medical Microbiology	3	28
Computer Science and Information Technology	3	24
Geography	1	4
Office (work done by line manager)	-	980
Total: Internal Departments	218	7 279

Table 2 shows the working hours spent on departments outside the Faculty of Natural and Agricultural Science (external departments).

Table 2:

External Departments	Number of work orders	Number of hours spent on the orders
Environmental Management	2	161
National Control Labs	9	101
Human Movement Science / Biokinetics	6	22
Paraxel	3	20
Total: External Departments	20	304

Problem Overview

The shrinking staff number in this Division is a matter of great concern. The problem is that technical artisans are no longer trained. Mary-Ann O'Donnel, a well-known journalist from *Engineering News*, stated that in 2010 a shortage of 80 000 artisans was experienced in South Africa, and that the average age of these craftsmen in 2010 was a disconcertingly high 53.

To neutralise the situation, or to handle the problem in the Division, another strategy should be considered: a modernisation of mechanical machines, which would include the possibility of purchasing a modern CNC machine. This machine would be able to assist the technicians to work faster and more cost efficiently. It must never be considered that the CNC machine could replace a technician, as continuous hand work and crafting cannot be eliminated.

Staff

Line Head: Mr PDS Botes .

Assistant Head: Mr J Erasmus.

Control Technicians: Messrs JPW Rautenbach and NJ Kruger.

Technical Assistants: Messrs E Hlazo and Gtswene.

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QwaQwa Campus

Department of Computer Science and Informatics: QwaQwa Campus

Overview

The Department of Computer Science and Informatics started their new Computer Science degree in 2014 with an exciting and updated program integrating mobile technologies. The mobile laboratory was created and contains modern laptops and a teaching-friendly environment. The lab currently has wireless access and plans have been put in place to expand the lab to include tablets and smart phones to support the mobile aspect of our new degree. Staff qualifications have proceeded at a steady pace and the Department is known on the campus as the leaders in Teaching and Learning, as well as the most organised department.

Activities and Achievements

Staff achievements for 2014 include the PhD achieved by Ms RD Wario and the master's degrees achieved by Messrs MB Mase and G Dollman. Staff presented at the International Society for the Scholarship of Teaching and Learning (ISSOTL) and Higher Education Learning and Teaching Association in Southern Africa (HELTASA). At the NAS' annual departmental achievement awards ceremony, the Department won two awards: for being the most organised and for taking part in social responsibility. The Department also initiated an iPad project where students had the opportunity to explore multiple education applications to enhance their learning.

Special Achievements

The Department held an open day in 2014. Learners from various schools were motivated and informed about the importance of a knowledge-based industry to local communities, as well as the benefits associated with it. The new mobility lab was designed, and constructed on the department floor. It is a modern learning space that is perfectly suited for lecturing and group work and includes state-of-the-art laptops, wireless Internet access, and a high-resolution 3D projector. The lab will be further enhanced with mobile devices in 2015 to serve as the Department's flagship mobility laboratory.

Open day event in 2014.

Community Service

RIS242 is a service learning course offered by the Department in community service. It is a semester course with eight credits. The objective of the course is to uplift the lifestyle of elderly and young people in the QwaQwa community by showing and teaching them to use computers and work with MS Word. This course is optional for UFS students, so we have seven to ten students every year who take this course because it is their choice and not because they are obligated by their curriculum or programme. The UFS had a show case day that included many exhibits from different companies and parties. RIS242 students of the 2014 batch participated in the event to exhibit the type of services we offer to the community.

Research Specialisation

Research in the Department is broad, involving different activities focusing on the fields of human-computer interaction (incorporating natural user interfaces), data warehousing, educational technologies, and eye tracking.

Dr RD Wario teaching students to work with an iPad.

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Department of Geography: QwaQwa Campus

Research Specialisation

The main research interests within the Department include climate change, rural livelihoods, community-based natural resource management, tourism, and agrarian reform. The Department has also been instrumental in setting up the Afro-Montane Research Unit at the QwaQwa Campus.

Highlights

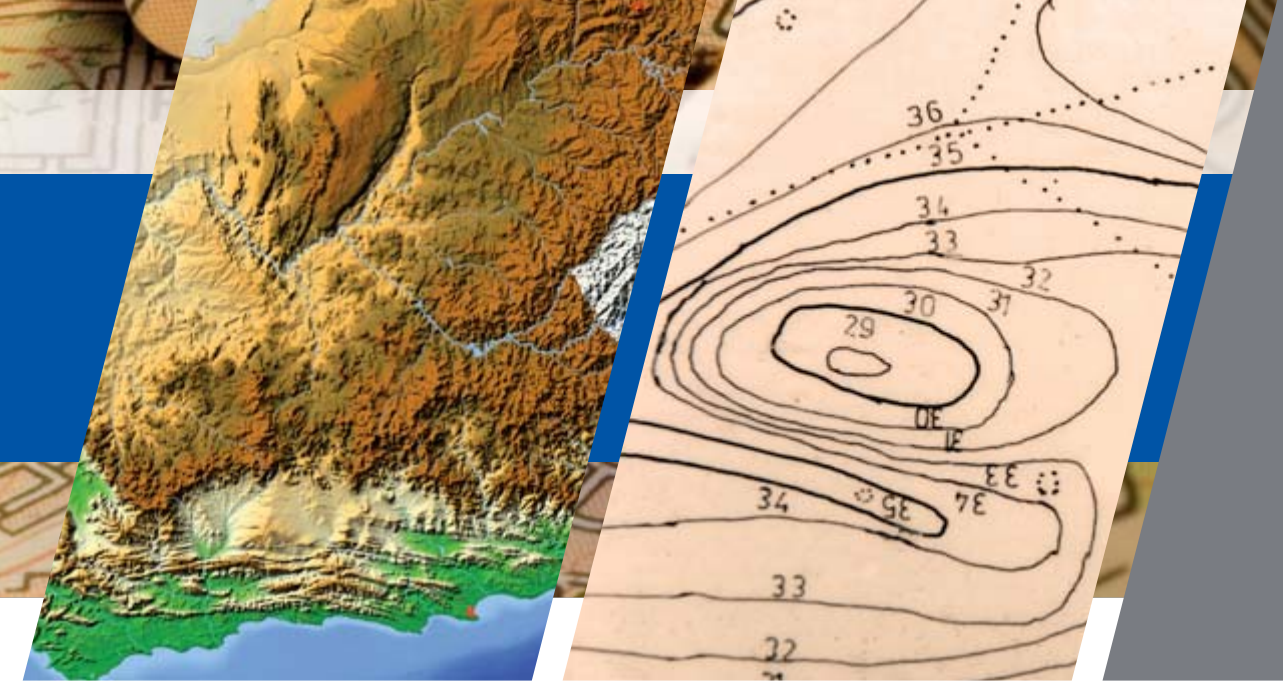
Two new members of staff joined the Department. They are Ms N Sekhele and Dr S Adelabu with effect from 1 June and 1 July 2014 respectively.

Mr P Mahasa completed two MSc degrees in Geography.

Dr G Mukwada was awarded a C-rating from the NRF.

Making a point – A master's student, Solomon Zondo, attending to learners during the open day. Behind Solomon (partly obscured) is Ms T Tlali, who was among the senior students that were manning the Geography stand during the event.

The Department of Geography of the QwaQwa campus. From the left: Mr Alex Adjei, Prof. Willem van Zyl, Ms Nthabiseng Mokhethi, Dr Geofrey Mulwada (Subject Head), Dr Hennie Claassen, Ms Merle Naidoo, and Mr Pululu Mahasa.



Prof. WF van Zyl: Presentation and Awards in Valuing Excellence in Teaching Scholarship Day: 17 September 2014. Runner-up in the category "Decoding the Discipline" with the Presentation "Addressing Bottlenecks for Developing a Touristic Attitude in Tourism Studies".

The Geography Department won the Basotho Cultural Village Award for "Best Support and Use of Basotho Cultural Village Services in 2014", in the Institution of Higher Learning Category.

Selected Research Outputs

Chingombe, W., Pedzisai, E., Manatsa, D., Mukwada, G. & Taru, P. 2014. A participatory approach in GIS data collection for flood risk management: Muzarabani district, Zimbabwe. *Arabian Journal of Geosciences* 8: 1029-1040.

Claassen, J.H.D., Mukwada, G., Naidoo, M. & Mahasa, P. 2014. Land reform and grain production: The case of emerging farmers in QwaQwa, South Africa. *Journal of Human Ecology* 46(2): 223-234.

Mukwada, G., Taru, P. & Chingombe, W.C. 2014. Role of social-ecological systems in forest and woodland conservation in Zimbabwean resettlement areas. *Journal of Asian and African Studies* 50(3): 276-288.

Taru, P., Chingombe, W. & Mukwada, G. 2014. A bullet laden park: Potential for battlefield tourism in the Golden Gate Highlands National Park. *African Journal of Hospitality, Tourism and Leisure* 3(2): 1-9.

Taru, P., Chingombe, W., Mukwada, G. & Van Zyl, W. 2014. What is in a grave? Conflict between the Golden Gate Highlands National Park management and park inhabitants. *African Journal of Hospitality, Tourism and Leisure* 3(2): 1-8.

Val, A., Taru, P. & Steininger, C. 2014. New taphonomic analysis of large-bodied primate assemblage from Cooper's D, Bloubank Valley, South Africa. *South African Archaeological Bulletin* 69(199): 49-58.

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Department of Mathematics: QwaQwa Campus

Research Specialisation

Prof. J Schoeder is doing research on discrete mathematics, combinatorics, and topology.

Mr Mbambo will register a PhD with Professor Acho from the Bloemfontein campus. The focus will be on mathematical modelling.

Mrs Faber is doing research on "Whiteboard/ipad interaction to enhance student engagement" under the Department of Teaching and Learning. She will start her MSc in Mathematical statistics in 2015.

Mrs Faber won the excellence 2013 Prestige Award as the winner of the Innovation Award: New and/or improved technology in the classroom.

Mrs Faber in her office, ready to work.

Mr MP Morake (third-year student) and MT Thekiso (second-year student) during the 2014 open day.

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Department of Plant Sciences: QwaQwa Campus

Overview

The Department of Plant Sciences is still growing considerably and is hosting a postdoctoral fellow (Dr Mutiu Kazeem) for the first time. The Department established an experimental garden for the second-year Plant Biotechnology and Propagation module. The garden also serves as the departmental community engagement plot where harvests are donated to the needy.

Student Achievements

Ms Nobuhle Mbhele and Ms Kemi Sobiyi received their honours degrees with distinctions.

Selected Research Outputs

Ashafa, A.O.T. & Olajuyigbe, F.O. 2014. Chemical composition and antibacterial activity of essential oil of *Cosmos bipinnatus* Cav. leaves from South Africa. *Iranian Journal of Pharmaceutical Research* 13: 1417-1423.

Ashafa, A.O.T. & Pitso, T.R. 2014. Effects of drying methods of the yield and chemical composition of essential oils from *Artemisia afra* Jacq. ex Willd. from the Eastern Free State. South Africa. *Journal of Essential Oil-Bearing Plants* 6: 1087-1093.

Cowden, C., Kotze, D.C., Ellery, W.N. & Sieben, E.J.J. 2014. Assessment of the long-term response to rehabilitation of two wetlands in KwaZulu-Natal, South Africa. *African Journal of Aquatic Science* 39(3): 237-247.

Departmental experimental garden: Over 350 bunches of spinach and 100 kg of carrots harvested from the garden were donated to Hope House (Harrismith), Leratong Children's Home (Phuthaditjhaba), Thekolohelong Old Age Home (Phuthaditjhaba), the Old Age Home (Harrismith), and Charlotte Theron Orphanage (Bethlehem).

Lamula, S.Q.N. & Ashafa, A.O.T. 2014. Antimicrobial and cytotoxic potential of *Dianthus basuticus* used in Basotho traditional medicine. *Bangladesh Journal of Pharmacology* 9: 105-111.

Ngara, R. & Ndimba, B.K. 2014. Model plant systems in salinity and drought stress proteomics studies: A perspective on Arabidopsis and Sorghum. *Plant Biology* 16: 1029-1032.

Ngara, R. & Ndimba, B.K. 2014. Understanding the complex nature of salinity and drought-stress response in cereals using proteomics technologies. *Proteomics* 14: 611-621.

Penduka, D., Basson, K.A., Mayekiso, B., Buwa, L. & Okoh, I.A. 2014. Gas chromatography-mass spectrometry characterisation of the anti-listerial components of *Garcinia kola* seeds. *Applied Biochemistry and Microbiology* 50(3): 297-305.

Penduka, D., Buwa, L., Mayekiso, B., Basson, A.K. & Okoh, A.I. 2014. Identification of the anti-listerial constituents in partially purified column chromatography fractions of *Garcinia kola* seeds and their interactions with standard antibiotics. *Evidence-Based Complementary and Alternative Medicine* 2014: 850347.

Yakubu, M.T., Sunmonu, T.O., Lewu, F.B., Ashafa, A.O.T., Olorunniji, F.J. & Eddouks M. 2014. Efficacy and safety of medicinal plants used in the management of diabetes mellitus. *Evidence-Based Complementary and Alternative Medicine* 2014: 973035.

Third-year Ethnobotany students visited the Basotho Cultural Village to learn about Basotho Ethnogeography and Ethnobotany. Standing on the right is the tour guide, with the chief sitting on the right.

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Department of Zoology and Entomology: QwaQwa Campus

Research Specialisation

The Department of Zoology and Entomology had a strong focus on parasitological research in 2014; continuing its cutting-edge exploration of tick-borne diseases in South African livestock. Researchers in the Department have also used specialised molecular and metabolomics techniques to investigate the health of wild mammals such as leopards, lizards, and snakes. Furthermore, the Department's research in the broader field of ecology has grown significantly in 2014, with students assessing the cognitive ecology of Samango monkeys in the Eastern Cape, and the behavioural ecology of bat-eared foxes in the Kalahari Desert. In addition to immunological research and the development of aquatic bio-indicator indices, lecturers at the Department have also made significant strides forward in the scholarship of Teaching and Learning; remaining at the forefront of this important, expanding field of study. Overall, our staff members have made some significant discoveries; such as the description of a new malaria species in Afromontane cordylid lizards, and entirely novel parenting behaviour in wild bat-eared foxes.

The Department's number of postgraduate students continues to grow; boasting six PhD students, six MSc, and four BSc Honours students in 2014.

Sadly, we have to note that our most productive researcher, Prof. Oriel Thekisoe, left the Department at the end of 2014 to further pursue his career at North-West University. Many of his postgraduate students do, however, remain at QwaQwa to complete their studies. Prof. Thekisoe will be sorely missed.

Publications

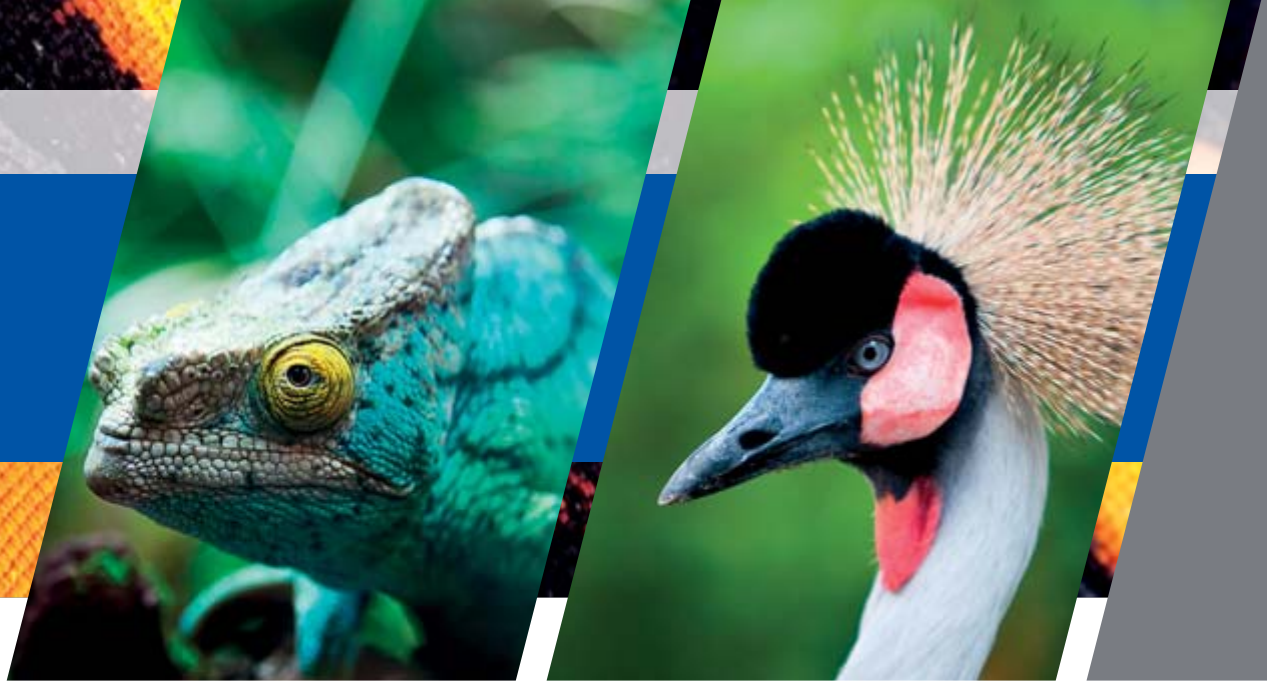
Collectively, the Department produced nine articles in ISI-rated, peer-reviewed journals, one contribution to a book, four presentations at international conferences, and six presentations at a South African conference (one of which resulted in a peer-reviewed conference proceeding paper). Not only did we present talks at conferences in the Natural Sciences, but we were represented by two staff members at the HELTASA (Higher Education Learning and Teaching Association of Southern Africa) conference. This is a strong indication of how the Department of Zoology and Entomology is also a leader in research on improved teaching and learning practices.

Special Notes

We hosted the reunion of the Parasitology Research Programme, which boasts many successful alumni from the Department. We are also proud of the graduation of one PhD student and three MSc students in Zoology at the May 2014 graduation ceremony.

The Department won several awards for research excellence:

- Prof. Oriel Thekisoe – Winner of 2013/14 NSTF-BHP Billiton Awards: The TW Kambule NRF-NSTF Award for an emerging researcher for outstanding contribution to SET through research and its outputs over a period of up to six years after award of a PhD or equivalent in research.
- Ms Ronel Pienaar (Zoology MSc graduate) – W.O. Neitz Award: Best 2014 MSc Dissertation. Presented by the Parasitological Society of Southern Africa.
- Dr Aliza le Roux – Elected to the South African Young Academy of Sciences to serve on the executive committee. This position is awarded for excellence in science and connecting science to society, and she will use the election to further these goals.
- Mrs Michelle van As – runner-up as the best postgraduate presenter at the International Congress on Parasites of Wildlife.



Selected Research Outputs

Le Roux, A., Beishuizen, R., Brekelmans, W., Ganswindt, A., Paris, M. & Dalerum, F. 2014. Innovative paternal care in the bat-eared fox. *Acta Ethologica* 17(1): 63-66.

Pienaar, R., Latif, A.A., Thekisoe, O.M.M. & Mans, B.J. 2014. Geographic distribution of *Theileria* sp. (Buffalo) and *Theileria* sp. (Bougasvlei) in Cape buffalo (*Syncerus caffer*) in Southern Africa: Implications for speciation. *Parasitology* 141(3): 411-24.

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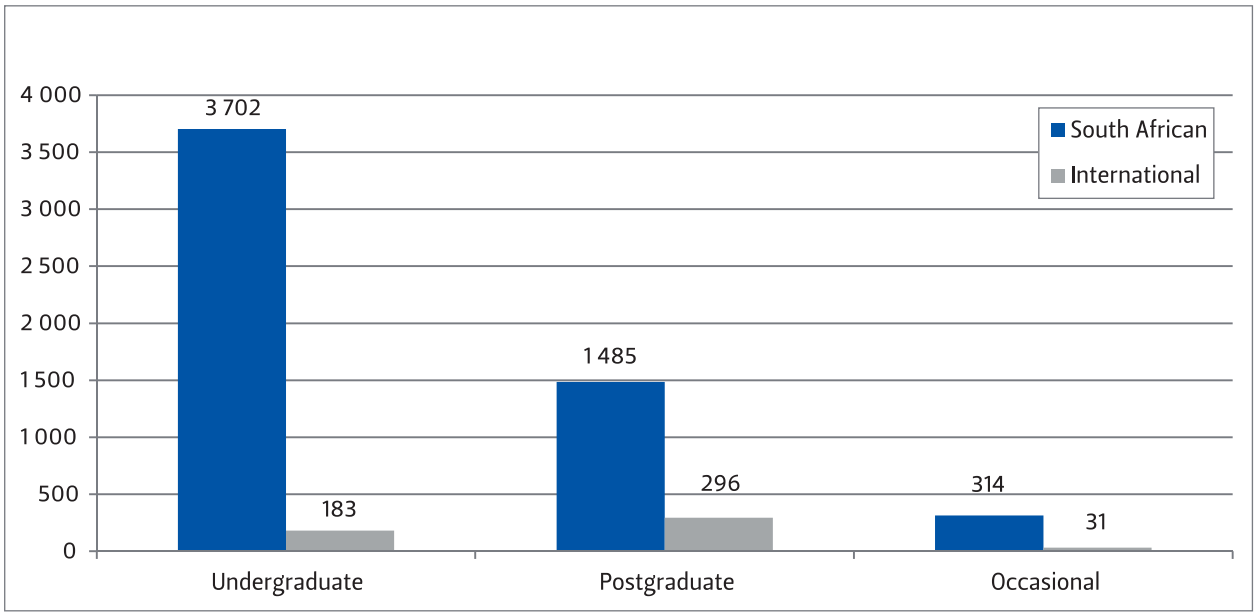
Statistical Data

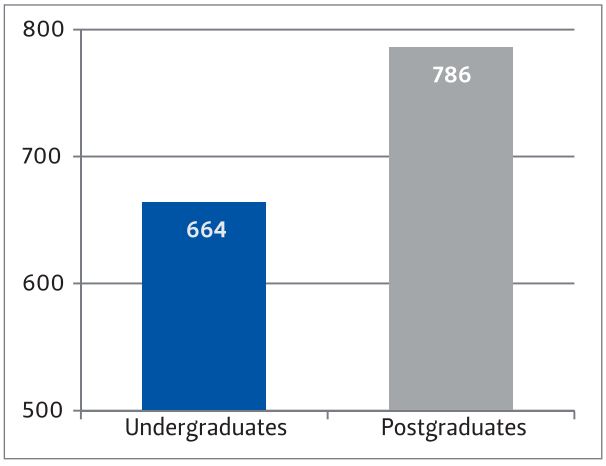
2014 Registrations by education level



2014 Registrations by Nationality

Qualification Level	Registrations
South African	
Undergraduate	3 702
Postgraduate	1 485
Occasional	314
Total	**5 501**
International	
Undergraduate	183
Postgraduate	296
Occasional	31
Total	**510**
Grand total	**6 011**

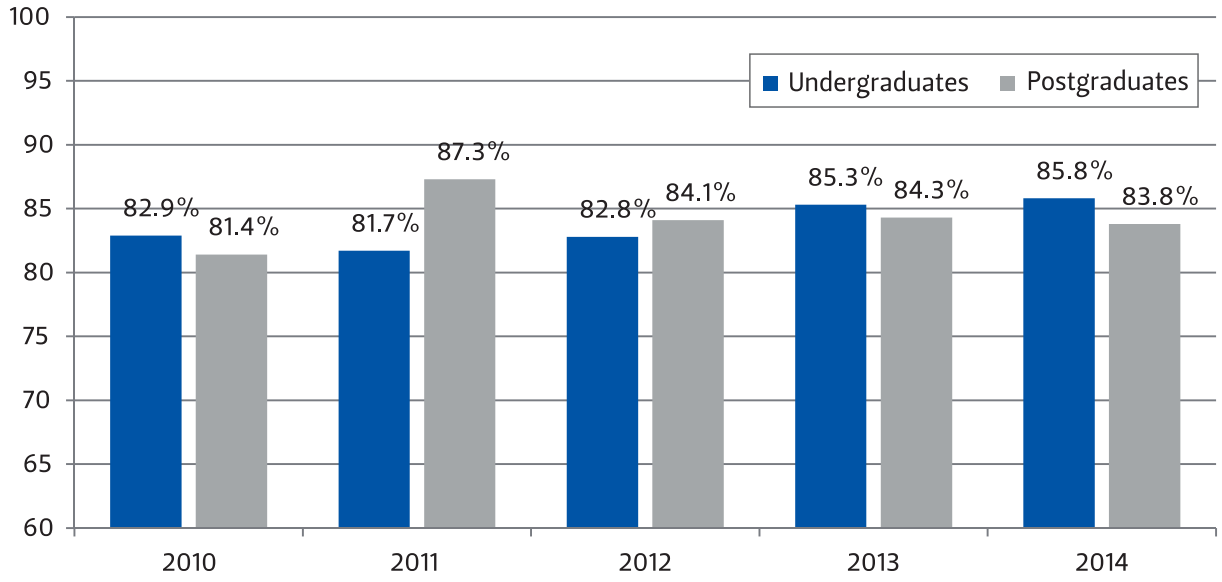
Graduates 2014



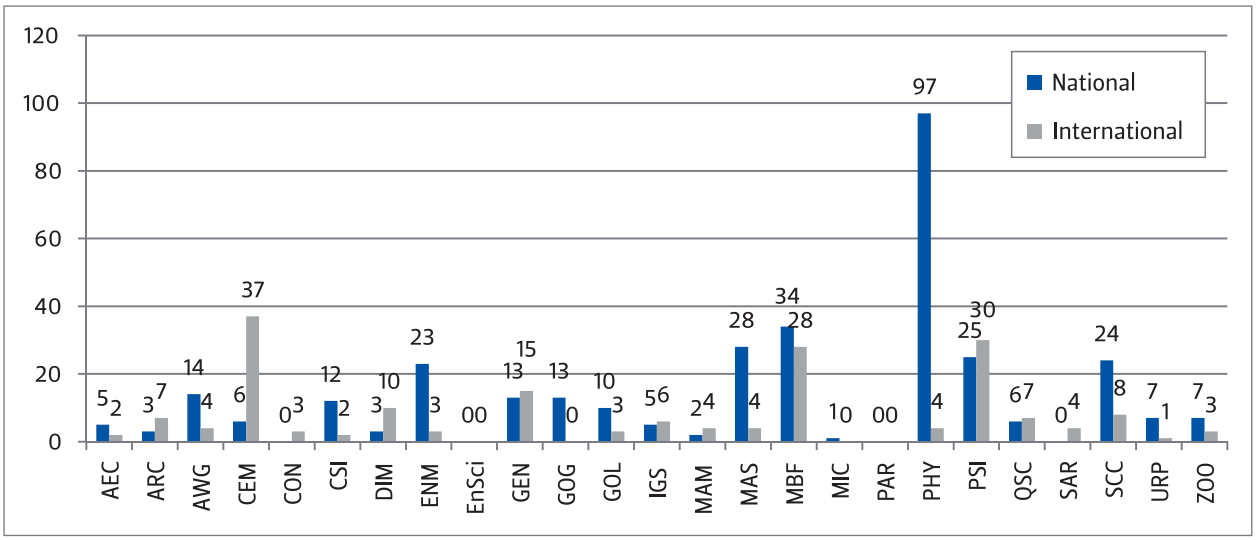
Student Figures: 2014

	Female					Male					Total
Qualification Level	African	Coloured	Asian	White	Total	African	Coloured	Asian	White	Total	
Undergraduate	1 269	50	9	537	1 865	1 174	50	20	776	2 020	3 885
Postgraduate	447	15	10	258	730	566	32	18	435	1 051	1 781
Occasional	139	5		14	158	119	4	1	63	187	345
Grand Total	1 855	70	19	809	2 753	1 859	86	39	1274	3 258	6 011

Success Levels: 2010 - 2014



Conferences: 2014



Abbreviations

AEC: Agricultural Economics
ARC: Architecture
AWG: Animal, Wildlife and Grassland Sciences
CEM: Chemistry
CON: Consumer Science
CSI: Computer Science and Informatics
DIM: Dimtec
ENM: Environmental Management
EnSci: Engineering Science
GEN: Genetics
GOG: Geography
GOL: Geology
IGS: Institute for Groundwater Studies
MAM: Mathematics and Applied Mathematics
MAS: Mathemetical Statistics
MBF: Microbial, Biochemical and Food Biotechnology
MIC: Center for Microscopy
PAR: Paradys Experimental farm
PHY: Physics
PSI: Plant Sciences
QSC: Quantity Surveying and Construction
SAR: Sustainable Agriculture, Rural Development and Extension
SCC: Soil, Crop and Climate Sciences
URP: Urban and Regional Planning
ZOO: Zoology and Entomology


40%
38%
36%
36%
35%
35%
32%
28%
28%
March
April
May
June
July August
September
October
November
December
January
February

Glossary

A

ADF	Amsterdam Density Functional Theory
ADH	Alcohol Dehydrogenase
ADI	Average Daily Intake
AEASA	Agricultural Economics Association of South Africa
AETFAT	Association for the Taxonomic Study of the Flora of Tropical Africa
AfSES	Africa Student Energy Summit
AGRA	Alliance for a Green Revolution in Africa
AI	Artificial Insemination
AMI	Advanced Metals Initiative
ARC	Agricultural Research Council
ARC-SGI	Agricultural Research Council Small Grain Institute
ARS-USDA	Agricultural Research Service United States Department of Agriculture
ASM	American Society for Microbiology
ASSAF	Academy of Science of South Africa

B

BCI	Brain-Computer Interface
BGRI	Borlaug Global Rust Initiative
BKB	Boeremakelaars (Koöperatief) Beperk
BOCC	Binational Organic Chemistry Conference

C

CIMMYT	International Maize and Wheat Improvement Center
CEM	Centre for Environmental Management
CENSARDE	Centre for Sustainable Agriculture, Rural Development and Extension
CFPL	Centre for Financial Planning Law
CIAV	*Comité international sur l'architecture vernaculaire*
CLSM	Confocal Laser Scanning Microscope
CNC	Computer Numerical Control
CPD	Continuing Professional Development (Architecture)
CSIR	Centre of Scientific Institute of Research
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CTL	Centre for Teaching and Learning, UFS

D

DAAD	German Academic Exchange Service
DiMTEC	Disaster Management Training and Education Centre for Africa
DNA	Deoxyribonucleic Acid
DSC	Differential Scanning Calorimetry
DST	Department of Science and Technology
DST-NRF	Department of Science and Technology National Research Foundation

E

ECA	European Crystallographic Association
Eco-DRR/CCA	Ecosystem-based Disaster Risk Reduction and Climate Change Adaptation
EREC	Emotion RECognition
ERP	Extension Recovery Plan
EU	European Union

F

FAO	Food and Agricultural Organisation
FHB	Fusarium head blight
FMP	Facilities Management Programme
FSIA	Free State Institute of Architects

G

GFAAS	Graphite Furnace Atomic Absorption Spectroscopy
GFRAS	Global Forum for Rural Advisory Services
GIS	Geographical Information Systems
GRF	German Research Foundation
GSSA	Grassland Society of South Africa

H

hERG-screen	human Ether-à-go-go Related Gene
HOD	Head of Department
HPC	High-Performance Computing
HTML	Hypertext Markup Language

I

ICID	International Commission on Irrigation and Drainage
ICP	Integrated Circuit Piezoelectric
IDC	Industrial Development Corporation
IFHE	International Federation for Home Economics
IFAMA	International Food and Agribusiness Management Association
IGS	Institute for Groundwater Studies
IIASA	International Institute for Applied Systems Analysis
ILEARN	Innovative Learning Environment and Research Network
IMWA	International Mine Water Association
IRSES	International Research Staff Exchange Scheme
ISRA	International Society for the Research on Aggression
IT	Information Technology
ITMO	Information Technologies, Mechanics and Optics
IUCr	International Union of Crystallography

J

JEOL	Japan Electro-Optics Laboratory

K

KUL	Katolieke Universiteit of Leuven

L

LA-ICP-MS	Laser Ablation-Inductively Coupled Plasma-Mass Spectrometry
LED	Light Emitting Diode

M

MOF	Metal Organic Framework
MRTM	Mineral Resource Throughput Management
MSA	Master's in Sustainable Agriculture
MS	Mass Spectroscopy
MS	Microsoft
mtDNA	Mitochondrial Deoxyribonucleic Acid

N

NAMC	National Agricultural Marketing Council
NAMPO	National Association of Maize Producers Organisation
NanoSAM	Nano Scanning Auger Microscopy
NECSA	Nuclear Energy Corporation of South Africa
NGO	Non-Governmental Organisation
NMMU	Nelson Mandela Metropolitan University
NNEP	National Nanotechnology Equipment Programme
NQF	National Qualifications Framework
NRF	National Research Foundation
NSF	National Science Foundation
NSTF-BHP	National Science and Technology Forum BHP Billiton
NTeMBi	Nuclear Technologies in Medicine and the Biosciences
NUI	Natural interface
NZG	National Zoological Gardens

O

OES	Optical Electronic and Mass Spectroscopy

P

PAST	Paleontological Scientific Trust
PGE	Platinum-Group Elements
POU	Publication Output Unit
PRT	Protein Research Trust

Q

QTL	Quantitative Trait Loci

R

rBST	recombinant bovine somatotropin
RFG	Research Foundation of Germany
RMRDSA	Red Meat Research and Development South Africa
RPO	Red Meat Producers Association / Rooivleisprodusente Organisasie

S

SAB	South African Breweries
SACO	South African Computer Olympiad
SACQSP	South African Council for Quantity Surveying Profession
SADC	Southern African Development Communities
SAENSE	Screening Applications and Novelty in Specialised Environments
SAFEX	South African Futures Exchange
SAHF	South African Housing Foundation
SANCID	South African National Committee on Irrigation and Drainage
SAPD	South African Police Department
SAPOA	South African Property Owners Association
SAPS	South African Police Service
SASAE	South African Society of Agricultural Extensionists
SASAqS	Southern African Society of Aquatic Scientists
SASAS	South African Society for Atmospheric Sciences
SASDiR	Southern Africa Society for Disaster Reduction
SASOL	South Africa Synthetic Oil Liquid
SASRI	South African Sugarcane Research Institute
SAWMA	Southern African Wildlife Management Association
SA-YSSP	South African Young Scientist Summer School Programme
SCU	Statistical Consultation Unit
SEM	Scanning Electron Microscope
SIMS-TOF	Secondary Ion Mass Spectrometry – Time-of-Flight
SLP	Short learning programme
SS	Seed suspension

T

TB	Tuberculosis
TEM	Transmission Electron Microscopy
TGA	Thermal Gravimetric Analysis
TIA	Technology Innovation Agency
TTKSK	Wheat Stem Rust Ug99 (Race TTKSK)
TUD	Technische Universität, Dresden

U

UFS	University of the Free State
UIA	International Union of Architects
UK	United Kingdom
UNEP	United Nations Environmental Programme
UNESCO	United Nations Educational Scientific and Cultural Organization
UNU-EHS	United Nations University – Environment and Human Security
UP	University of Pretoria
USA	United States of America
USB	Universal Serial Bus

W

WGT	Winter Grain Trust
WRC	Water Research Commission

X

XRD	X-Ray Diffraction
XRF	X-Ray Fluorescence

Y

YAS	Youth Ag-Summit