

FACULTY OF SCIENCE
ANNUAL REPORT

2017 • 2018



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STELLENBOSCH
UNIVERSITY

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1918 • 2018



2017 & 2018



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FACULTY OF SCIENCE ANNUAL REPORT

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From the Dean's office

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One of the first group photos of the BA class (Mathematics and Physical Science) in 1907, shows seven academics with 12 students. The lecturers were (in the second row) Prof W.E. Malherbe, Prof A.H. Mackenzie, Ms. A.V. Duthie, Prof R. Broom, Prof J.T. Morrison, Prof B. de St. J. van der Riet, and Mr A.B. Bartmann.



Photo: Watson-Lockley Collection, Stellenbosch University Archive

In 2018 the Faculty of Science has a staff complement of 173 academic and 164 support and technical staff members. They service over 3000 full-time registered under- and postgraduate students per year, as well as an additional 12 000 from the Faculties of Engineering, Economic and Management Sciences, AgriSciences and Education.



Photo: Anton Jordaan

FROM THE DEAN'S OFFICE

Research has become a powerful tool in the global economy. Worldwide developments in science, technology, and innovation are fundamentally altering the way people live, communicate and transact, with profound effects on economic growth and development. The majority of South Africa's new knowledge is developed within universities and research councils. For more than a century, the Faculty of Science has offered a first-class research environment and a wide range of institutional support and expertise to ensure the success of all our students.

RESEARCH HIGHLIGHTS

The Faculty maintains a strong research ethos, with eight SARChIs and three NRF-DST Centres of Excellence, while 70% of our FTE staff has NRF ratings. For the second year in a row, the Faculty has produced a record number of research publications, with the 2017 publication output units 14% higher than the 2016 output.

On the research front, a few highlights include a Research Project Grant (ROI) from the National Institutes of Health for research on the inhibitors of CoA biosynthesis as novel antitubercular and antistaphylococcal agents; the renewal of Prof Gary Stevens' SARChI research chair in Experimental Petrology for a third five-year cycle; and the first demonstration of stationary qubits in South Africa by Prof Hermann Uys and his team. Researchers from the NRF-DST Centre of Excellence for Biological Invasions were the lead authors of the first national status report on biological invasions in the country.

The Faculty also acquired high-level analytical equipment. Stellenbosch University is only the second institution in South Africa to have acquired Nanotracking Analysis equipment to analyse nano-sized particle numbers, 39 to 500 nm in diameter, in biological samples. We are also part of a consortium of four universities which have been awarded R35 million by the NRF to acquire a new nuclear spectrometer. The Gamma Ray Spectrometer for Knowledge in Africa will be housed at iThemba LABS where it will be used to study a wide range of nuclear physics and nuclear astrophysics phenomena.

During the year under review the Faculty obtained grants from the National Equipment Programme for two new analytical instruments. We were, however, unsuccessful in our NEP application for upgrading the aged NMR facility.

During the year under review the Faculty and its eight academic departments increased its international footprint significantly through active collaboration, staff and student exchange and co-publishing with international institutions and industries. Highlights include the signing of agreements with the University of Oslo's Department of Physics, and the Université Claude Bernard Lyon I. Joint PhD degrees were conferred with the Vrije Universiteit Brussel and the University of Jean Monet at Saint Etienne in France.

AWARDS TO STAFF AND STUDENTS

Several staff members and students received prizes and awards on a national and international level. The Suid-Afrikaanse Akademie vir Wetenskap en Kuns' Havenga awards for Physical Sciences and Life Sciences were awarded to Prof Ben Herbst and Prof Emile van Zyl respectively. Prof Resia Pretorius received the 2018 NSTF award for an established researcher, while Dr Rehana Malgas-Enus received the NRF Award of Excellence in Science Engagement.

Prof Harold Pasch was honoured with the 2017 Gold Medal of the SA Chemical Institute. Prof Bert Klumperman received the John FW Herschel-Medal of the Royal Society of South Africa (RSSA), while Prof Guy Midgley was the first recipient of the RSSA's Marloth Medal.

Prof Jannie Hofmeyr and Prof Emile van Zyl received the SU 2018 Chancellor's Award for excellence in research over an extended period, while Prof Ingrid Rewitzky was recognised for excellence in learning and teaching. From the Department of Mathematical Sciences, Prof Willem Visser was selected by the Association for Computing as one of a select group of distinguished members for his outstanding research contribution to the field of computing and information technology, while Prof Stephan Wagner received the South African Mathematical Society's Award for Research Distinction.

ACADEMIC AFFAIRS

The Faculty is one of a few science faculties in the country that achieved its enrolment targets for 2018, and we continue to attract more top-performing candidates from all ethnic groups. Just over 20% of the student body of 2 264 students are postgraduate students, while 35.2 % of the undergraduate and 40.7% of the postgraduate students are Black, Indian or Coloured. Since 2013, the number of postgraduate students have increased from 626 to 690 in 2018 (167 BScHons, 239 MSc and 264 PhD students, of which 20 are MSc students from AIMS).

For the ongoing training of tutors in the Faculty, a three level online short course was conceptualised in 2017. The first level has had steady enrolments of at least 25 tutors each semester, the second level was introduced in 2018, and the third level is in the development phase. The success of this initiative has inspired other faculties to develop similar short courses as well as a university project for Online Tutor Training. It is noteworthy to mention that the differentiated tutorial support programme has contributed to deeper learning engagement and increased pass rates for first year Mathematics, Physics, Chemistry and Biology.

A new compulsory module for all first year BSc students, Science in Context, was developed and introduced in 2018. The purpose of the module is to expose students to the benefits of integrating knowledge from different disciplines, when approaching scientific topics.

Through the Science Learning and Teaching Hub, researchers have presented their teaching and learning initiatives at faculty and CTL seminars and at the annual SU SoTL conferences. Noteworthy

achievements are the increase in presentations at the SU SoTL conference: from only five presentations in 2016 to 12 and 15 presentations in 2017 and 2018, respectively.

The Faculty's Advisory Board, established in 2016, continues to provide valuable input in faculty and departmental specific matters. At least one new agreement has been signed with international partners, and a five year research contract secured due to facilitation by Advisory Board members. The second Science Showcase, hosted in conjunction with the Faculty of Engineering, was again well attended. An agreement has been signed with Armscor for the Department of Physics to develop a Virtual Defense Engagement Programme and a Laser Defense Programme over the next three years.

The year under review witnessed increased involvement in multidisciplinary, trans-faculty initiatives, such as the Centre for Bioinformatics and Computational Biology, the SU Institute for Biomedical Engineering, the African Microbiome Institute and the newly proposed School of Data Science and Computational Thinking. A highlight for the year was the Deep Learning Indaba, hosted by the Applied Mathematics Division in collaboration with DeepMind and Google Brain. A special word of thanks here to the two vice-deans, Prof Ingrid Rewitzky (Teaching and Learning) and Prof Willem Visser (Research) for their support and hard work over the past two years.

IN CONCLUSION

One of the highlights of the Faculty of Science's centenary celebrations was the launch of a book on its founding and history over the past century. The coffee table book, A particular frame of mind. Faculty of Science, Stellenbosch University. 1918-2018 was launched during a special gala dinner on 1 October 2018.

What we have achieved over the past 100 years are due to the dedication, creativity and often brilliance of our staff and students, teachers, researchers and support staff who contributed to knowledge generation and knowledge sharing at Stellenbosch University, but also nationally and even internationally. Our success in future will continue to be dependent on people, and providing an environment wherein they can thrive.

Prof Louise Warnich
Dean: Faculty of Science, Stellenbosch University



Photo: Anton Jordaan

Professor Louise Warnich, the first female Dean of Science in the one hundred year history of the Faculty of Science, since 2013. She is assisted by two vice-deans, Prof Ingrid Rewitzky, Vice-dean for Teaching and Learning, and Prof Willem Visser, Vice-dean for Research.



The first Professor of Mathematics and Physical Science, Professor George Gordon, lectured in a small building with two rooms, located on the northwestern corner of Plein and Ryneveld Streets in Stellenbosch, from 1874 until his death in 1882. With an MA from the University of Aberdeen and an LLB from London, Professor Gordon is acknowledged for having trained the first MA student in mathematics to graduate from the University of the Cape of Good Hope.

Photo: Clive Hassall

Today, the Faculty of Science at Stellenbosch University is home to six A-rated researchers. This means they are unequivocally recognised by their peers as leading international scholars in their respective fields, for the high quality and impact of recent research outputs. Standing in front of the same building where Prof George Gordon lectured in the 1880s, are Prof Len Barbour, holder of the SARChI research chair in Nano-structured Functional Materials; Prof Helmuth Prodinger, Mathematical Sciences Division; Prof Guy Midgley, Department of Botany and Zoology; Prof Bert Klumperman, holder of the SARChI research chair on Advanced Macromolecular Architectures; Prof David Richardson, Director of the NRF-DST Centre of Excellence for Invasion Biology; and Prof Willem Visser, Computer Science Division.



Photo: Anton Jordaan

DEPARTMENT OF **BIOCHEMISTRY**

The Department of Biochemistry, established in 1974, is positioned at the interface between chemistry and biology, moving from molecular structures via macro-molecular activity to biological function. The department is also home to the South African research chair in Mechanistic Modelling of Health and Epidemiology.

RESEARCH INTERESTS

Immunology, Plant Bioinformatics and Molecular Systematics

Discovery and development of novel antibiotics and biocides

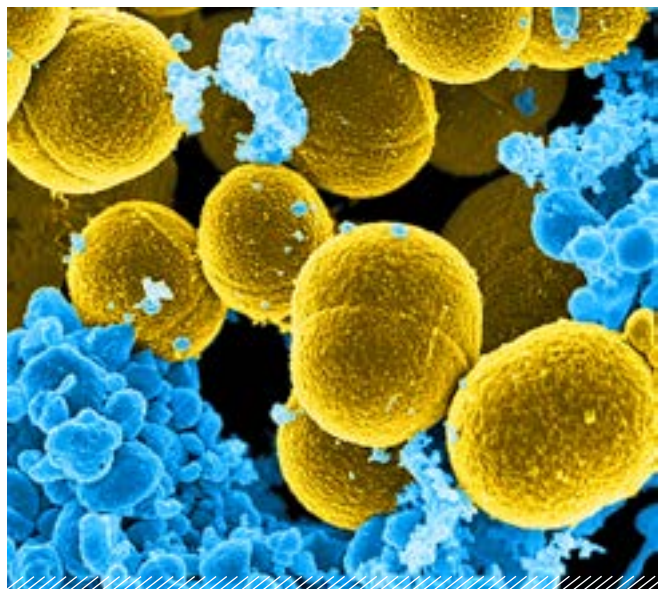
Steroids

Systems Biology

Epigenomics and Bioinformatics

RESEARCH HIGHLIGHTS

Searching for new compounds against tuberculosis and *Staphylococcus aureus*



A scanning electron microscopic (SEM) image, depicting a number of mustard-coloured, spheroid-shaped, *Staphylococcus aureus* bacteria, that were in the process of attempting to escape their destruction by blue-coloured, human white blood cells. Photo: Frank DeLeo, National Institute of Allergy and Infectious Diseases (NIAID)

Tuberculosis is one of the world's deadliest infectious diseases, while *Staphylococcus aureus* causes the majority of hospital-acquired infections, in South Africa and globally. Both organisms are proving increasingly difficult and expensive to treat due to the physiological phenomenon of persistence, co-infection with HIV and the emergence of drug-resistance.

To discover new treatments, we need to focus on targets that have been validated in an *in vivo* context, and that are tractable for inhibition by small molecules. In 2018 we received a R01 grant from the National Institutes of Health (NIH) in the United States for the project "Inhibitors of CoA biosynthesis as novel antitubercular and antistaphylococcal agents". The project outlines experiments in which new inhibitors of PPCS, an enzyme in the pathway that synthesizes the essential cofactor coenzyme A, will be developed, tested, and iteratively improved to yield compounds with potential for development as new antitubercular and antistaphylococcal agents.

- Prof Erick Strauss

Rooibos and stress

Adrenal steroid output is crucial in the maintenance of hormonal homeostasis, with imbalances being associated with many clinical conditions linked to adrenal disorders, diet and lifestyle. In the field of natural products, we have shown that Rooibos modulates glucocorticoid levels in humans and rats while also inhibiting the activation of cortisol, suggesting applications in a natural approach aiding in the management of stress and metabolic diseases. Analyses of steroid hormone levels and profiles indicate that Rooibos impacts the endocrine system via steroidogenic enzymes. Our findings underline the positive health benefits of Rooibos as a complementary functional food also counteracting the development of cardiovascular disease in those at risk.

- Prof Amanda Swart

At the forefront of adrenal and prostate steroid analyses

Our earlier investigations into Rooibos led to the first comprehensive quantitation of the adrenal steroids produced in the H295R adrenal cell model using ultra high performance liquid chromatography (UHPLC), coupled to tandem mass spectrometry (MS/MS). These studies also led to the revival of the forgotten adrenal androgen, 11 β -hydroxyandrostenedione (11OHA4). The rediscovery triggered subsequent studies into prostate cancer. Characterizing steroid hormone profiles, now also using state-of-the-art ultra-performance convergence chromatography mass spectrometry (UPC²-MS/MS) technology, has placed SU at the forefront of adrenal and prostate steroid analyses.

Analytical facilities enabled the establishment of the 11OHA4 pathway in which we identified novel C11-oxy androgens in prostate cancer tissue and in circulation as well as in patients suffering from polycystic ovarian syndrome. Our findings have furthermore shown that not all C11-oxy androgens are conjugated efficiently and may affect elimination leading to the accumulation of these steroids in the prostate with ensuing downstream cellular effects contributing to the progression of prostate cancer. Evidence as to the importance of these

C11-oxy androgens is rapidly mounting with their contribution to clinical conditions associated with androgen excess such as congenital adrenal hyperplasia and polycystic ovarian syndrome being recognised, influencing the approach to therapeutic strategies.

- Prof Amanda Swart

Importance of C11-oxy steroids in steroid metabolism

Investigating enzyme systems catalysing adrenal steroid biosynthesis and prostate steroid metabolism, while simultaneously being able to quantify steroids panels in cell systems allowing snapshot analyses of steroid profiles, will expand our current understanding of steroid metabolism. Our comprehensive analyses of steroid panels in cell systems recently led to the extension of another steroid metabolic pathway - the backdoor pathway. Slotting into this pathway, we have identified 11-hydroxyprogesterone as well as 21-deoxycortisol, both produced in the adrenal gland. Their peripheral conversion also leads to the production of active C11-oxy androgens, potentially exacerbating clinical conditions associated with androgen excess.

Our studies thus far have brought to the fore the importance and abundance of these C11-oxy steroids which to date have not been fully recognised in the steroid world. The knowledge of the existence of these steroids will require the re-evaluation of much of what is known and generally accepted today. The inclusion of the C11-oxy steroids and their downstream metabolites in the assessment of steroid hormones, their receptor interaction and subsequent modulation of target genes, together with steroid transport, steroid conjugation and elimination will most certainly expand our current understanding of steroid metabolism.

- Prof Amanda Swart

Novel antimalarials

Research is focused on identifying the specific target of pantothenate analogues (i.e. *N*-substituted pantothenamides) on Coenzyme A biosynthesis and utilization in *Plasmodium falciparum*. This work is specifically important in the context of developing these compounds further as novel antimalarials. This is supported by the fact that the MMV (Medicines for Malaria Venture) now has this class of compounds in its lead optimization program. In the process we hope to understand the biology of the parasite better since Coenzyme A is an essential cofactor and plays an integral role in metabolism. Ultimately we would like to transpose this knowledge to other parasites that are responsible for various neglected infectious diseases.

- Dr Marianne de Villiers

AWARDS TO STAFF AND STUDENTS

Prof Jannie Hofmeyr received the SU 2018 Chancellor's Award for excellence in research over an extended period. Prof Ann Louw was the recipient of a Fundación Mujeres por Africa Fellowship, as well as an Overseas Sabbatical Grant from the Oppenheimer Memorial Trust to spend a six month sabbatical in Spain. Two PhD students, L Barnard and M Barnard, were recipients of the Brownie and Schimmer New Investigator Poster Award at the 18th Congress on the Adrenal Cortex, Munich, Germany, 25-27 June 2018, while Desmaré van Rooyen received the Brownie and Schimmer New Investigator Award at the same conference.



Prof Jannie Hofmeyr receiving his award during the December 2018 graduation ceremony. Photo: Anton Jordaan

RESEARCH ACTIVITIES

Dr Donita Africander presented a poster at the Gordon Research Conference on Hormone-Dependent Cancers in August 2017 in Newry, Maine, USA. In 2018, she also presented a poster at the Society for Endocrinology, British Endocrine Society (SfE BES) endocrinology meeting in Glasgow, Scotland, and a lecture at the 18th International Congress of Endocrinology / 53rd SEMDSA Congress, Cape Town South Africa. A postdoctoral fellow in her lab, Dr Renate Louw-du Toit will present a lecture at the 17th International Congress on Hormonal Steroids and Hormones & Cancer, Stellenbosch, South Africa.

Prof Dirk Bellstedt attended the XX1st AETFAT Congress (Association for the Study of the Taxonomy of Tropical African Plants) held from 15 - 19 May, 2017, in Nairobi, Kenya, and gave a presentation entitled "The biogeography of the predominantly African genus *Erica*". He was also an invited speaker at the first international *Pterophyllum* conference, held from 26 to 27 May 2017 in Schwarzenbach am Wald, Germany, and gave a presentation entitled "The genetics of *Pterophyllum* species: New information about the types from the Rio Negro". He co-edited a book on the most important viral disease of potatoes entitled *Potato virus Y: Biodiversity, Pathogenicity, Epidemiology and Management*, edited by C. Lacomme, L. Glais, D. U. Bellstedt, B Dupuis, A. Karasev and E. Jacquot (2017), Springer Verlag. He co-authored two chapters in the book i.e. "Diversity, Characterization and Classification of PVY", and "Evolution and Origin of PVY". Prof Bellstedt was re-evaluated and rated as CI.

Dr Marianne de Villiers was an invited speaker at StellenCoA 2018 SASBMB focused meeting on Coenzyme A in Health, Disease and Biosciences, 28 October to 1 November 2018 in Stellenbosch. The title of her talk was "N-substituted pantothenamides - does one shoe fit all?" She presented a poster at the Gordon Research Conference from 1 to 7 July 2017 in Les Diablerets, Switzerland, entitled "Investigation on the mode of action of N-substituted pantothenamides as inhibitors of Coenzyme A biosynthesis in *Plasmodium falciparum*."

Prof Jannie Hofmeyr was invited to give the Reinhart Heinrich Lecture at the International Study Group for Systems Biology (ISGSB 2018) in Tromsø, Norway, and as keynote speaker at the 14th INCOSE South Africa Systems Engineering Conference in Pretoria. He also attended the fifth International Conference in Code Biology in Granada, Spain, and published several important research articles in a special issue of the journal *BioSystems* (2018), focusing on code biology.

Prof Ann Louw spent a six month sabbatical in 2017 at the Spanish National Cancer Research Centre (CNIO), a Severo Ochoa Centre of Excellence, working on the chemopreventative and/or chemotherapeutic properties of a *Cyclopia* extract. Her group published a paper in *Frontiers in Ethnopharmacology* (2018) confirming the ability of this *Cyclopia* extract to prevent breast cancer while displaying reduced side-effects in comparison to standard of care endocrine therapies. Furthermore, her group published the first study to show a novel requirement for dimerization of the glucocorticoid receptor in acquired glucocorticoid resistance, published in *Scientific Reports* (2018), which was followed by a review on disease and treatment associated acquired glucocorticoid resistance in *Endocrine Connections* (2018). Prof Louw was re-evaluated and rated as CI.

Prof Marina Rautenbach gave a keynote lecture at the Bacteriocins and Antimicrobial Peptides (BAMP 2018) symposium and the International Scientific Conference on Probiotics, Prebiotics, Gut Microbiota and Health (ICP) in Hungary. Three members of her research group, Dr Arnold Vosloo, Wilma van Rensburg and Wikus Laubscher, presented four posters on their antimicrobial peptide research at the 35th European Peptide Symposium (35EPS) in Ireland and at its satellite meeting, the 8th International Meeting on Antimicrobial Peptides (IMAP) in Edenborough, Scotland. Two MSc students, Gamu Mamhede and Rosalind van Wyk, presented their research on antimicrobial peptides at the South African Society for Biochemistry and Molecular Biology (SASBMB) conference in Potchefstroom in July 2018. Prof Marina Rautenbach was awarded a Corporate Social Responsibility (CSR) grant from the National Research Foundation for 2018 to 2020 and a US Sub-committee B Postdoctoral Fellowship.

Prof Johann Rohwer gave an oral presentation at the Metabolic Pathways Analysis 2017 conference, held in the USA, presenting his work on metabolic flux analysis of plant isoprene biosynthesis. He also spoke at the Beilstein Enzymology Symposium, held in Rüdeshheim, Germany, during September 2017, presenting STRENDA DB, the enzyme function database developed by the international STRENDA Commission, which develops Standards for Reporting Enzymology Data and of which he is a member. A paper describing this database, co-authored by commission members from across four continents, was published in the *FEBS Journal*, a peer-reviewed scientific journal published on behalf of the Federation of European Biochemical Societies. During 2018, he presented a poster on his work on the modelling of cellular redox networks with Dr Ché Pillay from the University of KwaZulu-Natal (UKZN) at the 18th Conference of the International Study Group for Systems Biology (ISGSB), held in Norway.

Prof Jacky Snoep presented the JWS Online project in an oral presentation at the COMBINE meeting in October 2017 in Italy. He spoke at the 65th anniversary symposium for Prof Hans Victor Westerhoff in February 2018, in The Netherlands, on synchronisation of yeast glycolytic oscillations. He also gave an oral presentation for the HotSolute project at Evonik Industries in Germany in June 2018. He presented a seminar at the Norwegian University of Science and Technology, Trondheim, on insulin signalling in skeletal muscle cells on 1 October 2018. He presented a paper on data and model management in a satellite workshop of the International Conference on Systems Biology (ICSB) in October 2018 in France. In 2018 he presented a lecture titled “Mechanistic Modelling of Cellular Function: putting Biochemistry to work!” as part of the centenary celebration of the Faculty of Science at Stellenbosch University.

Prof Jacky Snoep and **Dr Dawie van Niekerk** gave two oral presentations titled “Construction, reduction and analysis of a whole-body model of malaria infection” and “Control of glycolytic oscillations by adenylate kinase” at the International Study Group for Systems Biology conference held in Norway during September 2018. The content covered the progress in their joint research projects investigating whole-body modelling of glucose metabolism during malaria infection, and glycolytic oscillations in yeast. They also hosted

five international visitors: Prof Stig Umholt from the Norwegian University of Science and Technology (Norway), as part of their project on hypertension; Dr Marcel Vieira Lara from the University Medical Centre Groningen (The Netherlands), as part of their project on diabetes; Dr Martin Mojica Benavides from the University of Gothenburg (Sweden), as part of their project on yeast glycolytic oscillations; Dr Matthias König from Humboldt-University Berlin (Germany), as part of their project on whole body glucose metabolism; and Cor Stoof from the Vrije Universiteit Amsterdam (The Netherlands) to collaborate on the JWS online simulation platform. One of their PhD students, Alana de la Harpe, visited the laboratory of Prof N. Sampson at Stony Brook University (USA) from 28 October to 9 December 2017 to measure growth rate and biomass yields of *M. tuberculosis* in different media compositions.

Dr Marietjie Stander’s group published several important research articles during 2018 in journals such as *Crop Protection*, *Plant cell, tissue and organ culture*, *Journal of Chromatography B*, the *South African Journal of Biochemistry (SAJB)*, the *American Journal of Obstetrics and Gynecology*, *Antioxidants*, *Foods* 7, *Analytical Chemistry*, and the *Journal of Food Composition and Analysis*.

Dr Karl Storbeck presented an oral lecture at the 18th Congress on the Adrenal Cortex, in Germany from 25-27 June 2018 and published the first study in the *Journal of Steroid Biochemistry and Molecular Biology* (2018) to show that 11-oxygenated androgens are the preferred substrate for AKR1C3, a key enzyme in the peripheral activation of androgens. He also gave a talk at the joint meeting of the South African Society of Biochemistry and Molecular Biology (SASBMB) held in conjunction with the Federation of African Societies of Biochemistry and Molecular Biology (FASBMB). One of his PhD students, Monique Barnard, gave a talk at the 17th International Congress on Hormonal Steroids and Hormones and Cancer (ICHSHC). Dr Storbeck chaired sessions at the SASBMB/FASBMB and ICHSHC meetings as well as the 18th International Congress of Endocrinology.

In 2018 **Prof Erick Strauss** was awarded a Research Project Grant (R01) from the National Institutes of Health (NIH) in the USA for a project entitled “Inhibitors of CoA biosynthesis as novel antitubercular and antistaphylococcal agents”.

Prof Amanda Swart was an invited symposium speaker at two conferences: in 2018 at the symposium in celebration of the 50th anniversary of the discovery of Dihydrotestosterone (DHT) in the USA, and at the International Congress of Endocrinology (ICE-2018) in Cape Town, with a talk entitled “Novel steroid androgen precursor steroids and implications of the Adrenal Steroids: New Steroids, New Functions, New Therapies”. She was also a plenary speaker at the Anti-doping Lab Qatar (ADLQ) 8th symposium with a talk entitled “Flying under the radar: the C11-oxy androgens”, 1-2 May 2018 in Qatar. She was an invited speaker at the 4th Congress on Steroid Research, 8-11 July 2018, in the Republic of Korea, with the title “The contribution of 11 β HSD2 to the C11-oxy C19 and C11-oxy C21 steroid pool”. During 2018 her group published several important research articles in journals such as *Mol. Cell Endocrinology*, the *Journal of Steroid Biochemistry and Molecular Biology*, *Clinical Chemistry and Laboratory Medicine Published Online*, *Journal of Chromatography B*, *Steroids*, and *Food & Function*.

Dr Nicky Verhoog attended and presented a poster at the Inflammation: Basic Mechanisms and Relevant Diseases meeting in China in December 2017 and attended and presented a talk at the CANSA Research in Action Conference in July 2018 at the University of Pretoria. Two of her MSc students, Tammy Speelman and Nicole Green, presented posters at the SASBMB congress held in Potchefstroom in July 2018 and at the 17th International Congress on Hormonal Steroids and Hormones and Cancer in Stellenbosch, November 2018.

The Department of Biochemistry hosted the third international conference on Coenzyme A in Health, Disease and Bioscience at STIAS from 28 October to 1 November 2018.

SERVICE TO THE SCIENTIFIC COMMUNITY

Prof Marina Rautenbach's BIOPEPTM Peptide Group held the first international workshop on tyrocidines in December 2017. The two-day workshop sported four international speakers, Prof Burkhard Bechinger and Xavier Bossis, both from the University of Strasbourg (France), Prof Henrich Hasko Paradies from Jacobs University (Germany) and Prof Neil Hunt from University of York (United Kingdom).

Prof Erick Strauss and **Dr Marianne de Villiers** co-organised the third International Conference on Coenzyme A in Health, Disease and Bioscience that was held at STIAS from 28 October to 1 November 2018. Dubbed “StellenCoA 2018”, the focus of the conference is not a particular disease, but rather a molecule: the essential metabolic cofactor coenzyme A (CoA). The meeting brought together scientists from several different countries and a variety of disciplines, with the goal of creating an opportunity for the exchange of ideas between researchers that would otherwise not likely have met. The meeting drew great praise from all those who attended, both for the quality of the scientific programme and the venue and surroundings. Said one participant: “It was a once-in-a-career experience!”

The 17th International Congress on Hormonal Steroids and Hormones and Cancer held at STIAS in November 2018 was organised by **Dr Karl-Heinz Storbeck** (chairperson), **Dr Donita Africander**, **Prof Ann Louw**, **Prof Amanda Swart**, **Prof Pieter Swart** and **Dr Nicky Verhoog**.

Prof Johann Rohwer is a member of the International Advisory Board for the 18th Workshop of the International Study Group for Systems Biology, which was held in Tromsø, Norway, from 24-28 September 2018.



EDITORIAL ACTIVITIES

Prof Dirk Bellstedt served on the South African Plant Checklist Committee of the South African National Biodiversity Institute and as a sub-editor of the journal *Phytotaxa* in 2017 and 2018.

Prof Jannie Hofmeyr is president and a fellow of the Royal Society of South Africa, national chair of the Arthritis Foundation of South Africa, and associate editor of *BioSystems*.

Prof Ann Louw serves as an editorial board member of the journal *Steroids* and associate editor for *Frontiers in Pharmacology* (Ethnopharmacology).

Prof Marina Rautenbach is an editorial board member of *Journal of Microbiological Methods* and an editorial board review editor for *Frontiers in Chemistry and Molecular Biosciences* (Chemical Biology).

Prof Johann Rohwer serves as associate editor: *BMC Systems Biology* and review editor of *Frontiers in Plant Science* (section Plant Systems Biology). In 2018 he was appointed to the editorial advisory board of *In silico Plants*, a new online journal specialising in plant systems biology. He is a member of the international STRENDIA (Standards for Reporting Enzymology Data) Commission and is currently the chair of AHASA, the Alexander von Humboldt Association of Southern Africa's South-Western chapter.

Prof Jacky Snoep serves on the editorial boards of *Molecular Systems Biology*, *IET Systems Biology*, *Frontiers in Systems Biology*, and *Metabolomics*. During June 2018 he served on the evaluation panel for the computational systems biology projects for the Federal Ministry of Education and Research (BMBF) in Berlin, Germany.

Dr Karl Storbeck served as treasurer for the South African Society for Biochemistry and Molecular Biology (SASBMB), and is on the editorial board of *Steroids*.

Prof Erick Strauss has served on the editorial advisory board of *ACS Infectious Diseases* since 2017. Since 2015 he has served as member of the NRF BIOC (Biochemistry and Molecular Biology) rating panel, and as convenor of the panel in 2018.

Prof Amanda Swart serves on the editorial board of *Scientific Reports*.

Dr Nicky Verhoog is a council member and publicity officer of South African Society for Biochemistry and Molecular Biology (SASBMB).

COLLABORATION

Australia

Australian National University

Canada

McGill University

France

University of Strasbourg

Centre d'Immunologie de Marseille Luminy

Germany

Jacobs University

Leipzig Institute of Molecular Pharmacology

Technische Universität Dresden

University of Göttingen

Molecular Lab, SNSB-ZSM Bavarian State Collection of Zoology

Institut für Spezielle Botanik und Botanischer Garten,

Johannes Gutenberg Universität, Mainz

Max Planck Institute for Chemical Ecology in Jena

University of Duisberg-Essen

Rostock University

Italy

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Norway

Norwegian University of Science and Technology

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Switzerland

Zurich University of Applied Science, Wädenswil

Bern University Hospital, Inselspital Institute

University of Geneva, Department of Microbiology and

Molecular Medicine

The Netherlands

University of Amsterdam

VU Amsterdam

University of Groningen

University Medical Centre Groningen, Department of Cell Biology

Turkey

Marmara University, Istanbul

United Kingdom

University of Birmingham's Institute of Metabolism and Systems Research

University of Sheffield, Department of Oncology and Metabolism

Royal Botanic Gardens Edinburgh

United States of America

Fred Hutchinson Cancer Research Center, Seattle

Tulane School of Medicine

Traditional Medicinals

Stoney Brook University

FUNDING**SOUTH AFRICA**

BIOPEPTM Peptide Fund

Cancer Association of South Africa (CANSA)

Faculty of Science – Dean Start-up funding

Medical Research Council (MRC)

National Research Foundation (NRF)

NRF Thuthuka

Oppenheimer Memorial Trust

SA Rooibos Council

SARCHI research chair in Mechanistic modelling of health and epidemiology

South African Centre for Epidemiological Modelling and Analysis (SACEMA)

Stellenbosch University Sub-committee B

INTERNATIONAL

Academy of Medical Sciences (UK), Newton Advanced Fellowship

Biotechnology and Biological Sciences Research Council (BBSRC), FAIRDOM grant (United Kingdom)

Fundación Mujeres por Africa

National Institutes of Health (NIH)

The British Society for Endocrinology

Volkswagen Foundation

NRF-RATED RESEARCHERS**INTERNATIONALLY ACCLAIMED RESEARCHERS**

Prof Jacky Snoep | computational systems biology

Prof Erick Strausss | mechanistic enzymology and inhibitor development

Prof Johann Rohwer | computational systems biology

Prof Amanda Swart | bioactivity of rooibos and *Sutherlandia frutescens*

ESTABLISHED RESEARCHERS

Prof Dirk Bellstedt | plant molecular systematics and molecular plant virology

Prof Ann Louw | steroid receptor signal transduction

Prof Marina Rautenbach | antimicrobial peptides

PROMISING YOUNG RESEARCHERS

Dr Marianne de Villiers | chemical biology, antimalarial drug design and discovery, infectious diseases, mechanistic enzymology

Dr Karl-Heinz Storbeck | steroid hormones and castration resistant prostate cancer

ACADEMIC AFFAIRS

The department successfully offered practical laboratory training to 611 second-year Biochemistry students, a feat that could only be achieved by repeating practical sessions eight times across two weeks during November 2018.

In 2017 the Department again had a large cohort of 85 full-time postgraduate students and 11 postdoctoral fellows, while for 2018 there were 86 full-time postgraduate students and 12 postdoctoral fellows. At the 2017 graduation ceremonies 16 Honours, 15 MSc and four PhD students graduated successfully, while in 2018, 24 Honours, 10 MSc and five PhD students graduated successfully.

In 2018 Prof Marina Rautenbach acted as the official academic mentor for Dr Diane Rip (Food Science) and Dr Nicky Verhoog (Biochemistry) in the Early Career Academic Mentorship Programme of the University Capacity Development Plan by the South African Department of Higher Education. Dr Verhoog is a mentor for the Natural Science Student Committee (NSC) of the Faculty of Science at SU.

SOCIAL OUTREACH

The Department of Biochemistry presented a Faculty of Science Centenary lecture series from March to October 2018 to celebrate a hundred years of science, organised by Dr Marianne de Villiers. The lectures were "The complexity of life: from molecules to man" by Prof Jannie Hofmeyr; "Mechanistic Modelling of Cellular Function: putting Biochemistry to work!" by Prof Jacky Snoep; "Nature's Solutions to Antibiotic Resistance Armageddon" by Prof Marina Rautenbach; "The problem with giant genomes: the biological equivalent of the winzip/gzip utility" by Prof Hugh Patterton; "How DNA sequence data has helped us to understand the evolution of the flora of the Cape Floral Region" by Prof Dirk Bellstedt; "Gannabos, our GPS to better steroidal anti-inflammatory drugs" by Prof Ann Louw; and "Steroid Power?" by Prof Amanda Swart.

In October 2018 Prof Dirk Bellstedt was a speaker at the Faculty of Science's annual lectures on the work of the 2018 Nobel Prize Winners. Prof Jannie Hofmeyr is a regular contributor to the RSG programme "Hoe verklaar jy dit". Four academic staff members, Prof Africander and Drs Strobeck, Verhoog and De Villiers, were judges at the annual Eskom Expo for Young Scientists. The department was one of the best represented with 10 or more researchers and postgraduate students involved.

STAFF MATTERS

Dr Marianne de Villiers was appointed as lecturer on 1 March 2017. Mr Bradley Khoza and Ms Lihandra Prinsloo were appointed as Senior Technical Officers on 1 January and 1 March 2017 respectively. Prof Amanda Swart was appointed as Guest Professor at Bern University Hospital, Inselspital Institute (Switzerland) from 2017 to 2018. Dr Donita Africander was promoted to Associate Professor from 1 January 2018. Profs Amanda Swart and Jannie Hofmeyr retired at the end of 2018 after 43 and 44 years of service to SU, respectively.

Staff list, as at the end of 2018:

ACADEMIC

Prof DJ Africander
 Prof DU Bellstedt
 Dr A Botes
 Dr M de Villiers
 Prof J-HS Hofmeyr
 Prof A Louw
 Prof H Patterton
 Prof M Rautenbach
 Prof JM Rohwer (Head of department)
 Prof JL Snoep
 Dr K Storbeck
 Prof E Strauss
 Prof AC Swart
 Dr MA Stander
 Dr DD van Niekerk
 Dr NJD Verhoog

EXTRAORDINARY PROFESSORS

Prof WCA Gelderbloem

EMERITUS PROFESSORS

Prof P Swart

SUPPORT STAFF

Ms W Maart (Secretary)
 Mr AP Arends
 Mr KD Botha
 Mr R Brandt
 Mrs H Bredell
 Mrs CA de Villiers
 Mrs L du Toit
 Dr Y Engelbrecht
 Mrs AP Februarie
 Mrs GD Gerstner
 Mr CR Jansen
 Mr B Khoza
 Ms RP Louw
 Mrs L Prinsloo

POSTDOCTORAL FELLOWS

Dr T du Toit
 Dr T Kouril
 Dr N Le Maitre
 Dr R Louw-Du Toit
 Dr OR Oyenih
 Dr W Roos
 Dr JA Vosloo
 Dr Anton Hamann
 Dr Vikas Kumar
 Dr Deon Neveling

CONTACT DETAILS

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*BScHons students and staff in 1975.
At the back, B. Benade, G. van der Westhuyzen, K. Kritzing, P. Swart.
Second row, B. Kotze, J-HS Hofmeyr, H. Koch. Front, Prof Kirsten van der Merwe,
Dr H.W. Stindt, Prof J.L. de Wit,
Dr O.T. de Villiers.*

The Department of Biochemistry in 2018.



Photo: Anton Jordaan



DEPARTMENT OF BOTANY AND ZOOLOGY

Founded in 1903, the Department of Botany and Zoology strives to provide a deep understanding of the unique southern African flora and fauna and particularly its societal value in an African and global context. We achieve this through world-leading research directed at preserving the diversity of animal and plant life.

RESEARCH INTERESTS

Biotic diversity and ecology of the Cape Region and its coastline

Systematics and molecular ecology

Evolutionary ecology

Nutritional plant physiology and medicinal plant biology

Global change biology

NATUURWETENSAPPE

RESEARCH HIGHLIGHTS

Behavioral ecology - social behavior and communication

The invasive Argentine ant, *Linepithema humile*, has firmly established itself within natural environments in the Cape Floristic Region. They pose a significant threat to this biodiversity hotspot through their displacement of important native ant species and disruption of important mutualisms. Using stable isotope analysis, a technique used in palaeontology and anthropology studies for dating fossils and preserved materials, postdoctoral fellow, Natasha Palesa Mothapo in collaboration with Prof Theresa Wossler, traced carbohydrate resource use by invasive Argentine ants and native ants in the Fynbos. The study shows that Argentine ants exploit the abundant floral nectar more effectively by foraging in very high numbers, nesting close to the base of the trees and limiting access by other ant species. The results are published in the journal *Biological Invasions*.

– Prof Theresa Wossler



Argentine ants foraging on the floral nectar of *Protea repens*.
Photo: Eiriki Sunamura

Fynbos honey exhibits superior antibacterial activity

In recent years the demand for honey varieties based on their unique botanical origin and medicinal properties has grown worldwide. Novel research by PhD student Nanike Esterhuizen, supervised by Prof Theresa Wossler, on the characteristics of honeys produced from fynbos vegetation along the West Coast has shown that more than 50% of the samples collected over a three year period exhibit very good antibacterial activity and a further 22%

of samples show activity comparable to that of leading international honeys. This study has already shown promising results and will deliver important information that can be used to add value to South African honeys on the international honey market.

– Prof Theresa Wossler

Fine scale systematic sampling is critical for biodiversity detection

Recent broad-scale sampling of the primitive South African velvet worm genus, *Opisthopatus*, revealed the presence of five novel species. However, a phylogeographic study by Prof Savel Daniels and co-author on one of the recently described species, *O. amaxhosa* (a narrow endemic of the indigenous Afrotemperate forests around Baziya in the Eastern Cape province) revealed the presence of two distinct lineages in sympatry. These two lineages can be distinguished based on mitochondrial and nuclear DNA sequence data and scanning electron microscopy of diagnostic morphological characters, thus demonstrating the importance of fine scale sampling in detecting alpha taxonomic diversity among poorly studied invertebrate groups. One of these lineages corresponds to a new as yet undescribed species. In a recent paper published in *Zoologica Scripta* entitled “On the importance of fine-scale sampling in detecting alpha taxonomic diversity among saproxylic invertebrates: a velvet worm (*Onychophora: Opisthopatus amaxhosa*) template”, Aaron Barnes and Daniels highlight the importance of fine scale sampling when designing systematic projects to detect alpha taxonomic diversity among saproxylic invertebrate taxa.

Furthermore, since velvet worms generally tend to be narrow endemics, the study also demonstrated marked genetic differentiation within each of the clades corresponding to their decaying wood log habitat, suggesting that wood logs (the primary habitat of these animals), frequently collected for fire wood by local communities, should be left to decay on the forest floor. This pattern of heightened taxonomic diversity is probably also present in other microclimate specialists that are sensitive to dehydration and has a low dispersal capacity, such as, for example, naked snails and earth worms. Such molecular systematics is critical to document diversity in poorly studied invertebrate groups.

The conservation of diversity, in a biodiversity rich country such as South Africa, is dependent upon the

accurate delineation of species boundaries among taxa. This research was supported by a National Research Foundation Biodiversity grant that focused on documenting the biodiversity of forested regions in the Eastern Cape province of South Africa.

– Prof Savel Daniels



Opisthopatus amaxhosa, a narrow endemic velvet worm species from the Bazia forest complex in the Eastern Cape province, South Africa.
Photo: Theo Busschau

How do Guttural toads adapt to a dry Cape Fynbos habitat

We expect invasive species to succeed when moved to areas with similar climates to their native ranges. So moving toads from the humid summer rainfall area of Durban to Cape Town's dry mediterranean summer, would not be expected to result in an invasion. However, the Guttural toad, *Sclerophrys gutturalis*, has done exactly that. In a recent publication in the *Journal of Experimental Biology*, PhD student Giovanni Vimercati, and his supervisors Prof John Measey and Dr Sarah Davies from the NRF-DST Centre of Excellence for Invasion Biology (CIB), provided insight into physiological and behavioural adaptations that the toads have made to cope with their new habitat in a dry Cape climate. They found that the toads were able to withstand dehydration by hunkering down into a water-conserving posture. The invading toads were also found to be much better at performing endurance trials, by moving much farther than animals from their native Durban. Lastly, Cape Town toads were found to be able to withstand cooler conditions than Durban animals. The adaptations that these toads have made are even more remarkable when it is taken into consideration that the invasion is less than 20 years old (they were first discovered in 2000). This rapid adaptation to a novel climate means that Guttural toads could invade more areas than those identified by doing a climate match.

– Prof John Measey



A Guttural toad takes a water conserving posture.
Photo: John Measey

Controlling alien marine invasives

The first programme in Africa aimed at removing a marine alien species was undertaken by Drs Tammy Robinson and PhD candidate Clova Mabin, in collaboration with the South African National Biodiversity Institute (SANBI) and the CIB. The project saw the employment of more than twenty young biologists who spent twelve months trapping for the alien European Shore Crab in Hout Bay harbour. During this time 36 000 crabs were removed from the system. Although the species was not eradicated from the harbour, the project provided a sound case study that is being used to develop a basis for future marine eradication work in South Africa and internationally.

– Dr Tammy Robinson



Dr Clova Mabin and field workers trapping for European Green Crabs in Hout Bay harbour.
Photo: Tammy Robinson

Phosphorus variability in Fynbos and Nitrogen metabolism in legume nodules

Prof Alex Valentine worked with Dr Anathi Magadlela from the University of KwaZulu-Natal and Prof Emma Steenkamp from the University of Pretoria to investigate how Phosphorus availability affects the bacterial composition and Nitrogen metabolism in legume nodules. The study, published in the journal *Soil Biology and Biochemistry*, is the first to demonstrate that the variability in Phosphorus supply to *Virgilia divaricata* does not affect the bacterial composition of nodules. This indicates that the N₂-fixing bacteria are extremely well-adapted to maintain a functional symbiosis with the host legume in the P-poor soils of the Fynbos ecosystem. In spite of the nodule occupancy being unaffected, the acquisition and metabolism of inorganic Nitrogen was greatly affected by Phosphorus supply. These functional tolerances may be major factors that underpin the growth of *V. divaricata* under these variable soil conditions, ranging from forest margins to mature Fynbos. Moreover, the apparent bacteria-specific (*Burkholderia spp*) preference of *V. divaricata* may imply a very specific functional co-existence in a variable nutrient environment.

– Prof Alex Valentine



The root system (a), nodulated roots (b) and isolated nodules (c) of the Fynbos legume, *Virgilia divaricata*.
Photos: Dr Wafeeka Vardien

Diverse germination strategies key to successful radiation of Cape Oxalis

Most angiosperm species produce dormant seeds that experience a period of compulsory dormancy. Most species in the Cape Flora flower and set seed in spring or early summer, and seeds remain dormant through the dry summer, only to germinate at the onset of rains during the next winter. The massive Cape genus *Oxalis* is a noteworthy exception. About 40% produce dormant seeds, while the rest was thought to produce highly unusual, recalcitrant seeds. Recalcitrance is rare among angiosperms, and is mostly associated with climates with a very predictable wet season. They are incapable of drying, and germinate immediately upon release from the capsule.

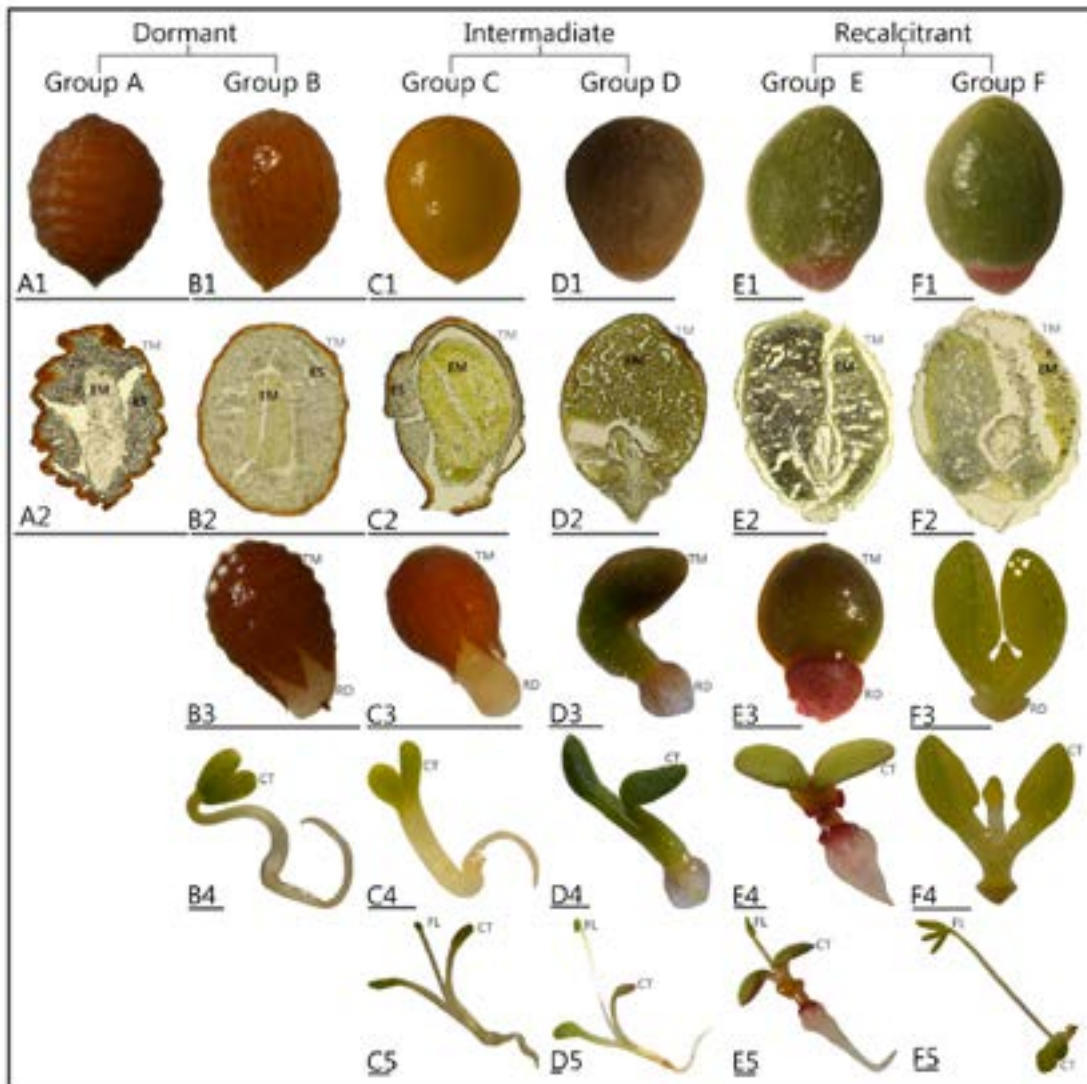
Prof Léanne Dreyer and PhD student Michelle Jooste recently explored the seed and seedling diversity of Cape *Oxalis*. Seed physiological traits were used to assign strategies to 64 *Oxalis* species. They then tested for morphological and/or phenological signals corresponding to defined strategies with cluster, principal component, K-means clustering and discriminant analyses. They showed that, in addition to true dormancy and recalcitrance, an intermediate germination strategy also exists among Cape *Oxalis*, and that each of these three strategies includes two distinct morphological groups. These could reflect a continuum of germination states, where an ancestral dormant strategy evolved towards a maximally recalcitrant peak, with a mosaic of intermediate states reflected in extant taxa.

Recalcitrant seeds germinate immediately after shedding, which may be advantageous if the seeds are shed during the wet winter months. They are metabolically active when shed, which enables them to mature much more rapidly than dormant seeds. This decreases the time exposed to post-shedding predation or microbial decay. Recalcitrance can, however, result in decreased growth rates or high mortality if seeds are shed during periods of low available moisture. Intermediate seeds are capable of both desiccation tolerance and rapid germination due to well-developed embryos upon release. They appear to have a cost-efficient bet-hedging strategy. The investment in lignified tegmens and endosperm may be costly, but ensure that the well-developed and metabolically active embryos can survive periods of desiccation. These seeds have the benefit of

immediate germination if environmental conditions are favourable, or delayed germination until conditions become favourable.

Environmental factors may affect germination strategy and distribution throughout the Cape, as recalcitrant and intermediate species are confined to the winter rainfall region. They occupy specialised niches and may be adversely impacted under predictions of climate change, meriting focused future conservation.

– Prof Léanne Dreyer



Seed morphology corresponding to six morphological groups from three germination strategies among Cape *Oxalis*. Each column corresponds to the best example of seeds and seedlings to represent each group. (a) Seed with tegmen, (b) seed cross section (TM=tegmen, ES=endosperm, EM=embryo), (c) germinating seed (RD=radicle), (d) seedling with opening cotyledons (CT=cotyledons), (e) seedling with emerging first foliar leaf (FL=foliar leaf). All scale bars represent 1mm. All seeds/seedlings oriented with radicle pointing to bottom (rows 1-2) or bottom right (rows 3-6) of figure.

Photos: Michelle Jooste

RESEARCH ACTIVITIES

Research output and funding

The Department published an excess of 380 ISI subsidized research papers for 2017 and 2018 combined and in addition also generated R12,2 million in outside research funding for 2017 and R11,1 million during 2018. Grants and or awards that were newly awarded during and initiated either in 2017 or 2018 included NRF Competitive Rated Researcher grants to Profs Bruce Anderson, Allan Ellis, Sophie von der Heyden, Léanne Dreyer and Alex Valentine. During this same period, numerous bilateral grants facilitating international collaboration were awarded to Profs Susanna Clusella Trullas (RSA/Flemisch), Nox Makunga (RSA/Kenya), Hannes van Wyk (RSA/Argentina) and Sophie von de Heyden (RSA/Namibia). Outside funding agencies included SANBI and SPARC grants to Prof Guy Midgley, Technology Innovation Agency (TIA) seed funding to Prof Nox Makunga and a Sasol Technology grant to Prof Alex Valentine. Prof Susanna Clusella-Trullas also received a grant from the Human Frontiers Science Programme.

Dr Natasha Mothapo was awarded a Mandela Washington Fellowship. This fellowship is the flagship program of the Young African Leaders Initiative, an effort initiated by the United States of America to invest in the next generation of African leaders.

Conferences and workshops

Several staff presented plenary and keynote addresses across the world.

Prof Bruce Anderson was invited to the 9th international congress of Dipterology 2018, where he delivered a keynote address entitled “Beauty and the Beast: Flies in the eyes of flowers”.

Prof Guy Midgley gave the plenary opening address at the fifth plenary session of the Intergovernmental Platform on Biodiversity and Ecosystem Services in Bonn, Germany, on 7 March 2017. He was also invited to give a talk at the International Biometric Society in Barcelona on 12 July 2018.

Dr Tammy Robinson gave a plenary talk at the tenth International Conference on Marine Bioinvasions in Argentina during October 2018, entitled “Intra-regional spread of marine alien species: Integrating research and management.”

Prof Dave Richardson was invited to present a talk entitled “Life on the loose: Species invasion and control”, at the annual symposium of the Australian Academy of Science, May 2017. He also presented at the annual conference of the Ecological Society of America, August 2017, USA, where he spoke about “Advances in Biodiversity and Ecosystem Science: Building on the Work of Harold A. Mooney”. He gave a talk at the tenth International Conference on Biological Invasions: New directions in invasion biology, Ireland; and another talk at the International Conference on Ecological Sciences, October 2018, France.

Dr Carol Simon was an invited speaker at the Japanese Society for Fisheries Science’s 85th Anniversary-Commemorative International Symposium held in Tokyo.

Prof Theresa Wossler gave an invited plenary at the International Union for the Study of Social Insects (IUSSI) conference, with a talk entitled “The secret life of the notorious Cape honey bee”, Brazil, August 2018.

EDITORIAL ACTIVITIES

Prof Bruce Anderson is editor of *Proceedings of the Royal Society B* and associate editor of the *Journal of Pollination Biology*.

Prof Susana Clusella-Trullas is editorial board member of *Functional Ecology* and the *Journal of Thermal Biology*.

Prof Léanne Dreyer is a member of the editorial board of *Botany Letters*.

Prof Conrad Matthee is associate editor for *Molecular Phylogenetics and Evolution* and member of the editorial boards of *Koedoe* and the *African Journal of Marine Science*.

Prof Guy Midgley is lead author for the sixth assessment report of the Intergovernmental Panel on Climate Change (IPCC), due to complete its work in 2021. He is also principle investigator for sub-Saharan Africa for the Global Environmental Fund’s (GEF) SPARC (Spatial Planning for Protected Areas under Climate Change) project; co-coordinating lead author and review editor for the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), based in Bonn, Germany; and coordinator of the climate change elements of the National Biodiversity Assessment for South Africa’s report to the Convention on Biological Diversity.

Prof Dave Richardson is associate editor of *Biological Invasions* and *Neobiota* (since 2011). He is a member of the editorial boards of *AoB PLANTS*, *Forest Ecosystems* and *Frontiers of Biogeography*, and for two book series for Cambridge University Press: *Ecology, Biodiversity, and Conservation* and *Conservation Biology* (since 2007). He is co-editor of a special issue of *AoB PLANTS* from the international workshop on "Evolutionary dynamics of tree invasions"; Co-editor of a special issue of *Bothalia (African Biodiversity and Conservation)* on "Assessing the status of biological invasions in South Africa"; Co-editor of a special issue of *Biological Invasions* on "Non-native species in urban environments: Patterns, processes, impacts and challenges".

Dr Carol Simon is co-editor in chief of *African Zoology*.

Prof Sophie von der Heyden is associate editor of *Frontiers in Marine Science*, *Frontiers Young Minds*, and *Estuarine, Coastal and Shelf Science*. She was elected as chair of the South African Network for Coastal and Oceanic Research (SANCOR) steering committee for 2018 to 2019. SANCOR promotes marine research in South Africa and beyond.

Prof Theresa Wossler is editor-in-chief of *African Zoology*.

AWARDS TO STAFF AND STUDENTS

Prof Dave Richardson was listed as a Highly Cited Researcher by Clarivate Analytics. He also received the Stellenbosch University Research Award for Exceptional Achievement, and an AI rating from the National Research Foundation for 2019-2024.

Prof Guy Midgley was the recipient of the first Marloth Medal from the Royal Society of South Africa, for his outstanding contributions in fundamental ecology, applied ecology and policy.

Dr Marnel Mouton was the winner of the people's choice award for her presentation at the Second International Legitimation Code Theory congress in Sydney, Australia, 3-7 July 2018.

Prof Alex Valentine was nominated by a top first year student as a lecturer who contributed the most to his/her academic achievement.

Postgraduate student **Ingrid Minnaar** was the winner in the Young Entomologists' Essay

Competition, organised by the Entomological Society of Southern Africa (ESSA), while **Dr Christopher Johnson** received the Bronze Medal from the South African Association of Botanists (SAAB) for the best PhD thesis in Botany.

NRF-RATED RESEARCHERS

LEADING INTERNATIONAL RESEARCHERS

Prof GF Midgley | ecology and ecophysiology; Global Change ecology

Prof DM Richardson | biological invasions and conservation biogeography

INTERNATIONALLY ACCLAIMED RESEARCHERS

Prof BA Anderson | plant-animal interactions

Prof MI Cherry | Behavioural ecology

Prof AG Ellis | Evolutionary ecology of plants and insects

Prof CA Matthee | Molecular systematics and phylogeography

Prof CA Pauw | Evolutionary ecology of plants and their pollinators

ESTABLISHED RESEARCHERS

Prof S Clusella-Trullas | thermal adaptation of ectotherms and implications for climate change

Prof SR Daniels | molecular systematics, phylogeography and conservation of invertebrata

Prof LL Dreyer | evolution of Cape Flora

Prof NP Makunga | medicinal plant biotechnology

Dr CA Simon | marine invertebrate reproduction and polychaete worm taxonomy

Prof AJ Valentine | molecular physiology of host-microbe interactions of legumes in phosphorus deficient soils

Prof S von der Heyden | marine molecular ecology and conservation

PROMISING YOUNG RESEARCHER

Dr TB Robinson | drivers, patterns and impacts of marine invasions

NATIONAL AND INTERNATIONAL COLLABORATORS

Argentina

Instituto de Salud y Ambiente del Litoral
Universidad Nacional de Mar del Plata

Australia

Australian Museum
Deakin University
University of Tasmania

Belgium

University of Ghent

Canada

York University

Chile

Pontificia Universidad Catolica de Chile

China

Xishuangbanna Botanical Garden

Czech Republic

Charles University in Prague
Czech Academy of Science

France

Aix-Marseilles University
Centre national de la recherche scientifique (CNRS)

Germany

Frankfurt University
Goethe University of Frankfurt
Senckenberg Biodiversität und Klima Forschungszentrum (BiK-F)

Hong Kong/China

University of Hong Kong

Italy

University of Siena

Japan

Iwate University
Tohoku University

South Africa

CSIR
Nelson Mandela Metropolitan University
North West University
Rhodes University
University of Cape Town
University of Johannesburg
University of Kwazulu Natal
University of Pretoria
University of the Western Cape
University of Venda

The Netherlands

Naturalis Biodiversity Center

United Kingdom

Durham University
University of Aberdeen
University of Bayreuth
University of Leeds
University of New South Wales
University of the West of Scotland

United States of America

California State University
Georgia Southern University
Northern Michigan University
Ohio University
Purdue University of Leeds
Texas A&M University
University California Santa Barbara
University of Hawaii
University of Washington
University of Wisconsin-Madison

Uruguay

Universidad de la República

FUNDING

Cambridge Conservation Institute
 City of Cape Town
 CSIR
 Escom Annual Koeberg Monitoring
 Eva Crane Trust
 Hunters Honey
 National Research Foundation (NRF)
 Rhodes University
 SA Berry Products
 Sasol
 Shark Project Austria
 South African National Biodiversity Institute (SANBI)
 SPARC (Spatial Planning for Protected Areas under
 Climate Change)
 Stellenbosch University
 Technology Innovation Agency (TIA)
 Western Indian Ocean Marine Science Association
 (WIOMSA)

ACADEMIC AFFAIRS

The first-year module, Biology 124, is in the process of being developed into a Mode 2 delivery module for Bioinformatics honours students and may in future also be used for undergraduate students. Dr Marnel Mouton and Prof Allan Ellis are involved in this new initiative. The BioExcel support programme is developed further each year and serves as learning support for first-year biology students. This platform also provides a valuable training opportunity for tutors to become future academics and lecturers with a scholarly approach. Furthermore, Prof Theresa Wossler, Dr Alex Flemming and Dr Marnel Mouton form part of a curriculum renewal task team to rethink curriculum and its delivery within the Faculty of Science.

Dr Marnel Mouton received a FIRTTL grant for the project "Using Legitimation Code Theory to cross the articulation gap between high school and first-year Biology" for 2017/2018. She presented her findings at the Scholarship for Teaching and Learning (SoTL) conference in 2017 and 2018, as well as at the Second Legitimation Code Theory Conference in Sydney, Australia in July 2017.

SOCIAL IMPACT

The Ingcungcu Project 2018

The City of Cape Town combines high human density with exceptionally high biological diversity. An ongoing challenge for the City is how to mitigate the impacts of the expanding city on its natural environment, while at the same time harness the benefits that biodiversity brings.

A unique aspect of the Fynbos vegetation that surrounds the city is that the dominant shrubs depend on birds for pollination and subsequent seed production. However, our earlier research has shown that these iconic creatures, including the sugarbirds and sunbirds with their long tails and iridescent colours, are reluctant to cross the urban expanse that now isolates the Table Mountain National Park from other mountains. This migration route is especially important when fires temporarily decimate the vegetation, forcing the birds to leave in search of nectar. The Ingcungcu Project tackles

this problem by reopening a migration corridor for nectar-feeding birds across the City by planting gardens of bird-pollinated plants on school grounds. These gardens of which there are now eight, act as “filling stations” for the birds. The migration corridor crosses the poor suburbs of Cape Town where school children from previously disadvantaged backgrounds are engaged in all aspects of the project, from planting to the collection of bird and plant data. For many this is their only contact with nature. Thus, the project aims to heal the relationship between plants and birds and people.

In 2018 the project was funded by the Faculty of Science's Social Impact Initiative, and in 2019 the project will be funded for the second time by the National Geographic Society. The project is currently run by a steering committee consisting of Prof Anton Pauw (SU), Dr Sjirk Geerts (CPUT), Ceinwen Smith (project manager), Gabriela Demergasso (project fund raiser and assistant), and Bongani Mnisi (City of Cape Town), who initiated the project as part of his MSc studies at SU.

– Prof Anton Pauw



Learners planting a new garden at Levana Primary on the Cape Flats.
Photo: Anton Pauw

STAFF MATTERS

Dr Carol Simon was promoted to associate professor and Prof Alex Valentine promoted to professor as from 1 January 2019. The Department had to greet Prof Jaco Le Roux, who took up a position at Macquarie University in Australia, as well as Dr Aleyasia Kleinert, who took up a position at the Agricultural Research Center. The Department took leave of two staff members who retired: Prof Le Fras Mouton retired (37 years of service) and Ms Ina Honing (20 years of service). Mr Andrew Fransman also unexpectedly left the services of the Department in 2018.

Staff list, as at the end of 2018:

ACADEMIC

Prof BA Anderson
 Prof MI Cherry
 Prof S Clusella-Trullas
 Prof SR Daniels
 Prof LL Dreyer
 Prof AG Ellis
 Dr AF Flemming
 Prof NP Makunga
 Prof CA Matthee
 Prof GF Midgley
 Dr M Mouton
 Prof CA Pauw
 Dr VR Rambau
 Prof DM Richardson
 Dr TB Robinson
 Dr CA Simon
 Prof AJ Valentine
 Prof JH Van Wyk
 Prof S von der Heyden
 Prof TC Wossler

ACADEMIC STAFF: CENTRE OF EXCELLENCE FOR INVASION BIOLOGY

Prof B van Wilgen
 Dr J Measey
 Dr S Kumchick
 Prof J Wilson

EXTRAORDINARY PROFESSORS

Prof D Baird
 Prof W Przybylowicz
 Prof J Mesjasz
 Prof W Foden

Prof L Foxcroft
 Prof JR Wilson

EMERITUS PROFESSORS

Prof V Smith
 Prof J Gilomee
 Prof JAJ Nel
 Prof AJ Reinecke
 Prof SA Reinecke
 Prof TJ Robinson
 Prof E van Dijk
 Prof VR Smith

SUPPORT STAFF

Ms J Basson
 Ms F Gordon
 Ms RM Honing
 Ms S Jacobs
 Ms S Johnson
 Ms DJD Jeftha
 Dr A Kleinert
 Ms J Law-Brown
 Mr R Robertson
 Ms MP Sauerman
 Mr M Siebritz
 Mr N Solomons
 Mr JP Williams
 Mr H Witbooi

SUPPORT STAFF: CENTRE OF EXCELLENCE FOR INVASION BIOLOGY

Ms L Cilliers
 Ms K Coombe-Davis
 Dr S Davies
 D du Plessis
 Ms M Mathese
 Ms S Kritzinger-Klopper
 Dr E Marais
 Ms C Momberg

Ms R Moses
 Ms L Msomi
 Ms E Nortjé
 Ms S Turner
 Ms M van der Vyver

POSTDOCTORAL FELLOWS

Dr S Andreotti
 Dr WJ Augustyn
 Dr FC Boucher
 Dr JM Da Silva
 Dr A Dalongeville
 Dr ML De Jager
 Dr G Diedericks
 Dr L Gallien
 Dr R Garcia
 Dr DT Guzha
 Dr H Hirsch
 Dr M Mairal Pisa
 Dr NA Masondo
 Dr IA Minnaar
 Dr C Minnaar
 Dr NP Mothapo
 Dr T Musvuugwa
 Dr K Peters
 Dr NL Phair
 Dr RJG Pierron
 Dr J Riley
 Dr RT Shackleton
 Dr N Stevens
 Dr JC Truter
 Dr FA Yannelli Lucero
 Dr J Zeyl

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Department of Botany staff and students, circa 1955.

Photo: G.C. Crafford, SU Archive

Department of Zoology staff and students circa 1964.



Photo: SU Archive



The Departments of Botany and Zoology joined forces in 2005 to form one Department of Botany and Zoology.

Photo: Anton Jordaan

DEPARTMENT OF

CHEMISTRY AND POLYMER SCIENCE

The Department of Chemistry and Polymer Science is one of the pre-eminent research departments in chemistry in South Africa, and is engaged in a wide range of research areas, including the largest research effort in polymer science in South Africa and Africa.

RESEARCH INTERESTS

Organic chemistry and medicinal chemistry

Inorganic chemistry and organometallic chemistry

Analytical chemistry

Polymer science

Physical and computational chemistry

Supramolecular chemistry and materials

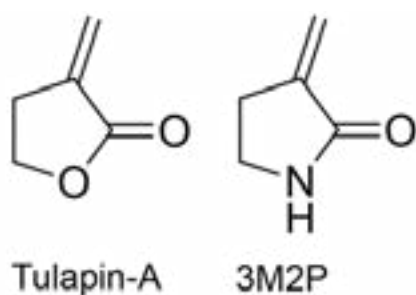
RESEARCH HIGHLIGHTS

Polymer chemistry research focuses on increased control and variation in chain topology

Over the years, there has been a shift in the focus of polymer chemistry research. Initially, the focus was largely on the development of new polymers for which in many cases new monomers were also required. In recent years, the attention has shifted to increased control and variation in chain topology, mostly using monomers that have been around already for a long time.

Simultaneously, much emphasis has been put on the development of monomers and polymers from renewable resources. One of the polymers that has been around for some time and that is based on a monomer that is produced through an enzymatic process is poly(3-methylene-2-butyrolactone) or poly(tulapin-A). Tulapin-A is a polymerizable compound that occurs naturally in tulips in tiny quantities. Its biosynthesis has been transformed into an industrial process, and poly(tulapin-A) has interesting properties, such as transparency and a high glass transition temperature, which makes it an interesting alternative for poly(methyl methacrylate), i.e. Plexiglas, in applications where the material gets exposed to temperatures where Plexiglas would fail.

Based on the limited available information about the biosynthesis of tulapin-A, we became interested in a closely related compound, 3-methylene-2-pyrrolidone (3M2P), which features a lactam as opposed to a lactone as its ring structure (see figure below).



A closely related compound, 3-methylene-2-pyrrolidone (3M2P) features a lactam as opposed to a lactone as its ring structure. Image: Bert Klumperman

We synthesized 3M2P through an organic synthetic multistep process as opposed to a biosynthetic pathway. This was done to provide proof-of-principle of

the polymerizability of the compound, and to get access to the polymer in order to assess its basic properties.

It turns out that poly(3M2P) possesses an even higher glass transition temperature than poly(tulapin-A), which we attribute to the stronger intermolecular interactions of the lactam/amide groups as opposed to the lactone/ester groups. Most remarkable of poly(3M2P) are its solution properties. The polymer turns out to be hardly soluble in common organic solvents, but very readily soluble in water. In addition to that, poly(3M2P) appears to be benign to mammalian cells, which means that the polymer has potential application in the biomedical field.

Upon publication of our first results on poly(3M2P), we were contacted by Prof Malcolm Kelland from the University of Stavanger (Norway), who anticipated that the polymer would have interesting properties as a so-called kinetic hydrate inhibitor (KHI). Initial tests showed that although poly(3M2P) acted as a KHI, it was not as good as some of the currently used materials. The main reason was thought to be the absence of a lower critical solution temperature (LCST), which is a temperature above which a polymer precipitates out of (aqueous) solution. In collaboration with Prof Kelland, we started to explore several options to introduce an LCST in 3M2P-based polymers. This can be done via a variety of different approaches that all rely on a subtle increase of the hydrophobicity of the polymer. In doing so, we found that the KHI properties can be improved to match those of currently used polymers.

Through the KHI project and through other projects, we have shown that 3M2P-based polymers can be employed as interesting alternatives to current polymers. Although the starting point of the 3M2P project was its potential biosynthetic accessibility, the development of such a process is still elusive, and beyond the scope of our research activities. It would still be interesting to team up with a specialized research group that is able to develop a biosynthetic route towards 3M2P.

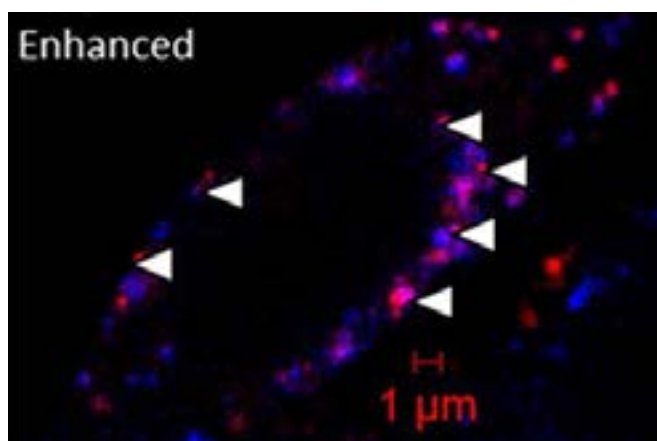
– Prof Bert Klumperman

Polymeric prodrugs

A number of students in the group are working on polymeric prodrugs. These polymeric prodrugs typically consist of a block copolymer, where the one block is hydrophilic and biocompatible, whereas the other block allows the reversible attachment of drugs. After the attachment of the drug, this

second block is usually hydrophobic, which leads to the self-assembly of the block copolymers into micelles or vesicles. The link between polymer and drug is made in a way that the drug gets released under conditions specific for the tissue/cells that are targeted. One of the examples that was published in 2018 is the treatment of glioblastoma by delivery of hydroxychloroquine to influence the acidification of endosomal/lysosomal compartments in the tumor cells. This work is carried out in collaboration with Prof Ben Loos from the Department of Physiological Sciences.

– Prof Bert Klumperman



Treatment of glioblastoma by delivery of hydroxychloroquine to influence the acidification of endosomal/lysosomal compartments in tumor cells. Image: Ben Loos

New research projects in Analytical Polymer Science

The focus of the SASOL Chair in Analytical Polymer Science group, under the leadership of Prof Harald Pasch, is the development of analytical methods for the analysis of complex macromolecular structures. Polymer science is an integral part of fundamental chemical research as well as nanoscience and nanotechnology. Polymers are macromolecular structures with different sizes, chemical compositions and molecular architectures. Molecular parameters to be analysed include molar mass, chemical composition, molecular topology and polymer microstructure. Methods that are used include multidetector column- and channel-based fractionation methods, spectroscopic methods, thermal analysis and comprehensive 2D-LC. Analytes of interest are all types of polymers (block and graft copolymers, polyolefins, water-soluble polymers, polyelectrolytes) and polymer assemblies (micelles, vesicles, liposomes, nanogels).

The research of the SASOL Chair addresses the molecular properties of complex polymeric materials

by using analytical techniques such as advanced fractionation and spectroscopic methods. The infrastructure and equipment of the SASOL Chair is unique for South Africa and compares with the best international laboratories. Among other technologies, multidimensional column- and channel-based fractionation technologies are used to fractionate macromolecules, nanoparticles and complex polymer assemblies such as micelles and vesicles.

In collaboration with major international companies such as SASOL (South Africa) and Borealis (Austria) analytical protocols for complex polyolefins are developed. A project with L'Oreal in France on the characterisation of cosmetic polymers has just been completed.

A completely new direction of research started recently addressing the valorisation of natural waste materials. The utilisation of fossil fuels as a feedstock in the chemical industry is unsustainable due to the dwindling fossil fuel sources and the accompanying deleterious environmental effects. Using biomass as an alternative chemical feedstock is desirable because biomass is sustainable and does not compete with societal needs. Lignin is the second most abundant natural polymer and the most abundant source of functionalised aromatic compounds. It is renewable, environmentally benign and is currently produced in large quantities as part of the pulp and paper industry, agroforestry and agricultural waste. Its valorisation through depolymerisation is the focus of the current research. The aim is to investigate and develop environmentally-friendly, selective and mild methods for effectively depolymerising lignin into low molar mass high value compounds. These compounds shall then be functionalised and used as monomers for the production of green (biodegradable) polymers. In a recently completed MSc project the proof of principle has been produced and the findings are now under consideration for patenting.

– Prof Harald Pasch

Delivery systems for antimalarial drugs

The Klumperman group is part of a Community of Practice (CoP) on the eradication of malaria. In the CoP, Research Chairs from around the country join forces to achieve a common goal, which in this case is the eradication of malaria. The CoP is led by Prof Lynn-Marie Birkholtz (University of Pretoria). The role of the Klumperman group is to design and prepare delivery systems for antimalarial drugs. Some of these drugs are existing ones with proven efficacy,

but problems in terms of drug resistance or in terms of administration. Alternatively, we work with drugs that come from the drug discovery group headed by Prof Kelly Chibale (University of Cape Town), who is also part of the CoP. The CoP has an initial duration of three years (2018-2020).

– Prof Bert Klumperman

Fifth European Crystallography School hosted at SU

In July 2018 the fifth European Crystallography School was organised at Stellenbosch University by Prof Catharine Esterhuysen, assisted by Prof Delia Haynes. An SU Africa Collaboration Grant allowed Haynes to support the attendance of her collaborator from Cameroon, Prof Justin Nenwa, and his student Mr Augustin Nana Nkwento at this school. These researchers stayed at SU for an additional week to carry out measurements on materials relevant to the collaborative project with Haynes, which involves investigating the crystal structures of cobalt oxalate materials.

– Prof Delia Haynes

International Conference on the International Solid State (ICCOSS)

The 23rd edition of the International Conference on the Chemistry of the Organic Solid State (ICCOSS) was successfully hosted in Stellenbosch, 2 – 7 April 2017, with the organising committee chaired by Prof Len Barbour. The conference showcased frontier research relating to various aspects of organic solid state chemistry, and brought together over 100 young and experienced scientists from around the world. The ICCOSS series of conferences is the premier forum for discussing groundbreaking research on the chemistry and physics of organic materials.

- Prof Len Barbour

Unlocking the potential of mohair fibre for functional textiles

MS Adine Gericke is currently doing research on the performance properties of fabrics containing mohair fibres. This included a sabbatical from middle March to July 2018. The purpose of the study is to quantify the thermal and moisture management properties of a range of textile materials that contain mohair fibres. A range of fabrics was developed and the thermal as well as moisture management properties evaluated.

Properties focussed on include thermal conductivity and resistance, wicking, moisture absorbance, drying rate, moisture vapour permeability and more. The results of this study will make a valuable contribution to unlocking the potential of mohair fibre for the development of functional textiles. The project was commissioned and funded by the South African Mohair Cluster (SAMC). The work included international collaboration with researchers from the Technical University of Liberec, Czech Republic and the Indian Institute of Technology (IIT) in New Delhi, India.

– Ms Adine Gericke

RESEARCH ACTIVITIES

Research grants and funding

Prof Bert Klumperman's research group was successful in the application of a BRICS Multilateral Joint Science and Technology Collaboration project with participants from China and from Brazil. The theme of the project is the development of drug delivery systems to fight parasitic diseases. Collaborators in the project are Prof Fenghua Meng from Soochow University in China, and Prof Vanessa Mosqueira and Dr Gwen Pound-Lana from the Federal University of Ouro Preto in Brazil. The project will run from 2019-2021.

Three postgraduate students in **Dr Katherine de Villiers'** research group received Freestanding Innovation and Scarce Skills Development Masters and Doctoral Scholarships from the NRF for 2017/2018.

Prof PE Mallon collaborated with a number of Universities as part of the EU Horizon 2020 RISE project MAT4TREAT.

High impact research

Two papers from **Prof Len Barbour's** group featured as cover articles in high impact international journals. The article entitled "Distinctive Three-Step Hysteretic Sorption of Ethane with In-situ Crystallographic Visualization of the Pore Forms in a Soft Porous Crystal" by Prem Lama and Len Barbour (*J. Am. Chem. Soc.* 2018, 140, 2145) was featured on the cover of the flagship journal of the American Chemical Society.

The article entitled "Supramolecular Solvatochromism: Mechanistic Insight from Crystallography, Spectroscopy and Theory" by Varvara Nikolayenko, Lisa van Wyk,

Orde Munro and Len Barbour (*Chem. Commun.* 2018, 54, 6975) was featured on the cover of the flagship journal of the Royal Society of Chemistry.

Research from a collaborative effort between **Profs Delia Haynes** and **Len Barbour** was published in *Angewandte Chemie* in 2018. The paper entitled "Solvent-Mediated Synthesis of Cyclobutane Isomers in a Photoactive Cadmium(II) Porous Coordination Polymer" by Isabella Claassens, Varvara Nikolayenko, Delia Haynes and Len Barbour, was selected as a 'Hot Paper' and highlighted on ChemistryViews.org.

Research infrastructure

The equipment for field-flow fractionation was significantly upgraded. It is now possible to conduct FFF experiments (asymmetric flow FFF and thermal FFF) with a five-detector arrangement.

International research visits

During **Prof Delia Haynes'** sabbatical from April to November 2018 she visited collaborators in South Africa, the United Kingdom, France, Spain and Poland. At the Aragon Institute for Materials Science at the University of Zaragoza in Spain she carried out measurements on the magnetic susceptibility on a series of inclusion compounds synthesised at SU. At the University of Warsaw in Poland she carried out high-resolution X-ray diffraction measurements, and spent time with collaborators learning how to effectively analyse this data. This work will lead to insights into the nature of pi radical dimerisation in the solid state.

Prof Bert Klumperman collaborated with Prof Timothy Dafforn from the University of Birmingham, United Kingdom, on the isolation of membrane proteins. Prof Dafforn is the co-inventor of a technology that is used to isolate membrane proteins in which a polymer is used that is in the center of Klumperman's research. In the collaborative research, they are further optimising and developing the polymers that enable the formation of lipid nanodiscs from phospholipid vesicles and cell membranes. Prof Klumperman's research group was successful in their application for a BRICS Multilateral Joint Science and Technology Collaboration project with participants from China and Brazil. The theme of the project is the development of drug delivery systems to fight parasitic diseases. Collaborators in the project include Prof Fenghua

Meng from Soochow University in China, and Prof Vanessa Mosqueira and Dr Gwen Pound-Lana from the Federal University of Ouro Preto in Brazil. The project will run from 2019-2021.

Ms Ilse Barnard, a PhD student in the Platinum Metals Chemistry Research Group of **Prof Klaus Koch**, was awarded an Erasmus+ Mundus travel Fellowship for a three month stay in Berlin, Germany, to carry out collaborative research toward her PhD with Prof Abram Ulrich from the Inorganic Department of the Freie Universität Berlin and Dr Pham. The work she carried out there will be part of a joint international paper in preparation. During November 2018, postdoctoral fellow Dr Henry Nkabyo, in Prof Klaus Koch's group, received an NRF mobility grant to carry out some Laser-NMR spectroscopy of photo-induced isomerization of palladium complexes, to study the possible mechanism of this process in collaboration with Prof Simon Duckett at York University during November 2018.

Prof. André de Villiers spent his research sabbatical from April to August 2018 at the University of Waterloo, Canada, and the University of Gent, Belgium. During this period his research focused on temperature modulation in comprehensive two-dimensional liquid chromatography (LC×LC). The use of temperature responsive polymers as LC stationary phases, where the properties of the stationary phase are altered with temperature, was also explored in this work to provide a novel means of improving LC×LC modulation. He also visited BOKU Vienna, where he performed research on ion mobility spectrometry in combination with LC-mass spectrometry for the analysis of complex natural products.

Conferences and workshops

Prof André de Villiers presented an invited lecture entitled 'Comprehensive 3-Dimensional LC×LC×ion mobility separations' at the 42nd International Symposium on Capillary Chromatography and 15th GC×GC Symposium held from May 13-18 2018 in Riva del Garda, Italy.

Dr Katherine de Villiers gave an oral presentation at the National Convention of the South African Chemical Institute, Pretoria, 2-7 December 2018.

Prof Catharine Esterhuysen presented invited lectures at the 24th International Union of Crystallography Congress in Hyderabad, India in

August 2017, at the 2nd Meeting on Porous Molecular Solids, Vietri sul Mare, Italy in June, 2018 and Indaba 9 at Skukuza in the Kruger National Park, in September, 2018. She also gave oral presentations at the 3rd International Symposium on Halogen Bonding (ISXB3), Greenville, SC, USA in June, 2018 and the SACI Inorganic 2017 conference held in Hermanus, in June 2017. She was invited to present a week-long course on "The role of noncovalent interactions in solid-state properties of materials" at the Jyväskylä Summer School in Finland in August, 2018.

Ms Adine Gericke was an invited speaker at the Textile Association India: Global Submit 17, November 2018, hosted by the India Institute for Technology in New Delhi; and at ATMP 2018, "Advances in Textile Materials and Processes", 19-20 November 2018, in India. She also presented a poster at AUTEX 2018 -18th World Textile Conference, 20-22 June 2018, Istanbul, Turkey.

Prof Delia Haynes gave a keynote lecture at the second meeting on Porous Molecular Solids in Italy in June, and co-chaired a microsposium at the 31st European Crystallography Meeting in Spain in August 2018. She was an invited speaker at 'Crystallography and development: What impact for Africa?' This event, held in Abidjan, Côte d'Ivoire in March 2018, celebrated the inauguration of the new diffraction laboratory at Félix Houphouët-Boigny University. As previous winner of the Jan Boeyens prize, Prof Haynes presented an invited talk at Indaba 9 in the Kruger National Park in September 2018.

Prof Bert Klumperman gave several invited lectures during 2018, including at the Electrospin2018 International Conference, Stellenbosch, the SMALP Meeting 2018: Overcoming Bottlenecks in Membrane Biology, Banff, Alberta, Canada, the 9th International Nanomedicine Conference, Sydney, Australia and the IUPAC World Polymer Congress Macro2018, Cairns, Australia. He also presented an invited talk at the Nanotechnology Workshop of the DST/Mintek Nanotechnology Innovation Centre (NIC), Pretoria, South Africa in 2018.

Prof Klaus Koch was joint organiser of a Microsymposium at the 43rd International Conference on Coordination Chemistry in Sendai, Japan, 29 July to 3 August 2018, entitled "The coordination chemistry of extractive metallurgy". He was also a keynote speaker at the same conference.

Prof Peter Mallon presented a keynote lecture at the 43rd National Convention of the South African

Chemical Institute, Pretoria, 2-7 December 2018. He attended and presented a paper at the World Polymer Congress (MACRO 2018) in Cairns Australia in July 2018. Under his leadership the Department hosted a workshop in July 2018 as part of the Mat4treat European Union Marie Skłodowska-Curie Action – Research and Innovation Staff Exchange (RISE) project in which several international and local researchers contributed and took part.

Prof Harald Pasch presented several plenary and invited lectures at international conferences. This includes the presentation of plenary lectures at the annual conference on Separation and Characterisation of Natural and Synthetic Macromolecules (SCM-8) held in Amsterdam in The Netherlands and at the International Symposium on GPC/SEC and Related Techniques held in New Orleans in the USA. This was in addition to the invited lecture he presented at Danube Vltava Sava Polymer Meeting, in Vienna, Austria. Prof Pasch presented the SACI Gold Medal Plenary Lecture at the 43rd National Convention of the South African Chemical Institute, Pretoria in December 2018.

Dr Margaret Blackie has made a significant contribution to the scholarship of teaching and learning in addition to her research in organic and medicinal chemistry. Her contributions have focused on the very topical issue of decolonisation of the science curriculum. She had the opportunity to present her research at several national and international conferences, including at the Education Close Up Conference in Cape Town in November 2018 and at the Legitimation Code Theory Conference in Sydney Australia, July 2017. Dr Blackie has also been invited to present her research in this regard at several South African universities after she presented her work at the Deans of Science Forum towards the end of 2018.

Dr Catherine Kaschula attended the American Association of Cancer Research Conference in Washington, USA in 2017 as an African Travel awardee. She interacted with the other African awardees at the conference and presented a poster there. In 2018, she made two trips to India and delivered three invited lectures as part of her NRF-Indo bilateral partnership. She visited Banaras Hindu University in Varanasi as well as The Cancer Research Institute at Swami Rana Himalayan Institute, and Jawaharlal Nehru University in New Delhi. Her PhD student Daniel Kusza accompanied her and presented a poster on one of the trips.

Prof Gareth Arnott presented two papers at the 43rd National Convention of the South African Chemical Institute, Pretoria in December 2018. One paper focused on his research on the synthesis of inherently chiral calixarenes and the other on his development of core assessment to the teaching and evaluation of undergraduate organic chemistry. Both of these papers were very well received.

Dr Prinessa Chellan presented paper at the 18th European Biological Inorganic Chemistry Conference at the University of Birmingham in the United Kingdom in August 2018.

Prof Willem van Otterlo presented invited lectures at the International Symposium on Cancer Prevention and Treatment held at Jawaharlal Nehru University in New Delhi, India and at the Trends in Biochemical and Biomedical Research: Advances and Challenges (TBRR-18) held at the Banaras Hindu University in India (both in February 2018). He presented two invited lectures in South Africa in 2018: one at the INDABA 9: Modelling and Structure conference in the Kruger National Park and the other at the South African National Biodiversity Institute - Grass Working Group Meeting, Kirstenbosch Research Centre, Cape Town. He also presented the prestigious 19th Warren Lecture of the Royal Society of Chemistry, South Africa Southern Section. This was held at UCT in April 2018.

Prof Selwyn Mapolie presented a paper at the International Conference on Organometallic Chemistry held in Florence, Italy in addition to acting as the chair of one of the scientific sessions. In late 2017, he presented a paper at the International Symposium on Synthesis and Catalysis held in Evora, Portugal.

Prof Len Barbour was invited to present a lecture at Moscow State University during 2017. He also presented invited, keynote and plenary lectures at several international conferences. These included two invited lectures each at the 67th Annual Meeting of the American Crystallographic Association, New Orleans, USA and the 4th European Crystallographic School; Warsaw, Poland. He also presented invited lectures at the 16th International Symposium on Inclusion Compounds, Kazan, Russia, the 5th European High Pressure Research Group Meeting in Poznań, Poland and the Crystal Engineering Gordon Research Conference in Newry Maine, USA. Keynote lectures were presented at the 6th International Conference on Metal-Organic Frameworks at University of Auckland, New Zealand and the 2nd Meeting on Porous

Molecular Solids in Vietri sul Mare, Italy. A plenary lecture was presented at the 6th Latin American Symposium on Coordination and Organometallic Chemistry, Puerto Iguazú, Misiones, Argentina;

Prof Jan Dillen presented a keynote lecture entitled "A comparison of energetic criteria to probe the stabilising interaction resulting from a bond path in the electron density between congested atoms" at the 23rd International Workshop on Quantum Systems in Chemistry, Physics, and Biology (QSCP-XXIII) held at the Mopani Camp in the Kruger National Park, South Africa in September 2018. This is in addition to the presentation he gave at the SACI National Inorganic Chemistry Conference and Carman Physical Chemistry Symposium held in June 2017 and at Indaba 9: Modeling of Structures and Properties, held in the Kruger National Park in September 2018.

Service to the scientific community

Prof Peter Mallon serves as the Vice President of the South African Chemical Institute (SACI) for the 2017-2019 term. He was elected as the National Representative to serve on the Division IV (Polymer Division) of IUPAC for a two-year term. He attended and contributed to the Division's Subcommittee of Polymer Terminology as an observer member at the meeting in Cairns, Australia in July 2018.

During 2018, **Prof Delia Haynes** was elected to serve on the Executive Committee of the European Crystallographic Association. She is also a member of the Executive Steering Committee of the African Crystallographic Association.

Prof Harald Pasch serves as an editorial board member of the *International Journal on Polymer Analysis and Characterization* (IJPAC) and *Polymer International* (PI). He was the Editor of the *Polymer Laboratories Textbook* series published by Springer. He is a Governing Board member of the International Symposium on Polymer Analysis and Characterization (ISPAC) and served as a member of the organising committee of ISPAC 2018 held in Linz, Austria in June 2017.

Dr Margaret Blackie continues to serve as the Treasurer of Western Cape branch of the South African Chemical Institute and as a full member of the Organisation for Women in Science in the Developing World since 2016.

Prof Gareth Arnott has been appointed to the NRF Chemistry Rating Panel.

Prof Catharine Esterhuysen served on the programme committees of the Faraday Discussion on “Halogen Bonding in Supramolecular and Solid State Chemistry” in Ottawa, Canada 10-12 July, 2017, where she also chaired a session, and of the International Symposium on Halogen Bonding (ISXB-3), Greenville, SC, USA, 10-14 June, 2018. She also represented South Africa at the Congress of the International Union of Crystallography in Hyderabad, India in August 2017.

Prof Willem van Otterlo served as the convener of the NRF Chemistry Rating Panel in 2017. He is also an Associate Editor (Organic Chemistry) for the *South African Journal of Chemistry*.

Prof Bert Klumperman is a member of the Council of the Royal Society of South Africa and he serves as the Editor-in-Chief of the Society's journal, *Transactions of the Royal Society of South Africa*. He is an Editor of the *European Polymer Journal* (Elsevier) and serves as a member of the Editorial Advisory Board of the *Journal of Macromolecular Science, Part A: Pure and Applied Chemistry*.

Prof Selwyn Mapolie serves on the executive committee of the Catalysis Society of South Africa (CATSA). In 2018 he was elected to serve on a CATSA three-person panel to develop a roadmap for catalysis in South Africa. The mandate of the panel was to assess the current state of catalysis in South Africa and to propose the way forward in terms how the discipline could contribute to the economic development of South Africa.

Prof Len Barbour serves on the Editorial Advisory Boards of *Crystal Engineering Communications* (published by the Royal Society of Chemistry), *Crystal Growth and Design* (published by the American Chemical Society) and *ACS Sustainable Chemistry & Engineering* (also published by the American Chemical Society). He is an associate editor of the *New Journal of Chemistry* and of the 9-volume major reference work *Comprehensive Supramolecular Chemistry* (2nd edition). In 2017, he chaired the organising committee of the 23rd International Conference on the Chemistry of the Organic Solid State, which was hosted in Stellenbosch. He also served on the scientific committee of the 2nd Meeting on Porous Materials, which was hosted in Italy in 2018.

NRF-RATED RESEARCHERS

Dr Katherine de Villiers received a new NRF rating (C2) since January 2018. In the field of Polymer Science, Prof Bert Klumperman renewed his A2 rating, while Dr Rueben Pfukwa and Dr Nonjabulo Gule both received their first rating (Y2).

LEADING INTERNATIONAL RESEARCHERS

Prof Len Barbour	nanostructured functional materials
Prof Bert Klumperman	living radical polymerization and advanced macromolecular architectures

INTERNATIONALLY ACCLAIMED RESEARCHERS

Prof Ben Burger	chemical communication in living organisms
Prof Harald Pasch	analytical polymer science, multidimensional chromatography
Prof Helgard Raubenheimer	ligand design aimed at applications in homogeneous catalysis, gold chemistry
Prof Willem van Otterlo	organic synthesis and medicinal chemistry
Prof André de Villiers	separation science fundamentals and applications
Prof Klaus Koch	platinum group metals

ESTABLISHED RESEARCHERS

Prof Catharine Esterhuysen	intermolecular interactions
Prof Ivan Green	small molecules syntheses for medicinal application
Prof Peter Mallon	complex polymer materials and polymer nano-composites
Prof Selwyn Mapolie	homogeneous catalysis via dendrimeric complexes
Prof Albert van Reenen	polyolefins
Prof JLM Dillen	computational studies
Dr Robbie Luckay	ligand design for metal ion coordination in industrial and medical applications
Prof Delia Haynes	crystal engineering of non-metal containing materials
Dr Gareth Arnott	inherently chiral calixarenes; asymmetric methodology
Dr Katherine De Villiers	antimalarial agents

COLLABORATION

South Africa

CSIR
Kansai Plascon
North West University, Potchefstroom Campus
Rhodes University
SASOL
Stellenbosch University
University of Cape Town
University of Pretoria
University of the Witwatersrand

Africa

Botswana: Botswana Institute for technology Research and Innovation
Cameroon: University of Yaoundé
Namibia: University of Namibia

Australia

University of Queensland

Austria

Borealis
BOKU Vienna

Belgium

Free University of Brussels
University of Gent

Canada

University of Alberta
University of Windsor
University of Waterloo

China

Nankai University

Denmark

Aalborg Universiteit

France

L'Oreal
University of Lorraine
University of Strasbourg

Germany

Dresden Institute of Polymer Research
Friedrich-Alexander Universität Erlangen-Nürnberg
Technical University Darmstadt
Technical University Dortmund
University of Cologne
University of Leipzig
University of Mainz

Italy

Politecnico di Torino
Università di Torino
University of Naples
University of Salerno

India

Goa University
Jawaharlal Nehru University

Netherlands

Vrije Universiteit Amsterdam

Poland

Adam Mickiewicz University, Poznań
University of Warsaw

Republic of Ireland

University of Limerick

Saudi Arabia

King Abdullah University of Science and Technology

Spain

University of the Basque Country
University of Zaragoza

Sweden

Lund University

Thailand

Siam Cement Group (SCG) Chemicals

UK

Imperial College
Lancaster University
University of Birmingham
University of Warwick

USA

Emory University
Texas State University
University of South Florida
Virginia Tech

FUNDING

Borealis
Juniper LLC Research and Development
Kansai Plascon
L'Oreal
MAT4TREAT – EU Horizon 2020 – RISE Project
National Institutes of Health, USA
National Research Foundation (NRF) Incentive Funding
NRF Competitive Support for Unrated Researchers programme
Revolution Contraceptives LLC
SASOL
Siam Cement Group (SCG) Chemicals
Stellenbosch Nanofibre Company (SNC)
Stellenbosch University
Technology and Human Resource for Industry Programme (THRIP)
Vortex Innovation

AWARDS TO STAFF AND STUDENTS

During 2017, **Prof Harold Pasch** received an award from the Vice-Rector: Research, Innovation and Postgraduate Studies, for making the biggest contribution in terms of the publication subsidy unites of the Department of Higher Education and Training. He was also awarded the Gold Medal of the South African Chemical Institute (SACI). This is the highest award that the Insitute can give to one of its members and is given in recognition of an outstanding contribution in research.



Prof Harold Pasch received the Gold Medal of the South African Chemical Institute (SACI) in 2017.

Prof Len Barbour received the Stellenbosch University Chancellor's Award for Research Excellence (2017). The commendatio specifically mentioned his research group's contribution to SU's standing on the "Nature Index".

Prof Catharine Esterhuysen received the Stellenbosch University Chancellor's Award for Excellence in Teaching (2017).

Prof André de Villiers was invited to present the prestigious P.D. Hahn memorial lecture at the Department of Chemistry at the University of Cape Town (UCT). His talk presented on November 20 2018 was entitled 'New dimensions in chromatographic separations'.

During 2018, **Dr Rehana Malgas-Enus** was awarded the National Research Foundation's Award of Excellence in Science Engagement for her outstanding contributions to public engagement with and understanding of various areas of science over a sustained period.

Prof Bert Klumperman was the recipient of the John FW Herschel-Medal of the Royal Society of South Africa. He was also elected as a Fellow of the African Academy of Science.

Our postgraduate students also performed well on the national and international level: Dr GH Greyling received the Postdoctoral Fellow Award for Exceptional Achievement from Stellenbosch University. Ms Sunel de Kock received the SU Rector's Award for Excellent Achievement and the SU Medal for the top MSc student. Ms Nonkululeke Radebe won the Borealis Poster Award at the International Conference on Polymer Analysis and Characterization (ISPAC) held in Austria in June 2017. Mr Lucky Muza won the award for the best poster at the eighth International Symposium on the Separation and Characterization of Natural and Synthetic Macromolecules, The Netherlands, February 2017.

In 2018, Ms Alet van der Westhuyzen received SACI's 2018 Postgraduate Award for innovation, independence and enterprise. Ms Ilse Barnard won the best poster prize at the tenth International Symposium on Nano- and Supramolecular Chemistry, Germany. Mr Sithandile Ngxangxa won the award for the best oral presentation by a postgraduate student at Analytika 2018.

ACADEMIC AFFAIRS

Dr Katherine de Villiers was awarded a FINLO grant for the prwoject "Live Experiments in First Year Chemistry Lectures" in collaboration with Profs G Arnott, W van Otterlo, and Drs T le Roex and M Lutz, starting in 2019.

SOCIAL IMPACT

Department of Chemistry and Polymer Science Outreach

During 2017 and 2018, the Department's flagship outreach programme hosted seven "Practicals with Purpose" events, enabling 700 Grade 11 and Grade 12 learners from disadvantaged schools to carry out their prescribed chemistry practical experiments in our fully equipped labs. The practicals are assessed and form part of the learners' Physical Sciences year mark. We also collaborate with the Faculty of Education, where their PGCE pre-service students volunteer as demonstrators along with postgraduate

chemistry students. This collaboration allows pre-service teachers to have practical experiment training aligned with CAPS.



Postgraduate chemistry students from the Faculty of Science and PGCE students from the Faculty of Education, along with staff from both faculties who volunteered for the “Practicals with Purpose” workshops.

The workshops are sponsored by the SBA (Stigting vir die Bemagtiging deur Afrikaans), and we wish to acknowledge them for their continuous support of the SUNCOI project since January 2017. The SBA has pledged their continued support for the 2019 financial year.

The Department also hosted four Teacher's Workshops, three at Stellenbosch University and one in Matsikamma, during which teachers from 20 schools were trained. These workshops were hosted for Grade 8 to 9 Natural Science teachers (Grade 8-9), as well as Physical Science teachers from Grade 10 to 12. During this period, we trained 220 teachers from 120 schools and four different education districts, enabling them to perform practical experiments in their under-resourced classrooms.

On 2 February 2018 the SUNCOI Satellite Project was launched in collaboration with the University of Pretoria (UP) and Nelson Mandela University (NMU). A licensing agreement was signed between the universities and UP-SUNCOI as well as NMU-SUNCOI was born.

Dr Rehana Malgas-Enus and the SUNCOI team were also acknowledged for their contribution to the Metropole South Education District. The award was presented at the annual teacher's workshop hosted by SUNCOI on November 17, 2018.

Chemistry Festival with 85 learners

The Department of Chemistry and Polymer Science, in collaboration with the University of the Witwatersrand, have received a grant from the American Chemical Society to host a Chemistry Festival, aimed at Grade 8 and 9 learners. On 3 November 2018, 85 learners from Kylemore Secondary High School attended the ACS Ukudlala Chemistry Festival at SU. “Ukudlala” means “to play” in Zulu.



All volunteers were acknowledged with a certificate signed by Prof Charles De Koning, chapter head of the American Chemistry Society in South Africa, and Prof Peter Mallon, Head: Department of Chemistry and Polymer Science.

Reaching out on the airwaves

Dr Rehana Malgas-Enus recorded a series of inserts for the Afrikaans radio station RSG, which was broadcast over the December 2017 to January 2019 period. This involved explaining everyday chemistry to the broader community and covered topics such as converting used cooking oil to soap and candles, how to chop onions without the tears, the chemistry behind baking soda and its many uses, making a lava lamp, how to make layered drinks and cocktails, how to make ice-cream in a bag and cool your drinks in two minutes by using salt, water and ice.

ALCHEMUS outreach activities

Over the past two years the AlchemUS Chemistry Society has seen growing interest in our events, a bigger committee as well as growing support for our vision of open and critical scientific debate not only amongst those skilled in the field but also within the general public.

The 23 new BScHons students were welcomed in January 2017 with a potjiekos competition. During the event we also bid farewell to potjiekos master of renown and an esteemed technical officer within our department, Mr William Adonis.

In March 2017 AlchemUS promoted chemistry-themed talks at the US Woordfees. Prof Delia Haynes and Prof André de Villiers participated in Science Café Stellenbosch during Woordfees 2019. During April we hosted Prof Marc Zimmer from Connecticut College who presented his work on the proteins which cause bioluminescence in jellyfish and fireflies, a topic related to the 2008 Nobel Prize in Chemistry.

We introduced the first AlchemUS sports day in May 2017 in the form of a cricket tournament. The purpose of the AlchemUS sports day was to promote cancer awareness and the importance of physical activity amongst postgraduate students and staff in the Department. Chemists are exposed to carcinogenic substances in the laboratory on a daily basis, a risk which we are all constantly aware of. Through the sports day we wish to encourage students to take their health and safety seriously.

The final event in September 2017 was also the highlight of our AlchemUS year; the Chemistry Magic Show. The theme was The Chemical X Factor, and learners from Sun Valley Primary School and Idas Valley Primary School were invited to attend.

The centenary year of Stellenbosch University brought with it an energy and drive to showcase everything that the University had to offer. This energy was strongly felt within the AlchemUS Chemistry Society. In February 2018 we welcomed 15 new Honours students with our annual potjiekos competition.

During April 2018 AlchemUS assisted students of UCT in hosting a Young Chemists' Symposium sponsored by the South African Chemical Institute and the Royal Society of Chemistry. Chemistry students from Stellenbosch University, UCT, UWC and CPUT participated in both oral and poster presentations. During a panel discussion, established academics and experienced individuals from industry discussed topics such as job opportunities for graduates and promoting the sciences to disadvantaged youth.

The 2018 Chemistry Magic show took place in September. With the centenary in mind we aimed to make the 2018 show bigger and better than anything we had previously done. With the theme "Harry Potter and the AlchemUS Stone", we attracted the attention of viewers of all ages. Learners from Sun Valley Primary School and Idas Valley Primary School attended and the excitement of the scholars was heartwarming to witness.

During November 2018 our society was fortunate to be given an opportunity by the American Chemical Society (ACS) to host an ACS chemistry festival.



The AlchemUS magic show for 2017 was entitled "The Chemical X Factor".

AlchemUS assisted Dr Rehana Malgas-Enus in organizing a fun festival to promote chemical education among scholars from schools in disadvantaged communities. To give the ACS chemistry festival an African flair we dubbed it the Ukudlala Chemistry Festival which means 'play', as our aim was for the learners to play with chemistry and experience how enjoyable our field is. We entertained more than 70 scholars from Kylemore Secondary School who thoroughly enjoyed our Ukudlala Chemistry Festival.

Our final event of 2018 was the AlchemUS sports day, this year in the form of a soccer tournament. A large number of teams consisting of postgraduate students and staff participated. We also initiated the hashtag #chemistsagainstcancer in honour of one of our postgraduate students, Gerbrandt Kotze, whom we lost to cancer in 2018. AlchemUS sold cupcakes at the soccer tournament and raised a total of R812 which will be donated to CANSA in his memory.

Now and into the future, the aim of our society has always been to promote chemistry in society by creating an environment for scientific debate and critical thinking where students and members of the public can learn more about chemistry and the role it plays in our world. These past two years we have upheld this mission in earnest and will continue to do so in the future.

STAFF MATTERS

Several new appointments were made in 2017 and 2018. They are Dr Catherine Kaschula (Senior Lecturer, January 2017); Mrs Brenda Chordnum (Administrative Officer, April 2017); Mr Maxwell Wakens (Technical Assistant July 2017); Ms Yolanda Mqgala (Technical Assistant July 2017); Mrs Mariana Snyman (Administrative Officer December 2017); Ms Noluntu Ntwana (Assistant, April 2018); Mr Mbuso Dlodlu (Departmental Manager in September 2018). Two extraordinary professors were appointed: Prof Albena Lederer (October 2017-September 2020) and Prof Wolfgang Mackenroth (January 2018-December 2020). The following staff members took up new positions within the department: Mr Gabriel Marupula (Assistant Technical Officer from April 2017); Mr Raymond Willemse (Junior Technical Officer from April 2017). The following staff members were promoted: Prof André de Villiers (Professor from January 2018); Prof Catharine Esterhuysen (Professor from January 2018); Dr Rueben Pfukwa (Senior Researcher from January 2018). Prof Catharine Esterhuysen is the first female Full Professor of Chemistry in the more than 100-year history of the Department. The following staff members have retired: Mrs Mary Johnson (July 1984-December 2017); Mr Glenn de Jongh (June 1985-January 2018); Prof Klaus Koch (May 2000-December 2018); and Mr Moebarrick Bickerstaff (February 1981-December 2018).

STAFF LIST

ACADEMIC STAFF

RESEARCH CHAIRS

Prof JL Barbour
Prof B Klumperman
Prof H Pasch

PROFESSORS/ ASSOCIATE PROFESSORS

Prof AJ de Villiers
Prof JLM Dillen
Prof C Esterhuysen
Prof DA Haynes
Prof KR Koch
Prof PE Mallon (*Departmental Head*)
Prof SF Mapolie
Prof WAL van Otterlo
Prof AJ van Reenen

SENIOR LECTURERS/ LECTURERS

Dr GE Arnott
Dr MAL Blackie
Dr P Chellan
Dr K de Villiers
Dr WJ Gerber
Mrs A Gericke
Dr CH Kaschula
Dr T le Roex
Dr RC Luckay
Dr M Lutz
Dr R Malgas-Enus
Dr C Pretorius
Dr PFM Verhoeven

SENIOR RESEARCHERS/ RESEARCH ASSOCIATES/ FELLOWS

Prof IR Green
Dr NP Gule
Dr R Pfukwa
Dr AGJ Tredoux

EXTRAORDINARY PROFESSORS

Prof A Lederer
Prof W Mackenroth

EMERITUS PROFESSORS

Prof BV Burger
Prof HG Raubenheimer

ADMINISTRATIVE STAFF

Mrs BR Chordnum
Mrs MMG Cooper
Mr MK Dlodlu (*Departmental Manager
from Sep 2018*)
Ms M du Plessis
Mrs AE Fourie
Mr JG Goldie
Mrs SG May
Mrs MC Snyman

TECHNICAL STAFF

Mr DJ Koen
Mr EJ Lukhele
Mr MG Marupula
Mr MA McLean
Mr S Mohamed
Mr JS Motshweni
Mr A Nxopo
Dr H Pfukwa
Mrs PJ Steyn
Mr GR Willemse

ASSISTANTS

Mr M Bickerstaff
Ms D Isaacs
Ms M Jones
Mr KB Mbalo
Ms Y Mgqala
Ms CJ van Reenen
Mr MK Wakens
Ms DC Wenn

POSTDOCTORAL FELLOWS

Dr A Blanckenberg
Dr DC Castell
Dr N Chaudhary
Dr L Engelbrecht
Dr GH Greyling
Dr WA Hadasha
Dr A Hazra
Dr A Kargaard
Dr P Lama
Dr L Loots
Dr S Mbizana
Dr HA Nkabyo
Dr DD Robertson
Dr W Saban
Dr S Sanyal
Dr NO Tshililo
Dr B Vatsha

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Staff and third year students of the 1923 class – the first final year class in the new De Beers Building. The five lecturers in the second row, seated, are Dr D.B. Joubert, Prof C.D. van der Merwe, Prof B. de St J. van der Riet, Prof D.F. du Toit and Dr J.M. Joubert.



Photo: Watson-Lockley Collection, SU Archive



Staff and postgraduate students of the Department of Chemistry and Polymer Science in 2018.

DEPARTMENT OF EARTH SCIENCES

Founded in 1895, the Department of Earth Sciences at Stellenbosch University has a long and proud history that can be traced back to the discovery of diamonds (1867) and gold (1886) in South Africa. We are one of the leading training and research centres in the country in general geology, experimental petrology and geochemistry.

RESEARCH INTERESTS

Geology

Tectonics and orogenic processes
Sedimentology and palaeontology
Igneous petrogenesis
Metamorphic petrology
Experimental petrology
Shear-zone hosted gold deposits
Massive sulphide deposits
Heavy mineral placer deposits
Metallogenesis of mobile belts
Geometallurgy

Environmental geochemistry

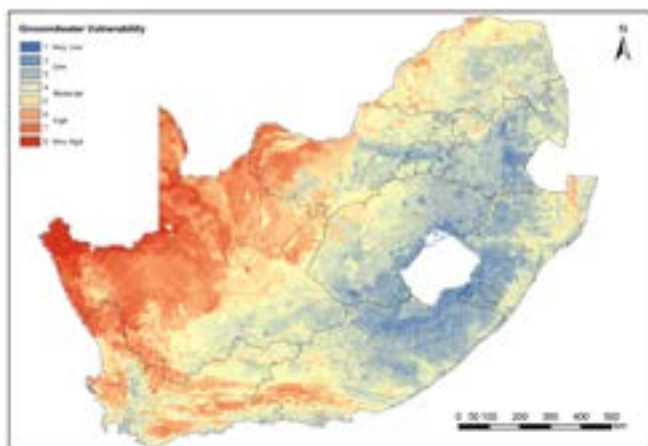
Trace-element and isotope
geochemistry
Marine geochemistry
Hydro-geochemistry
Pollution
Isotope Hydrology

GEOLOGIE

RESEARCH HIGHLIGHTS

Vulnerability of groundwater in the Western Cape

The drought situation in the Western Cape has brought many challenges to water management and this has driven research into sustainable groundwater resources. We have been working on quantifying and modelling sustainable groundwater and developing new ideas about what groundwater vulnerability is and how this differs from groundwater sustainability. This work forms the core of the work of PhD student Jared van Rooyen who has been using tritium isotopes to develop a new model for groundwater vulnerability. This model shows groundwater vulnerability across the whole of South Africa and highlights the vulnerability of groundwater across large parts of the Western Cape and Northern Cape.



Modelled groundwater vulnerability across south Africa on a scale of 1 to 8, incorporating drought potential indicators (mean annual precipitation, groundwater tritium activity, potential evapotranspiration, mean annual surface temperature) and pollution risk indicators (cultivated land use, population density, chemical composition of groundwater, aquifer type and terrain slope). The model also takes into account global circulation models to examine how groundwater vulnerability will change in the future. Graphic: Jodie Miller

It also shows the importance of the Cape Fold Belt Mountains for groundwater recharge. In conjunction with this work, MSc students Zita Harilall and Yaa Agyare-Dwomoh are using radiocarbon, radon, strontium and carbon isotopes to look at the longevity of groundwater in the Table Mountain Group Aquifer, an important aquifer in the Western Cape targeted as a potential source of water to augment the Cape Town Municipal water network. The work is being supported by the Water Research Commission and done in conjunction with the Hungarian Academy of Sciences, who are providing a large proportion of the isotope data.

- Prof Jodie Miller

Crowdfunding for groundwater sampling project

During 2017, three postgraduate students under the supervision of Dr Jodie Miller were trying to find out how sustainable South Africa's groundwater resources are. To do this required collecting rainfall and groundwater samples from across the country, and for this they needed funding and sample collection help. The students embarked on this initiative, starting in late February 2017, using the South African crowdfunding platform Thundafund. They successfully raised R150 000 which allowed the work to begin. The funding was used to purchase sampling equipment, set up rainfall collectors and to sample groundwater from existing boreholes around the country. Citizen scientists also collected groundwater to send back to Stellenbosch for analysis.

It is important to understand how regularly groundwater is recharged and whether it is a renewable resource. The teams are using Tritium (^3H) activities to determine when water that enters the groundwater system was last in contact with the atmosphere. Radioactive tritium is produced naturally in the stratosphere and is rained out on the Earth's surface. Once it enters the groundwater system and becomes isolated from the atmosphere, it decays at a constant rate. So, the longer groundwater is isolated from the atmosphere, the lower the tritium activity. Once the residence time of the groundwater is known the renewability of the resource can be modelled, and it will be possible to identify areas that have renewable groundwater resources for sustainable agricultural developments, as well as those where the water resources need to be protected.

- Prof Jodie Miller



The crowdfunding team from the Department of Earth Sciences, from left to right, MSc student Jared van Rooyen and BScHons students Yaa Agyare-Dwomoh and Zita Harilall, with their supervisor, Prof Jodie Miller. Photo: Stefan Els

The world's oldest gold

In over 130 years of mining, some 350 tons of gold have been produced from the ancient Barberton Greenstone Belt in the Lowveld region of Mpumalanga. The central Fairview, Sheba and New Consort mines are some of the earliest and still active mining operations in southern Africa. They also mine some of the geologically oldest, known gold mineralization on earth dating back to over three billion years.

The long mining and exploration history has identified a plethora of gold-bearing structures, so-called reefs, with different orientations, country rocks, mechanics, internal structures and timing, greatly complicating exploration for further resources. This is where researchers from Stellenbosch and Pan-African Resources, owners of the Barberton mines, teamed up in 2017 to better understand the controls and origin of the gold. The team of researchers consists of postgraduate students, led by Prof Alex Kisters and Dr Bjorn von der Heyden. They will tackle various issues, ranging from the structural controls of hydrothermal fluid flow, via the chemistry and origin of the mineralizing fluids to the P-T conditions and absolute timing of the mineralization. First results of the research have already been published in leading international journals and presented at conferences.

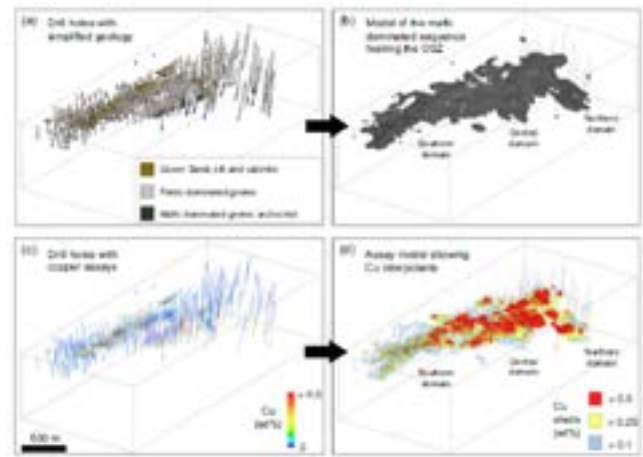
– Prof Alex Kisters

Below the surface

Large and economically viable mineral deposits will no longer be found on surface and future mineral exploration has to delineate and help visualize hidden deposits in the subsurface.

A team of researchers from Stellenbosch University re-logged and re-interpreted some 100 km of drillhole core from the largely sand-covered Omitiomire copper deposit in the Damara belt of central Namibia. Using new logging techniques, down-the-hole photography and 3D modelling software, PhD student Shawn Kitt and Prof Alex Kisters modelled the geometry of the deposit and the structural controls that led to its formation and deformation.

Proffs. Ian Buick from Stellenbosch University, Jan Kramers from the University of Johannesburg and Torsten Vennemann from the University of Lausanne



provided detailed geochronological and isotopic data that helped constrain the long evolutionary path of the deposit. The data point to the initial formation of the rocks over one billion years ago, followed by the burial of the sequence to some 30 km below surface some 500 million years later to its final exhumation and erosion.

– Prof Alex Kisters

Application of detrital mineral geochronology for improving depositional age estimates

Dr Ryan Tucker is actively engaged with a number of ongoing collaborative projects where his expertise in sedimentary environments, chemical tracers of sedimentary provenance (e.g., detrital zircon geochronology; Lu-Hf isotopes), and palaeontology, are used to address questions about the fossil record and the evolution of sedimentary basins. He is particularly interested in addressing questions concerning the development of new strategies for improving the depositional age of clastic stratigraphic successions through the application of detrital mineral geochronology; timing and pattern of basin development in Gondwana during the Cretaceous (Mesozoic); vertebrate taphonomy and vertebrate palaeontology.

– Dr Ryan Tucker

Enzymatic remediation of cadmium-contamination

Our oceans' future is threatened by global warming as well as pollution. Our oceans are, however, extremely important for various roles, including CO₂ removal (i.e. fighting global warming) and fisheries (i.e.) food security. From 2018 to 2021, we will work with scientists in Iran as part of the South Africa Science and Technology Collaboration Programme to advance our understanding

of an enzyme that plays a key role in both CO₂ and pollutant removal: the carbonic anhydrase (CA).

Carbonic anhydrase catalyses the hydration of carbon dioxide (CO₂) and dehydration of bicarbonate, playing thus a superior role in the marine carbon cycle. Its role in the carbon sequestration make it furthermore interesting for industrial purposes, for instance, to enhance oil recovery or use in production line of industrial plastics. At the same time, CAs are metalloenzymes, which active site consists of a Zn(II) ion that can coordinate to cadmium automatically without losing functionality. In this proposal, we aim specifically to study the potential of ζ-CAs regarding the cadmium-uptake capacity and their potential as enzyme candidates for bioremediation of cadmium-contaminated water resources. The project is titled “Carbonic anhydrases from marine microbes and phytoplankton for enzymatic remediation of cadmium-contaminated water resources”.

– Dr Susanne Fietz

Interdisciplinary team to address marine pollution

The world's oceans are subject to a range of related threats including climate change and pollution. While several studies have provided some insights into the impact of climate change, little is known regarding marine pollution. To reduce this knowledge deficit, we have assembled an interdisciplinary team including oceanographers, ecologists, geochemists and biotechnologists from South Africa and Mexico as part of a Joint Science and Technology Research Collaboration.

We propose a series of related experiments aimed at assessing the distribution and characteristics of hydrocarbon and metal contamination in the four ocean realms adjacent to South Africa and Mexico, as well as the ecosystem structure related to it, with a special focus on the microbial communities. We then take the research a step further, scrutinising the microbial genomes for biotechnological applications. We aim to contribute to the scientific understanding of ocean pollution and its remediation and contribute substantially towards capacity development in both partner countries through training postgraduate students. Taken together, this study will generate fundamental insights that will contribute towards the implementation of the Blue Economy in both countries. The title of the project is “Exploiting microbes for remediation of pollution in oceans”.

– Dr Susanne Fietz

Metal bioavailability in the Southern Ocean

The oceans are changing under pressure of global changes, such as increase in temperature, sea-ice melt, stratification, acidification or pollutants. While the microorganisms in the oceans will mostly adapt to it, it will most likely result in shifts in community composition and thus in biogeochemical fluxes, including the export of carbon, essential for an efficient drawdown of atmospheric CO₂.

As part of the South African National Antarctic Programme (SANAP), we will investigate the key role of metal bioavailability in the bottom-up control of microorganisms in the Southern Ocean, one of the world's most important potential sinks for anthropogenic CO₂. In turn, we will support interpretation of the striking patterns in the regional, vertical, and temporal distribution of essential micronutrients, including, but not limited to iron. The title of the project is “Shifts in phytoplankton and microbial community composition and functional diversity”.

– Dr Susanne Fietz

Stellenbosch students rack up core-logging experience

The Department of Earth Sciences invested in two new core-display racks that enable students to gain essential and fundamental core-logging skills. During the first practical session to use the facility, students thoroughly enjoyed their first exposure to core, and ably identified structures and rock types at the centimetre to decimetre scale. The Department gratefully acknowledges Kolomela Mine for the iron-ore core and Exxaro Resources for core segments from the coal-bearing Karoo stratigraphy. Should any other mines have mineralised or interesting core that could be donated toward student training needs, the Department would be a welcoming recipient.



Postgraduate students at the new core-display racks. They are Harry Lines, Kaururauwe Kanguuechi and Tanisha Schulz. Photo: Dr Bjorn von der Heyden

Dr B von der Heyden also acquired a new reflected light ore microscope to advance teaching and research in the broad field of ore microscopy; as well as a second new microscope equipped with a Linkam heating-freezing stage to conduct fluid inclusion analyses at SU.

– Dr Bjorn von der Heyden

RESEARCH ACTIVITIES

Conferences and workshops

Dr Susanne Fietz presented an oral presentation titled “Shifts in phytoplankton and microbial community composition in function of trace metal cycling in the Southern Ocean” at the NRF South African National Antarctic Programme (SANAP) Symposium, Hermanus, August 2018. She was the corresponding author on a number of student presentations presented at the International Symposium on Medical Geology in Africa (ISMGAf), Johannesburg, South Africa, November 2018; and at POLAR 2018, Switzerland, July 2018.

Dr Bjorn von der Heyden presented a poster titled “Trace element chemistry of base metal sulphide ore from the Aggenys-Gamsberg ore district”, Society for Geology Applied to Ore Deposits, Quebec, Canada, 2017. He gave an Oral presentation on the importance of synchrotron radiation towards advancing ore geology research, 2018 Geocongress; and another oral presentation on the effects that trace metals have on the beneficiation and flotation response of synthetic sphalerite, 2018 conference of the South African Institute for Mining and Metallurgy Geometallurgy. Two of his students presented posters on fluids responsible for gold mineralisation in Barberton, and trace element influences on sphalerite mineral behaviour, at the 2018 conference of the Society of Economic Geologists, Keystone, Colorado. He also gave two oral presentations on the importance of industry-university knowledge transfer, and relevance of peer and near-peer learning opportunities, at the 2018 conference of the Higher Education Learning and Teaching Association of South Africa.

Dr Ryan Tucker was co-author on a paper titled “Establishing Public Education-Research Collaborations using citizen science in the Western Cape of South Africa: Identifying the challenges”, presented at the Citizen Science Association Conference, Raleigh, North Carolina, USA, 2018. He was co-author on a paper titled “Recent advances in temporal calibration

for newly discovered dinosaurian assemblages in the Mussentuchit Member of the Cedar Mountain Formation, Central Utah, USA”, delivered at the 78th Annual Meeting of the Society of Vertebrate Paleontology (SVP) in Albuquerque, New Mexico, USA, 2018. He was also co-author on papers delivered at the 78th Annual Meeting of the Society of Vertebrate Paleontology (SVP) in Albuquerque, New Mexico, USA, 2018; and at the fifth International Palaeontological Congress, Sorbonne University; National Museum of Natural History, Paris, France, in July 2018.

Prof Gary Stevens hosted Prof Chris Lana from the Universidade Federal de Ouro Preto, Brazil.

His SARChI research chair in Experimental Petrology, was renewed for a third five-year cycle.

Service to the scientific community

Prof Jodie Miller is a member of the organising committee of the Southern African Institute of Mining and Metallurgy (SAIMM) Geometallurgy Conference, held in Cape Town from 6 to 8 August 2018; a member of the Council of the International Association of Geochemistry. Her PhD student, Jared van Rooyen, was elected chair of the Early Career Hydrologists Network, a division of the International Association of Hydrogeologists.

Dr Susanne Fietz is a member of the GEOTRACES Steering Committee and editor of *International Review of Hydrobiology*.

Dr Bjorn von der Heyden is organiser of the session “Recent Advances in Ore Geology” at the 2018 Geocongress, 18-29 July 2018, University Johannesburg.

Prof Alex Kisters is chairman of the South African Committee for Stratigraphy (SACS) for Neoproterozoic sequences; and a member of the SACS Committee for Archean granitoids and gneisses.

Awards to staff and students

For two years in a row, postgraduate students from the Department of Earth Sciences were recipients of awards from the Geological Society of South Africa (GSSA). The 2016 Corstorphine Medal was awarded to Ms Kelly Swana for her MSc thesis entitled “Application of hydrochemistry and residence time

constraints to distinguish groundwater systems in the Karoo Basin prior to shale-gas exploration". The medal is awarded for a thesis that, in the opinion of the adjudicators, is of outstanding merit, reflecting international 'best standards'. Kelly was supervised by Prof Jodie Miller. MSc student Tarryn Cawood (née Rudnick) received the 2017 Corstorphine Medal for the best MSc thesis in South Africa. Her work, under supervision of Profs Albert Rozendaal and Ian Buick, contributed valuable insights into the geology and genesis of the Swartberg base-metal deposit in the Northern Cape. BScHons student Stephan Dunn received the Houghton Award from the GSSA for the best Honours thesis submitted in 2017. His research focused on secondary gold growth in a Tanzanian placer deposit. His study leader was Dr Bjorn von der Heyden.

Dr Ryan Tucker has been awarded the Outstanding Recent Graduate Award from his alma mater, the South Dakota School of Mines (SDSM), USA, in 2017. Ryan gained his Master's degree in vertebrate palaeontology from SDSM in 2010 and his PhD in geology from James Cook University, Australia, in 2014. He has a wide variety of on-going research projects both in South Africa and other countries.

PhD student Matthew Mayne, supervised by Prof Gary Stevens, competed in the 2017 Young Persons' Lecture Competition, organised by the South African Institute of Materials, Minerals and Mining (IOM3). The aim of this competition is to provide an atmosphere of friendly competition for young scientists and engineers, so that they can hone their presentation skills while addressing a generalist but informed audience. Regional heats were held at Nelson Mandela Metropolitan University. Having won the regional heat, Matt went on to compete in the national event. Matt won for his lecture entitled "How do rocks melt? A question requiring both chemistry and thermodynamics", which described a cataclysmic world governed by simple laws. He also introduced a new software tool (<https://tinyurl.com/Rcrust>) that will assist geologists in investigating a variety of earth processes. In October 2017 Matt represented South Africa in the international competition which took place in Perth, Australia.



The three finalists in the South African competition: Matt Mayne from Stellenbosch University, Oscar Tarique from the University of Pretoria, and Bridget Nomshado Zuma from the University of the Witwatersrand.

The Department of Earth Sciences had a strong showing at the 2017 SU Scholarship of Teaching and Learning (SOTL) conference. This even aims to foster a culture of innovation and reflection in teaching and learning at the Stellenbosch. Dr Bjorn von der Heyden submitted two abstracts and one of his presentations was awarded the overall runner-up prize (covering all expenses to present at a 2018 South African Teaching and Learning conference). In 2018 he received the SU Developing Teacher award for presenting a strong teaching portfolio documenting approaches towards teaching and learning as well as notable teaching interventions.

BScHons student Lindo Makhathini was selected as one of Media24's top 100 Mandelas of the Future, for her role in and aspirations toward encouraging women's empowerment in the economic geology and mining sectors. Lindo also serves as chair of the student chapter of the Western Cape Society of Economic Geologists (SEG-SGA).



BScHons student Lindo Makhathini.

PhD student Ismael Kanguuehi, supervised by Dr S Fietz, won the prize for best oral presentation at the Medical Geology Symposium in Johannesburg on 7 November 2018. The title of the talk was "An air quality assessment of the Saldanha Bay Municipality".

NATIONAL AND INTERNATIONAL COLLABORATORS

Australia

University of Queensland
University of Western Australia

Germany

University of Aachen (RWTH)
University of Hamburg

Hungary

Hungarian Academy of Sciences

Iran

National Institute of Genetic Engineering and Biotechnology

Mexico

National Autonomous University of Mexico (UNAM)

Mozambique

Conseng

Norway

Norwegian University of Science and Technology

South Africa

Cape Peninsula University of Technology
Council for Geosciences
Council for Scientific and Industrial Research
GEOSS Groundwater and GIS Consultants
Iphakade Program, coordinated by Nelson Mandela
Metropolitan University
Saldana Bay Municipality
University of Cape Town
University of Pretoria
University of the Western Cape
University of Witwatersrand

Sweden

Linköping University

Switzerland

University of Lausanne

Taiwan

National Taiwan University

Tanzania

University of Dar es Salaam

United States of America

Argonne National Laboratory
James Cook University
Lawrence Berkeley National Laboratory
Macalester College
Natural History Museum of Los Angeles County
North Carolina Museum of Natural Science
North Carolina State University
Princeton University

Zimbabwe

Midlands State University

FUNDING

Anglo American Ltd.
Black Mountain Mining
Centre for Collaboration in Africa
Centre of Excellence for Integrated Minerals and Energy Resource Analysis (CIMERA)
Faculty of Science, SU, Social Impact Funding
International Atomic Energy Agency
KSB Pumps and Valves Pty Limited
National Research Foundation (NRF)
NRF Competitive Programme for Rated Researchers (CPRR)
NRF International Research Grant: South Africa/Mexico
Joint Science and Technology Research Collaboration
Pan-African Resources
Resources for Future Generations
Royal Academy of Engineering Higher Education in sub-Saharan Africa
Scientific Committee on Antarctic Research (SCAR), USA
South Africa National Antarctic Programme (SANAP)
Stellenbosch University Sub-committee B
Stellenbosch University Africa mobility grant
Stellenbosch University FINLO
Vedanta
Water Research Commission

NRF-RATED RESEARCHERS

INTERNATIONALLY-ACCLAIMED RESEARCHERS

Prof John Clemens	granite petrology
Prof Ian Buick	metamorphic petrology
Prof Alexander Kisters	structural geology
Prof Gary Stevens	experimental petrology (SARCHI Chair)
Prof Alakendra Roychoudhury	environmental geochemistry

ESTABLISHED RESEARCHER

Dr Susanne Fietz	biogeochemistry
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ACADEMIC AFFAIRS

Prof Jodie Miller developed a new third year module on hydrogeology. The introduction of the module was timely with the current drought situation in the Western Cape and proved popular with the students. The module was taught jointly by existing staff as well as groundwater consultants and academic staff from other institutions to provide a broad based module. The module is part of a package of environmentally-focused modules that have been created to address the environmental interests of students studying the broad Earth Sciences. The Department intends to develop this into an important component of undergraduate teaching and this feeds into the Environmental Biogeochemistry and Isotope Hydrology research interests of some of the academic staff.

Dr Bjorn von der Heyden developed a new second year field trip to view/investigate manganese mineralisation in Hout Bay and Tin mineralisation in Kuilsriver. He was also involved in the new first year module, Science in Context, exposing the students to Economic Geology. During 2017 he received FINLO funding to run a video learning intervention, and in 2018 to develop geological drilling simulation software.

SOCIAL OUTREACH

Citizen science workshop for researchers and educators

A group of researchers and educators interested in developing Citizen Science outreach projects participated in a three-day workshop at Stellenbosch University from 9 to 11 July 2018. With this workshop, SU's Department of Earth Sciences, in collaboration with North Carolina State University and the Western Cape Education Department (WCED), plan to foster the development of Citizen Science projects within Western Cape and South African classrooms. The title of the initiative is the Transatlantic Science Education Cooperative (TSEC). The workshop included engagement with researchers, teacher success stories, and how to start a citizen science project. The data collected during all of these projects are part of ongoing research within local, regional, or even global frameworks. Over the three-day workshop, participants enjoyed a mix of demonstrations and discussion-based hands-on projects.

– Dr Ryan Tucker

Primary school learners inspired to study Earth Sciences

The Earth Sciences Introduction-Inspiration (ESII) initiative offers primary school learners the opportunity to visit the Department, see the exhibition and learn about different topics. In 2018 the Tony Haus Children's Foundation, a SU society that tutors underprivileged pupils in Kayamandi, visited the Department on Saturday 18 August 2018. The group of about 25 learners arrived in the 'prac room' under guidance of dedicated students. Dr Martina Frei gave them insight to what Earth Sciences is and what is important in becoming and being a geologist.



Later in the year Rhenish Primary School's Environmental Club visited the department for the second time on the topic of rock types and if one can see through rocks.

– *Dr Martina Frei*

Other outreach activities

Dr Susanne Fietz participated in SU's Transformation Indaba and she and Dr Martina Frei attended the workshop on "Embracing a new normal". Dr Fietz maintains a blog and Facebook page on their work in the Southern Ocean. Dr Von der Heyden was involved with the first year orientation programme, as well as the Departmental "Open Day" for prospective learners in July 2018.

STAFF MATTERS

Prof Alex Kisters became our new Head of Department in October 2017. He has been with the Department as Associate and then full Professor since 1999. During 2017 Dr L Braccialli was appointed as the manager of the U-(Th)-Pb Geochronology Division, Central Analytical Facilities and as an extraordinary lecturer. Dr Ian Basson, Dr Neil Phillips and Dr Dave Cornell were appointed as extraordinary professors.

Dr Jodie Miller was promoted to Associate Professor as from 1 November 2018. Prof John Clemens, who joined the department, first as Executive Head in October 2007 and, since 2012, as an ordinary Professor, will retire at the end of 2018. He will continue to have a presence in the department as Professor Emeritus, continuing with various research collaborations and student supervision.

Staff list, as at the end of 2018:

ACADEMIC

Prof IS Buick
 Prof JD Clemens
 Dr S Fietz
 Dr R Heyn
 Prof A Kisters
 Dr M Klausen
 Dr J Miller
 Prof A Roychoudhury
 Prof G Stevens
 Dr R Tucker
 Dr B von der Heyden

EXTRAORDINARY PROFESSORS

Dr I Basson

SUPPORT STAFF

Ms M Frei
 Mr G Olivier
 Ms G Strydom
 Mr F Timmey

EMERITUS PROFESSOR

Prof A Rozendaal

POSTDOCTORAL FELLOWS

Dr A Baker
 Dr JL Menzel
 Dr M Storm
 Dr S Saumik
 Dr J Taylor

CONTACT DETAILS

Tel: 021-808-3219

E-mail: gstrydom@sun.ac.za

Web: www.sun.ac.za/english/faculty/science/earthsciences



Photo: SU Archive

The Department of Earth Sciences today. At the back, Fiazal Timmey, Prof Jodie Miller, Dr Martin Klausen, Dr René Heyn, Dr Bjorn von der Heyden, Prof J.D. Clemens, Prof Alex Kisters (HOD). In front, Gillian Olivier, Prof Gary Stevens, George Olivier, Prof Alakendra Roychoudhury, Martina Frei, Dr Susanne Fietz and Dr Ryan Tucker.



Photo: Anton Jordaan

DEPARTMENT OF MATHEMATICAL SCIENCES

MATHEMATICS | APPLIED MATHEMATICS | COMPUTER SCIENCE

Together, the divisions of Mathematics, Applied Mathematics and Computer Science form the Department of Mathematical Sciences at Stellenbosch University. The Department has 50 staff members and six extraordinary appointments, a research chair and one DST-NRF Centre of Excellence.

RESEARCH INTERESTS

Applied Mathematics Division

Computer vision, pattern recognition, machine learning

Fluid dynamics & modelling

Numerical analysis and scientific computing

Applied discrete mathematics

Computer Science Division

Artificial Intelligence, Machine Learning and Data Science

Automata and Grammars: Theory and Applications

IP networks

Software Engineering and Verification

Mathematics Division

Algebra

Algebraic number theory and arithmetic algebraic geometry

Discrete mathematics and algorithms

Foundations of mathematics

Topology

Functional analysis

Biomathematics and computational biology

RESEARCH HIGHLIGHTS

Deep Learning Indaba hosted at SU

Machine Learning is a core research focus within the Applied Mathematics Division, and has been for about 20 years. The division's expertise in this field pertain to the mathematical foundations of probabilistic modelling, statistical learning, Bayesian inference and deep learning, as well as applications of machine learning in computer vision, biometrics, natural language processing, robotics, sequence modelling, time series analysis for climatological prediction and natural resource management. Maties Machine Learning (MML) is a seminar series and discussion forum with the goal of bringing together people working on machine learning at Stellenbosch University.

In 2018 the division hosted the second Deep Learning Indaba, in collaboration with DeepMind and Google Brain and with strong support from Stellenbosch University and the Faculty of Science, in particular. More than 500 of Africa's brightest machine learning graduate students and industry professionals gathered on campus for what turned out to be the largest machine learning summer school of its kind in the world, to strengthen machine learning in Africa, to debate policies, and to address issues of diversity.

The keynote speaker on the final day of the Deep Learning Indaba was Jeff Dean, head of Google's Research and Machine Intelligence Division. Photo: Anton Jordaan



Dr Moustapha Cisse, lead of the Google Artificial Intelligence Research Lab in Ghana, was one of the keynote speakers during the Deep Learning Indaba hosted at Stellenbosch University in September 2018. Photo: Stefan Els

New appointments in the machine learning group

The machine learning research group within the Applied Mathematics Division also expanded this year with the appointment of Prof Hugo Touchette, previously at the National Institute for Theoretical Physics, who works on the modelling and simulation of random systems arising in complex machine learning models. Dr Ulrich Paquet, a staff research scientist at DeepMind in London, was appointed as an Extraordinary Professor in the division. Dr Paquet has been working closely with the Applied Mathematics Division to set up a world-class structured MSc programme in Machine Learning and Artificial Intelligence, to be offered at Stellenbosch University in the very near future.

New MOU signed with TU Braunschweig

The Faculty of Science signed a memorandum of understanding with the Carl-Friedrich-Gauss Faculty of the Technical University of Braunschweig (TUBS), Germany, to establish close international collaboration in computer science that includes joint projects and staff and student exchanges.

New research group in Computer Science

Artificial Intelligence, Machine Learning, and Data Science is a new research group in Computer Science that considers almost any aspect of the general decision-making problem, including sequential decision-making under uncertainty. Major sub-problems considered are planning, machine learning, and search algorithms. Their approach is grounded in probability theory and game theory for managing uncertainty and multi-agent systems. They also investigate the combination of machine learning and big data, and specifically data from earth observation satellite sensors and radio interferometers.



Back from left to right: Prof Ina Schaefer, Dean of Studies, Carl-Friedrich-Gauß-Fakultät, TUBS, Prof Bernd Fischer, Head of Computer Science, SU); Prof Bruce Watson, Head of Information Sciences, SU. In the front are Prof Wolf-Tilo Bahlke, Dean, Carl-Friedrich-Gauß-Fakultät, TUBS, and Prof Louise Warnich, Dean, Faculty of Science, SU.

RESEARCH ACTIVITIES

Research funding and grants

Professors Lynette van Zijl, Willem Visser, and Bernd Fischer have been awarded competitive research (CPRR) grants from the National Research Foundation. These include bursaries for MSc and PhD students. Prof Lynette van Zijl was awarded a grant for her research project “Hybrid extended symmetric difference nondeterministic finite automata”. Prof Willem Visser’s project “Applications of Model Counting to Software Testing” proposes a novel approach to improve the testing of software. Prof Bernd Fischer received funding for his project “Grammar-based generation of passing and failing test cases for complex domains”.

With the DST-NRF Research Development Grant for nGAP scholars, Dr RONALDA BENJAMIN travelled to Nigeria and Zambia during June and July 2018. She was a plenary speaker at the Second Conference of West African Women in Mathematics, held at the University of Ibadan, Nigeria, and presented a series of three talks at the University of Zambia, where she also collaborates with Dr Kelvin Muzundu, an SU alumnus.

Through the Bilateral Exchange Agreement between SU and KU Leuven, Dr H Coetzer secured funding for his research leave at KU Leuven from September to November 2018. During this time he established a collaborative research project with Jeroen Bertels and Dirk Vandermeulen entitled “Deep Learning-Based Connection Type Recognition for Dental Implants”.

International research visits

During 2017 the following international scholars visited the department:

- Dr Sylvie Ancombe, University of Central Lancashire, collaborating with Dr Gareth Boxall on “When forth suffices in back-and-forth arguments”.
- Dr Adrien Deloro, Université Pierre et Marie Curie, Paris, hosted by Dr Gareth Boxall to offer a course on Groups of Finite Morley Rank to MSc student Nathan Pillay.
- Prof Clemens Heuberger and Dr Benjamin Hackl, Klagenfurt, Austria, February/March 2017 and February/March 2018: Research visitors of Prof S Wagner and H Prodinger.
- Dr Niels Jakob Laustsen, Department of Mathematics and Statistics, Lancaster

University, UK January 2017, collaborating with Sonja Mouton on r-Fredholm theory in Banach algebras.

- Dr Ulrich Paquet, a Research Scientist at DeepMind, London, who has also been appointed as an Extraordinary Professor of Applied Mathematics.
- Prof Michal Ziemkowski, Warsaw University of Technology, collaborating with Prof Leon van Wyk on Polynomial identities in matrix algebras.
- Dr Eric Andriantiana, Rhodes University, hosted by Stephan Wagner, working on the research project “Extremal problems for graph invariants”.
- Prof Eva Czabarka and Prof László Székely from the University of South Carolina, hosted by Prof Stephan Wagner, for research on the inducibility of trees.
- Dr Benjamin Hackl and Dr Clemens Heuberger from Alpen-Adria Universität Klagenfurt, was hosted by Profs Helmut Prodinger and Stephan Wagner to work on the asymptotic behaviour of recursive combinatorial and digital structures.
- Dr Vonjy Rasendrasana, L’Ecole Normale Supérieure Antananarivo, was hosted by Dr Dimbinaina Ralaivaosaona and Prof Stephan Wagner in 2017 and 2018 to work on sparse acyclic digraphs.
- Dr Matas Šileikis, Czech Academy of Sciences, hosted by Dr Dimbinaina Ralaivaosaona and Prof Stephan Wagner to work on almost local tree functionals.
- Dr Jan Baetens, University of Ghent, Belgium, collaborating with Prof Lynette van Zijl on clustering in cellular automata.
- Prof Ina Schaefer, Technische Universität Braunschweig, Germany, was hosted by Prof Bernd Fischer during numerous visits for their research on the visualization and exploration of requirements documents

And during 2018:

- Dr Narjess Afzaly, Australia National University, collaborating with Dr Karin Howell on hierarchical canonical labelling and graph generation.
- Prof Michal Ziemkowski, Warsaw University of Technology, collaborating with Prof Leon van Wyk on polynomial identities in matrix algebras.
- Dr Clément Requilé, Technische Universität Wien, hosted by Dr Dimbinaina Ralaivaosaona and Prof Stephan Wagner to conduct research on limiting distributions for parameters of random subcritical graphs.
- Dr Harry Schmidt, University of Manchester, collaborating with Dr Gareth Boxall on

rational values of transcendental functions and arithmetic dynamics.

- Prof CM Mynhard, University of Victoria, Canada, collaborating with Dr Riana Roux on reconfiguration problems in graphs.
- Dr GM Rotskoff, Courant Institute of Mathematical Science, New York University, USA, collaborating with Prof Hugo Touchette on neural networks for large deviation sampling.
- Prof Frédéric Dias, University College Dublin, School of Mathematics and Statistics, collaborating with Dr Sonia Fidler-Woudberg on modelling and analysis of extreme ocean waves.
- Dr Hellis Tamm, Cybernetics Institute, Tallinn, Estonia, hosted by Prof Lynette van Zijl, to work on cycle heights in XNFA.
- Prof Matthew Dwyer, University of Virginia, and Dr Antonio Filieri, Imperial College London, hosted by Profs Willem Visser and Berndt Fischer, conducting research on the project “Towards Conditional Probabilistic Software Analysis”.
- Dr Yunho Kim, Korea Advanced Institute for Science and Technology, hosted by Profs Willem Visser and Berndt Fischer, working on directed compositional concolic testing with function summary refinement for crashing input generation.
- Dr Michael Whalen, Amazon, hosted by Profs Willem Visser and Berndt Fischer, working on veritesting with SPF (Sender Policy Frameworks).

Conferences and workshops

During 2017/2018 staff presented at more than 25 national and international conferences.

Dr Willem Bester co-authored a paper with Martin Berglund and AB van der Merwe entitled “Formalising Boost POSIX Regular Expression Matching” at the 15th International Conference on Theoretical Aspects of Computing (ICTAC 2018) held in Stellenbosch from 16-19 October 2018.

Prof Berndt Fischer presented a paper at the 15th International Conference on Software Engineering and Formal Methods, Trento, Italy, September 4-8, 2017, entitled “Using Shared Memory Abstractions to Design Eager Sequentializations for Weak Memory Models”. He also presented a paper at the 32nd IEEE/ACM International Conference on Automated Software Engineering, Urbana, IL, USA, 30 October to 3 November 2017, entitled “Parallel bug-finding in concurrent programs via reduced interleaving instances”.

Dr Nick Hale

- Presented a paper at SANUM 2017, March 2017, held at the University of the Witwatersrand, entitled “A fast and well-conditioned spectral method for Fredholm and Volterra integro-differential equations with convolution kernels”.
- Presented a paper at SANUM 2018 held in April 2018 at Stellenbosch University.
- Co-presented a paper at SANUM 2018, April 2018, with Mr S'yanda Mungwe entitled “Using Spectral Methods on HIV Infection with Tat and Ssu72 Activation”.
- Presented a paper at ICOSAHOM2018, July 2018, London, United Kingdom, entitled “A fast and spectrally convergent algorithm for rational-order fractional integral and differential equation”.

Dr Karin Howell presented a paper entitled “An introduction to near-vector spaces” at WYMSIG September 2017.

Prof Cang Hui hosted and presented at the following workshop: “Synergy between Invasion Ecology and Community Ecology”, 19 - 21 September 2018, Stellenbosch. He paid an academic visit to the University of Alberta in Edmonton, Alberta, Canada, 11 - 17 October 2018.

Prof Zurab Janelidze presented a paper at the Topology, Algebra, Analysis and Geometry conference held from 16-19 September 2018, Durban, entitled “Algebraic Toolkit for Generalized Elements”. He also presented at the XI Portuguese Category Seminar, 9 June 2017, in Coimbra, Portugal, with a paper entitled “On exactness properties preserved under pro-completion of finitely complete categories, and why this is useful”. He presented at the fourth Workshop on Categorical Algebra, which took place from 28 May to 1 June 2018 in Gargnano, Italy. Title of the talk was “Some questions on the logic of categorical algebra”.

Dr Sonja Mouton was a keynote speaker at the Vector lattices and applications symposium in honour of Prof Koos Grobler's 75th birthday, Johannesburg, South Africa, 23 March 2018. The title of the talk was “The upper Browder and lower Weyl spectrum properties in ordered Banach algebras”. She presented a paper entitled “Fredholm theory in ordered Banach algebras” at the 23rd annual conference on Banach algebras and Applications, Finland, from 3-11 July 2017. She also presented papers at Positivity IX, held in Edmonton, Canada, from 17-21 July 2017, and at the annual congress of

the SA Mathematical Society (SAMS) at North West University, Potchefstroom, 20-22 November 2017.

Dr Riana Roux presented at the 61th Annual Congress of the South African Mathematical Society, 3-5 December 2018, South Africa, on Irredundance graphs; and at the Workshop for African Women in Discrete Mathematics and its Application, 23 to 25 January 2018, South Africa, on Reconfiguration problems in domination. She also presented and co-presented papers at the following conferences:

- 60th Annual Congress of the South African Mathematical Society, 20-22 November 2017, South Africa, on Domination critical graphs with respect to multiple edge subdivision.
- 17th Workshop on Graph Theory: Colourings, Independence and Domination, 17-22 September 2017, Poland, on k -Dominating graphs.
- SANUM, March 2017, University of the Witwatersrand, on "A fast and well-conditioned spectral method for Fredholm and Volterra integro-differential equations with convolution kernels".
- SANUM, April 2018, Stellenbosch University.

Prof Hugo Touchette presented a paper at the Workshop on Entropic Relations in Mathematics and Physics, 29 Oct - 2 November 2018 University of Montreal, Canada, entitled "Markov process conditioned on large deviations".

Ms Jacoline van Jaarsveld (MSc student supervised by Dr Sonia Fidler-Woudberg) attended the 9th International Conference on Computational and Experimental Methods in Multiphase and Complex Flow, 20-22 June 2017, in Tallin Estonia and presented a paper entitled "An empirical versus analytical approach for modelling biofilm growth in biofilters".

Prof Brink van der Merwe presented papers at the 22nd International Conference on Implementation and Application of Automata, 27-30 June 2017, Université Paris-Est Marne-la-Vallée, France; at the annual conference of the South African Institute of Computer Scientists and Information Technologists (SAiCSIT 2017), Thaba'Nchu, South Africa, 26-28 September 2017; and at the tenth Workshop on Non-Classical Models of Automata and Applications (NCMA 2018), Košice, Slovakia, 21-22 August 2018.

Prof Leon van Wyk presented the paper "Lie solvability and a related polynomial identity in matrix algebras" at the Annual Congress of the South African Mathematical Society, December 2018.

Prof Lynette van Zijl presented two papers at SAICSIT, September 2018, Port Elizabeth, South Africa, entitled "The state complexity of language operations on XNFA-succinct unary regular languages" and "Ant sorting based on cellular automata with clustering".

Prof Willem Visser co-authored an invited talk with Sarfraz Khurshid and Corina S. Pasareanu at the ACM SIGSOFT International Symposium on Software Testing and Analysis (ISSTA2018), Amsterdam, The Netherlands, 1-2 July 2018, entitled "Test input generation with Java PathFinder: then and now". He was responsible for a tutorial on "Symbolic Execution for Java" at ICTAC, October 2018. He co-presented a paper with Corina S Pasareanu at the annual conference of the South African Institute of Computer Scientists and Information Technologists (SAICSIT 2017), 26-28 September 2017, Thaba'Nchu, South Africa, entitled "Probabilistic programming for Java using symbolic execution and model counting". PhD student Heila Botha presented a co-authored paper with Oksana Tkachuk, Brink van der Merwe and Willem Visser entitled "Addressing challenges in obtaining high coverage when model checking Android applications" at the 24th International SPIN Symposium on Model Checking of Software, Santa Barbara, California, 13-14 July 2017.

Prof Stephan Wagner was an invited speaker at several national and international conference, including:

- Plenary speaker at the fourth Strathmore International Mathematics Conference, Nairobi, Kenya from 19-23 June 2017, with a talk entitled "Distribution of tree parameters";
- Invited speaker at the International Conference on Recent Trends in Graph Theory and Combinatorics, which took place from 26 to 29 April 2018 in Cochin, India. The talk was entitled "Extremal problems for trees with given degree sequence";
- Invited talk, entitled "Enumerative parameters of trees", at a workshop on Enumerative Combinatorics which took place from 14 to 18 May 2018 at Oberwolfach, Germany.
- Invited talk entitled "Extremal problems for trees with given degree sequence" at the International Symposium on Graph Theory, Combinatorics and Theoretical Chemistry, Kunming, China, 1 to 4 July 2018; and
- Invited talk entitled "Eigenvalue distribution in random trees" at the Workshop on Algebraic Graph Theory and Complex Networks, Naples, Italy, 13-14 September 2018.

- Talk titled "Eigenvalue distribution in random trees", 3-5 Dec 2018, Annual Congress of the South African Mathematical Society, Rhodes University.

Prof Wagner gave a series of lectures titled "Analytic Combinatorics" at the Summer School on "Techniques in Random Discrete Structures", held in Athens, Greece from 22-27 May 2017. He attended a workshop on Graph Spectra, Combinatorics and Optimization in Aveiro, Portugal, from 25 to 27 January 2018. Profs Wagner and Prodinger attended ANALCO/ALENEX/SODA from 16-19 January 2017 in Barcelona, Spain. Prof Wagner was co-chair of the programme committee of ANALCO/ALENEX/SODA 2018, which took place in New Orleans, USA; member of the programme committee for AofA'18 (29th International Meeting on Probabilistic, Combinatorial, and Asymptotic Methods for the Analysis of Algorithms) which took place from 25 to 29 June 2018 in Uppsala, Sweden.

Prof André Weideman was the co-contributor on a number of talks at national and international conferences, including:

- Contributed talk at SANUM 2017, held at the University of the Witwatersrand in March 2017, entitled "A Gauss-Hermite Quadrature Method for Laplace Transform Inversion";
- Contributed talk at the 27th Biennial Conference on Numerical Analysis, June 2017, Glasgow Scotland, entitled "A Gauss-Hermite method for Laplace Transform Inversion".
- Contributed talk at SANUM 2018, April 2018, Stellenbosch, entitled "Gauss-Hermite vs Trapezium Rule".
- Contributed talk at the annual meeting of SIAM, July 2018, in Portland OR, United States of America, entitled "Gauss-Hermite vs Trapezoidal Rule".
- Contributed talk at SAMS, December 2018, Rhodes University, entitled "Finite time singularities of the complex Burgers and KdV equations".

Editorial activities

Prof Cang Hui is associate-editor of the journals *Ecological Complexity*; *Biological Invasion*; and an editorial board member of the journals *Journal of Dynamics and Games*; *Frontiers in Ecology and Evolution*; *BMC Ecology and Applied Mathematics*; *Computational Sciences*.

Prof Zurab Janelidze is member of the editorial board of the journals *Cahiers de Topologie et Géométrie Différentielle Catégoriques* and *Applied Categorical Structures*.

Prof Helmut Prodinger is a member of the editorial boards of the journals *Theoretical Computer Science*, *International Journal of Intelligent Computing and Cybernetics*, *Universal Computer Science*, *The Pioneer Journal of Advances in Applied Mathematics*.

Prof Ingrid Rewitzky is associate editor of *Quaestiones Mathematicae*.

Prof Brink van der Merwe and **Prof Lynette van Zijl** are editorial board members of the *Journal of Universal Computer Science*.

Prof Willem Visser is a member of the editorial board of the *Association for Computing (ACM)* journal.

Prof Stephan Wagner is a member of the editorial boards of the journals *Afrika Matematika*, *Applicable Analysis and Discrete Mathematics*, *Communications in Combinatorics and Optimization*, *Journal of Integer Sequences*, *MATCH Communications in Mathematical and in Computer Chemistry*, *Quaestiones Mathematicae*, *Theory and Applications of Graphs*.

Prof André Weideman is associate editor of the journals *Quaestiones Mathematicae*, *Numerical Algorithms* and *Electronic Transactions of Numerical Analysis*.

Conferences hosted

The Applied Mathematics Division hosted the 42nd Annual South African Numerical and Applied Mathematics (SANUM) Conference, which took place from 4 to 6 April 2018; as well as the Deep Learning Indaba from 9 to 14 September 2018. The Computer Science Division hosted the 14th African Conference on Research in Computer



Participants in the 42nd annual conference of the South African Numerical and Applied Mathematics (SANUM) conference hosted at Stellenbosch University in April 2018.

Science, 14-16 October 2018; the 15th International Colloquium on Theoretical Aspects of Computing, 12-14 October 2018; the sixth Grammatical Framework Summer School; and an AC2I (Academic Consortium) workshop entitled "Finding Software Errors before they Find You", collocated with ICTAC 2018, Stellenbosch, 15 October 2018.

In the Mathematics Division, Dr Charlotte Kestner and Dr Gareth Boxall organised an international conference on model theory at Stellenbosch University, with one session hosted by AIMS-SA in January 2017.

Sabbatical research visits

Dr RONALDA BENJAMIN visited Prof Marcel de Jeu at Leiden University from 1 September 2016 to 31 May 2017 as part of the nGAP programme. She gave research seminars at Leiden University, Leipzig University (with hosts Prof Tanja Eisner and Dr Agnes Radl), Technische University at Dresden (with host Dr Anke Kalauch) as well as a three-hour lecture on Geometric Duality of Cones.

Mr WILLEM BESTER took PhD research leave from January-June in 2017 and again in 2018.

Dr HANNO COETZER visited the Processing Speech and Images (PSI) Division in the Department of Electrical Engineering (ESAT) at KU Leuven, and the Document, Image, and Voice Analysis (DIVA) group at the University of Fribourg, from July to December 2018.

Dr SONIA FIDDER-WOUDBERG visited the Material Science group in the Department of Applied Physics, University of Groningen in The Netherlands, from 8 January to 13 July 2018.

Dr SONJA MOUTON took research leave from January to June 2018 to focus on five key research projects, including "Further aspects of the boundary spectrum".

Prof HELMUT PRODINGER took a sabbatical from January to May 2017 to collaborate with Profs Clemens Heuberger, Benjamin Hackl and Daniel Krenn from Klagenfurt, Austria.

Prof LEON VAN WYK was on a research visit from 23 July to 30 November 2018 at the Hungarian Academy of Sciences in Budapest, Hungary, the University of Miskolc in Hungary, the University of Bucharest in Romania, and in the USA he visited Texas A&M University and the University of Louisiana at Lafayette.

AWARDS TO STAFF AND STUDENTS

Prof Willem Visser was selected by the Association for Computing (ACM) as one of a select group of distinguished members for his outstanding research contribution to the field of computing and information technology. ACM is the world's largest educational and scientific computing society.

Prof Stephan Wagner was awarded the South African Mathematical Society award for Research Distinction. The award, in the form of a silver Mobius band, serves to recognise and stimulate excellence in research. It is only made in recognition of important research contributions to Mathematics or to the applications of Mathematics in any field.

Prof Helmut Prodinger was short-listed as a finalist of the 2016/2017 NSTF-South32 Awards in the category of Lifetime Award for research contributions over fifteen years or more.

Prof Cang Hui, holder of the South African Research Chair (SARChI) in Mathematical and Theoretical Physical Biosciences, was short-listed as a finalist of the 2017/2018 NSTF-South32 Awards in the category TW Kambule-NSTF Awards: Researchers for contributions to research and its outputs over a period of up to fifteen years of research, predominantly in South Africa.

In September 2018, the Suid-Afrikaanse Akademie vir Wetenskap en Kuns awarded the Havenga prize for Physical Sciences to **Professor Ben Herbst** in recognition of an academic career that spanned over 40 years.



Prof Ben Herbst (middle) with Prof Irma Eloff, chair of the SA Akademie vir Wetenskap en Kuns, and Prof André Weideman, Stellenbosch University. Photo: SA Akademie vir Wetenskap en Kuns

Prof André Weideman was elected as Fellow of SIAM (Society for Industrial and Applied Mathematics) in 2017. From January 2018, Prof Weideman was elected to the SIAM Committee on Committees and Appointments. He will be an invited speaker at the International Congress on Industrial and Applied Mathematics (ICIAM 2019), which will take place in July 2019 in Valencia, Spain. Held every four years, this is the biggest meeting of its kind in the world. He is one of five international co-organizers of a research programme “Complex Analysis: Techniques, Applications and Computations for the 21st Century,” already approved for September to December 2019. This will be held at the prestigious Newton Institute in Cambridge, United Kingdom.

Prof Ingrid Rewitzky was awarded the Chancellor’s Award 2018 for exceptional educational leadership in facilitating and supporting a scholarly approach to learning and teaching in the Faculty of Science, including the establishment of an active Teaching and Learning Hub and a differentiated tutorial support programme for undergraduate students.

The Computer Science Division rewarded their top students during the annual prize giving event in 2018. Awards were presented to Joseph Rautenbach, Dario Trincherro and Conrad Strydom (Best first year students, prize sponsored by Epi-Use Labs); René Spoerer (Best second year student, prize sponsored by Praelaxis); Lisa van Staden (Best third year student and recipient of the Van der Walt medal, prize sponsored by ACI); Joseph Stoker (Best BScHons student in Computer Science, prize sponsored by ACI); Francois Meyer (Best BScHons student in Data Science, prize sponsored by Epi-Use Labs); Francois Meyer (Best BScHons Project, prize sponsored by Barclays); Ashleigh Schepers (Best student in Machine Learning, prize sponsored by Altron/Bytes and Alphawave).

The top achievers in Applied Mathematics were rewarded for their hard work with certificates and book prizes sponsored by Cambridge University Press. Dario Trincherro came out as the top first year student for 2017 with an average of 100%, while Freddie Ryk de Villiers and Emma Catherine King both maintained an average of 91% for their second year. The best third year students were Jeandré Boshoff and Esmari Maré, and the best BScHons-students were Shane Josias and Peter Thompson. The Applied Mathematics Division specifically thanked Cambridge University Press for their continuous sponsorship of the book prizes over the years.



Top performers in Applied Mathematics, from left to right, Esmari Maré, Emma King, Fred De Villiers, Shane Josias, Jeandré Boshoff, Peter Thompson, Prof Francois Smit (head of the division), and Dario Trincherro. Photo: Wiida Fourie-Basson

Three postgraduate students in Mathematics had the privilege of attending the Heidelberg Laureates Forum which took place from 23 to 28 September 2018 in the historic town of Heidelberg in Germany. This is an once-in-a-lifetime opportunity for students to learn from and interact with the recipients of the most prestigious awards in the fields of Mathematics and Computer Science, namely the Abel Prize, the Fields Medal and the Nevanlinna Prize in Mathematics, and the A.M Turing award and the ACM Prize in Computing. These awards are on the same level as the Nobel Prize. Sogo Pierre Sanon, Hosana Ranaivomanana and Dylan Nelson competed against postgraduate students across the world in order to be able to attend.



Three of the Mathematics Division’s students were selected to attend the Heidelberg Laureates Forum in Germany during September 2018. They are Sogo Pierre Sanon, Hosana Ranaivomanana and Dylan Nelson. Photo: Heidelberg Laureate Forum

During the annual Congress of the South African Mathematical Society from 20 to 22 November 2017, PhD student Valisoa Razanajatovo Misanantenaina won the Best talk by a PhD-student with his talk entitled “Extremal trees with fixed degree sequence”. During the 2018 SANUM conference, 3-5 Dec 2018 at Rhodes University, BScHons student Sarah Selkirk gave a talk with the title “Ternary trees and equinumerous combinatorial objects” and won a prize in the category Best talk by an MSc student.

Two Stellenbosch University teams of undergraduate students from Computer Science and Engineering were placed third and fourth in Entelect's Challenge University Cup. For this one-day hackathon the teams were challenged to solve a coding problem. At the first fintechathon held by SU in partnership with LaunchLab and Innovus, teams of students were challenged to find innovative ideas to create seamless payments or information-sharing experiences for consumers. The challenge was won by a team of students from the Computer Science Division, namely Joseph Visser (BScHons), Shaun Wurdeman (BScHons), leuan Uys (third year) and Elke van der Walt (BScHons). They created an app called "Disconnekt", which utilises the connectivity of Bluetooth beacons to process payments.

The Investec IT Explore Hackathon was won by the team from the Computer Science Division. They are Matthew Venter, Reece Murray, Lisa van Staden, Ashleigh Schepers, and Steyn van Litsenborgh. The aim of this challenge is to develop within a 16 hour time constraint a mobile application that revolutionises the recruitment process for Investec's IT Graduate Programme. The Stellenbosch team decided to implement a basic Project Management simulation, where a profile is built for each user based on the decisions that they make.

The BitPhase team from Stellenbosch University won the main challenge of the first Cybersecurity Challenge that took place during the annual conference of the Centre for High Performance Computing (CHPC) in Pretoria from 3 to 6 December 2017. First year computer science students Luke Joshua, Joseph Rautenbach, Jonathan Botha and MSc student Nicolaas Weideman outwitted seven other teams during the gruelling four day main challenge which consisted of multiple cyber security scenarios and teams had to attack a system in order to exploit its vulnerabilities.

A group of Mathematics students from Stellenbosch University participated in the 25th annual International Mathematics Competition for university students that took place in Blagoevgrad, Bulgaria, from 22 to 28 July 2018. More than 350 students from 43 countries competed in the Olympiad-style competition with examinations that took place over two days. Participants wrote two exams spanning five hours each for a total score of 100. The scores were then ranked from highest to lowest, with the top two-thirds awarded first, second or third prizes.

The Stellenbosch University team, consisting of third year BCom student Lourens Van Niekerk and three BScHons-students in Mathematics, Sarah Selkirk, René Spoerer, and Robin Visser, placed 54th out of a total of 70 teams. Visser and Spoerer won second and third prizes respectively, while Selkirk and Van Niekerk both received honourable mentions. The team was accompanied by team leader Liam Baker, a PhD student in Mathematics.

After a hiatus of a few years, two teams from Stellenbosch, with Dr Nick Hale as the team advisor, were entered into the Mathematical Contest in Modelling (MCM) in 2017. Team members were Renè Spoerer and Jeandrè Boshoff, and Sarah Selkirk, Anthonie de Beer and Esmari Marè. Both teams were placed in the Honourable Mention category. The increasing popularity of the MCM contest led to three teams being entered in 2018, with Dr Nick Hale as team advisor. They were Jeandrè Boshoff, Renè Spoerer, and Mbali Tyolo (Team 1); Roelof Maritz, Shaqir Rodgers, and Nicole Wahl (Team 2); Wessel Blomerous, Johannes Coetzee, and Andrew Harrison-Miochi (Team 3). All three teams were placed in the Successful Participant category.

Since 2017 the Applied Mathematics Division, under the leadership of Dr Nick Hale and Dr Riana Roux, organises its own local version of the South African Mathematical Modeling Contest (SAMMC). The main aim of SAMMC ("Sam-see") is to provide South African undergraduate students in science and engineering disciplines some exposure to applied mathematics problems more relevant to real-world applications than they might otherwise encounter in the classroom. It is a chance to challenge their brain and develop problem-solving skills, gain experience in working in a team, and possibly win some prizes. The format of the contest is loosely based on the international COMAP MCM competition, held every January/February. A secondary aim of SAMMC is to gain experience in solving MCM-type problems and to help select teams for the international competition.

Seven teams from four universities, including SU, University of Pretoria, Nelson Mandela University and the University of the Witwatersrand, competed in SAMMC 2018. In joint second place were the teams from the University of Pretoria and the University of the Witwatersrand. In first place was one of the SU teams, consisting of Christiaan van der Merwe, Dario Trincherro and Jeroen Bormans.

NATIONAL AND INTERNATIONAL COLLABORATORS

The different research groups are all well connected internationally. This has led to exchanges of postgraduate students and joint research projects with international collaborators that also involved some of our postgraduate students. The department has also maintained a strong link with the African Institute of Mathematical Sciences (AIMS-SA) in Muizenberg by presenting AIMS courses, supervising AIMS essays, and participating in workshops and thereby contributes to the growth of mathematical sciences in the broader Africa.

Austria

Alpen-Adria Universität Klagenfurt, Austria
 Technical University Graz
 Technical University Wien

Belgium

University of Louvain-la-Neuve

Canada

University of Victoria

Czechoslovakia

Czech Academy of Sciences

France

IMT Atlantique, Nantes
 University of Notre Dame
 Université Paris Sud

Germany

Leipzig University
 Technische Universität Berlin
 University of Tübingen

Ireland

Trinity College, Dublin
 University of Dublin

Italy

University of Trento

Madagascar

University of Antananarivo, Madagascar

Norway

Telemark University College
 University College of Southeast Norway
 University of Bergen

Poland

University of Warsaw
 Warsaw University of Technology

Russia

Joint Institute for Nuclear Research, Dubna

Serbia

University of Novi Sad

Sweden

University of Stockholm
 Umeå University
 Uppsala University

Switzerland

ETH-Zurich

Spain

Universitat de Girona

The Netherlands

KU Leuven University

Portugal

University of Aveiro
 University of Coimbra

South Africa

CSIR
 eThekweni Municipality
 Pioneer School for the Blind (Worcester)
 Platters Wine Guide
 Praelix
 Rheinmetall Denel Munitions (Pty Ltd)
 Rhodes University
 University of Johannesburg
 University of Limpopo
 University of the Western Cape
 University of the Witwatersrand

Taiwan

Academia Sinica

United Kingdom

Imperial College London
 Lancaster University
 Oxford University
 University of Central Lancashire
 University of Manchester
 University of Southampton
 University of Warwick

United States of America

Cornell University
 Georgia Southern University
 NASA Ames Research Center
 University of Colorado at Boulder
 University of Louisiana at Lafayette
 University of South Carolina

FUNDING

NRF Competitive Program for Rated Researchers
 NRF Rated Researcher Incentive Funding
 NRF SARCHi Grant
 Winetech

NRF-RATED RESEARCHERS

Two staff members were newly rated as from January 2019: Dr Trienko Grobler (Y) in the field Remote Sensing Data; and Dr Sonia Fiddler-Woudberg (Y) in the field of Fluid modelling.

LEADING INTERNATIONAL RESEARCHERS

Prof H Prodingar	Analysis of algorithms, number theory and combinatorics
Prof W Visser	Software failure, software engineering and software development

INTERNATIONALLY ACCLAIMED RESEARCHERS

Prof B Fischer	Software engineering
Prof Z Janelidze	Category Theory
Prof L Van Wyk	Ring theory and matrix algebras
Prof S Wagner	Graph theory and combinatorics
Prof JAC Weideman	Numerical analysis and scientific computing

ESTABLISHED RESEARCHERS

Dr J Geldenhuys	Software engineering and specifically model checking and process algebra
Prof S Mouton	Banach algebras and spectral theory
Prof AB van der Merwe	Automata theory
Prof L van Zijl	Theoretical computer science and assistive technologies

PROMISING YOUNG RESEARCHERS

Dr G Boxall	Model theory and applications
Dr J Gray	Category Theory
Dr N Hale	Numerical analysis and scientific computing
Dr K-T Howell	Near Vector Spaces

PRESTIGIOUS AWARDEE

Prof C Hui	Mathematical and theoretical physical biosciences
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ACADEMIC AFFAIRS

Mathematical Sciences colleagues were recognized at the First-year Prestige Dinner in 2017 and 2018 for their contributions to inspiring the top first year students of the preceding year. They are Prof F Breuer, Prof J Geldenhuys, Dr K Howell, Prof I Rewitzky, Dr R Roux, Ms L Wessels in 2017; and Dr B Bartlett, Dr J Gray, Dr K Howell, Dr D Ralaivaosaona and Dr M Wild in 2018.

Prof Ingrid Rewitzky was awarded a Stellenbosch University Teaching Fellowship (2017-2019) for a project on the evaluation of programmes in Science in the South African Higher Education Context. Funding for Innovation and Research in Learning and Teaching (FIRLT) was secured in 2017 for two projects in Mathematics:

- Online interactive content for Mathematics: Mrs Bessie Burger, Dr Jacques Masuret, and Prof Ingrid Rewitzky for improving deeper learning and understanding of core concept of Mathematics, encouraging self-study in preparation for contact sessions (lectures, tutorials), and providing a resource for undergraduate students to address the articulation gap between Grade 12 and first year.
- Gamification of Mathematics 186 Lectures: Awarded to Dr Jacques Masuret and Prof Ingrid Rewitzky, for increasing the content and classroom engagement and motivation levels of first-years students in Mathematics 186 by employing the elements of gamification in lectures.

As part of the programme renewal project in the Faculty of Science, the Mathematical Sciences programme committee has been rethinking the Mathematical Sciences Programme. The Computer Science Division is expanding their offering to fulfil the need for a wide spectrum of computer professionals in South Africa and beyond and work is underway for a new Computer Science Programme. In the Applied Mathematics Division, Dr Willie Brink and Dr Ulrich Paquet have designed a structured masters in Machine Learning and Artificial Intelligence which, subject to approval, will be implemented from 2020.

SOCIAL OUTREACH

The Bridging the Gap initiative began at the end of 2017 with an invitation to Dr Karin Howell by the AP mathematics teachers to their workshop at Bridgehouse School. Subsequently there have been numerous school visits and talks on techniques for studying mathematics and mathematics as a degree option. A “Starting the conversation: bridging the gap between school and university mathematics” workshop with the AP maths teachers in the region was held in 2018. It included content specific sessions with lecturers from the Mathematics Division, as well as a panel discussion on how we can assist learners in bridging the gap. The feedback was very positive and we plan to host more workshops in the future.

As part of the SU centenary activities, the Patterns of the World (POW) initiative exposed 100 Grade 11 learners to the importance/relevance of Mathematics in Science as a whole.

STAFF MATTERS

During 2017/2018 the Division Heads were as follow: For Computer Science, Prof Jaco Geldenhuys (2016-2017) and Prof Bernd Fischer (2018-2019); for Applied Mathematics, Prof Francois Smit (2016-2018); and for Mathematics, Prof Stephan Wagner (2016-2017) and Prof Leon van Wyk (2018-2019).

New appointments joining the department in 2017 and 2018 were: Dr Andie de Villiers (Lecturer, Applied Mathematics, from 1 April 2017), Dr Trienko Grobler (Lecturer, Computer Science, from April 2017), Mrs Lisa Muller (Administrative Assistant, Mathematics, 1 January 2017), Mr S'yanda Mungwe (Junior Lecturer, Applied Mathematics, from 1 January 2018), Prof Hugo Touchette (Professor, Applied Mathematics, from 1 September 2018). In the Mathematics Division, three staff members were promoted to senior lecturers, namely Dr Bruce Bartlett (from 1 January 2017), Dr James Gray (from 1 January 2017), and Dr Naina Ralaivaosaona (from 1 January 2018).

At the end of 2017 there were three (early) retirements: Dr Paul Grobler (Applied Mathematics, 2003-2017), Dr Cornelia Naude (Mathematics, 2004-2017), and Prof Ben Herbst (Applied Mathematics, 1998-2017).

During 2018 there were two resignations from the Mathematics Division: Prof Florian Breuer accepted the appointment of Professor of Mathematics at the University of Newcastle in Australia from 1 April 2018; Prof Farai Nyabadza accepted the appointment of Professor of Applied Mathematics at the University of Johannesburg from 1 July 2018.

Staff list, as at the end of 2018:

ACADEMIC

Dr B Bah (jointly with AIMS-SA)
Dr B Bartlett
Dr DJ Basson
Dr R Benjamin
Mr W Bester
Dr G Boxall
Dr W Brink
Mrs EJ Burger
Dr H Coetzer
Dr M Cloete
Dr A de Villiers
Dr H Diedericks
Dr S Fidler-Woudberg
Prof B Fischer (Division Head: Computer Science)
Prof J Geldenhuys
Dr JRA Gray
Prof BW Green (AIMS-SA Director)
Dr N Hale
Dr R Heymann
Dr K-T Howell

Prof C Hui (SARCHI)
Dr CP Inggs
Dr Z Janelidze
Dr A Keet
Dr S Kroon
Dr MF Maritz
Dr J Masuret
Prof S Mouton
Mr S Mungwe
Prof H Prodinge
Dr D Ralaivaosaona
Prof IM Rewitzky (Executive Head)
Dr R Roux
Prof F Smit (Division Head: Applied Mathematics)
Prof H Touchette
Prof AB van der Merwe
Prof L van Wyk
Prof L van Zijl
Prof WC Visser
Prof S Wagner (Division Head: Mathematics)
Prof JAC Weideman
Ms L Wessels
Prof M Wild

EXTRAORDINARY APPOINTMENTS

Prof J Bishop (Extraordinary Professor, Computer Science)
Prof B Herbst (Extraordinary Professor, Applied Mathematics)
Dr M Hoffmann (Extraordinary Senior Lecturer, Computer Science)
Dr U Paquet (Extraordinary Professor, Applied Mathematics)
Prof H-E Porst (Extraordinary Professor, Mathematics)

EMERITUS PROFESSOR

Prof AE Krzesinski

SUPPORT STAFF

Mrs L Adams
Mrs H du Plessis
Mrs V du Plessis
Mrs S Fortuin
Mrs W Isaacs
Mr B Jacobs
Mrs L Muller
Mr A Roman
Mr D Stephanus

POSTDOCTORAL FELLOWS

Luca Demangos (Function field arithmetic)

Genevieve Diedericks (Genetic and Phylogenetic Turnover)

Pietro Landi (Adaptive Dynamics and Diversification)

Guillaume Latombe (Community Assembly Patterns and Processes)

Henintsoa Onivola Minoarivelo (Coevolution in Mutualistic Networks)

Olugbenga O. Oluwagbemi (Epidemiological Modelling)

James G. Rodger (Allee Effects from Pollen Competition)

Wolf-Christian Saul (Seed Dispersal Networks of Myrmecochory)

Mario Mairal (Functional Biogeography of the Antarctic)

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Computer Science Division

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E-mail: head@cs.sun.ac.za / secretary@cs.sun.ac.za

Web: <http://www.cs.sun.ac.za>

Facebook: <https://www.facebook.com/groups/csmaties/>

Mathematics Division

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E-mail: maths@sun.ac.za

Web: <http://www.sun.ac.za/english/faculty/science/Mathematics>

The IBM 1620 computer with 20 kilobytes capacity filled an entire desk. In front of the computer sits Prof S.R.F. Göldner and behind him are Mr P.J. Lombard, Mr J.E. Louw and Prof S.P. Cilliers.



Photo: SU Archive

The Department of Mathematical Sciences today consists of the Divisions of Mathematics, Computer Science and Applied Mathematics.



Photo: Hennie Rudman

DEPARTMENT OF MICROBIOLOGY

The Department of Microbiology's historical roots can be traced back to 1918 when plant pathology was recognized as a field of expertise in the then Faculty of Agriculture. Today, the Department has eight research groups working in state-of-the-art laboratories in the JC Smuts Building.

RESEARCH INTERESTS

- Bioprocessing
- Enzyme engineering and bioinformatics
- Lactic acid bacteria
- Microbial ecology and Mycology
- Water treatment
- Fungi biotechnology for bioenergy and the bioeconomy
- Functional microbial bioinformatics
- Biotechnologies for water treatment

RESEARCH HIGHLIGHTS

NanoPOC point-of-care device wins most innovative award

The NanoPOC point-of-care device, developed by Prof Leon Dicks' research group, in collaboration with Prof Willie Perold at the Department of Electrical and Electronic Engineering, won an international competition for the most innovative idea. A leading pharmaceutical group will fund the developing of the device, aimed at commercialisation in 2022. Two patents cover the intellectual property.

A novel antibacterial and antifungal non-ribosomal antibiotic Rhabdin was discovered and characterised to structural level as part of the research by PhD student Elzaan Booysen. Postdoctoral fellow, Dr Francesco Salini from Udine University, Italy, spent ten months in Prof Dicks' research group. This led to the discovery of at least three new antimicrobial peptides that are now being patented and commercialised in Italy as food preservatives.

The probiotic, Entiro™, developed by Prof Dicks and his research group and launched three years ago, is fast becoming the leading probiotic with the latest annual turnover close to R50 million. More than 50 scientific papers back the product.

International collaboration to find natural habitat of *Emergomyces africanus*

Prof Alf Botha was previously approached by Prof Chris Kenyon from the Institute of Tropical Medicine in Antwerp, Belgium, and Dr Ilan Swartz from the Department of Medicine, Faculty of Medicine and Dentistry at the University of Alberta, Canada, to take part in a multinational collaborative study aimed at understanding the ecology of a novel opportunistic pathogen known to infect HIV/AIDS patients in South Africa. This dimorphic fungus, named *Emergomyces africanus*, forms a yeast phase known to cause disseminated mycosis in patients. The responsibility of Prof Botha's research team was to characterize the physiology of the fungus, with the ultimate aim to determine its natural habitat. PhD student Barbra Lerm subsequently played a pivotal role in exploring the physiology and identifying this emerging pathogen in South African soils.



Prof Botha was invited to present a talk on the urease activity of pathogenic *Onygenalean* fungi at a pre-congress workshop of the 20th Congress of the International Society for Human and Animal Mycology (ISHAM 2018) that was held during June 2018 in Amsterdam. PhD student Barbra Lerm presented her findings on the urease activity of another pathogenic fungus, *Cryptococcus neoformans*, at ISHAM 2018.

Innovative water treatment technologies investigated

Prof Wesaal Khan currently collaborates with Dr Pilar Fernandez-Ibanez from Ulster University in the United Kingdom on a Royal Society Newton Mobility Grant to investigate biocontrol, physical and chemical technologies for the treatment of rainwater. Predatory bacteria are used in combination with SODIS-CPC reactors and immobilised titanium dioxide-reduced graphene oxide (TiO₂-rGO) to disinfect harvested rainwater.

As part of the collaboration, PhD student Monique Waso was based at Ulster University from April to June 2018 to receive training on the design of Compound Parabolic Collecting (CPC) reactors and chemical disinfectant strategies. During the same time Prof Khan visited Ulster University in June 2018 and was invited to present a keynote address at the International Research Workshop on Solar Technologies for Water Disinfection for Developing Communities, while Waso presented an overview of her MSc research at the science workshop.

Five novel *Trichoderma* species

Prof Karin Jacobs, together with MSc student Ihan du Plessis and collaborators from the University of Vienna, Austria, and the Hebrew University of Jerusalem, published a survey of *Trichoderma* spp in South Africa. They identified five novel species and the artwork was used as the cover page for *Mycologia* (May-June 2018). PhD student Tersia Conradie presented a poster on the *Acidobacteria* from fynbos soil at the annual conference of the International Society for Microbial Ecology (ISME 2018) in Germany.



Developing a carboxylate platform using rumen inocula

Prof Emile van Zyl is collaborating with Prof P. Weimer from the University of Wisconsin in the USA on the application of the carboxylate platform by using rumen inocula to valorise South African agricultural waste. Prof Weimer visited SU for two months from mid-September till mid-November. He also acts as a co-supervisor for Mr Sesethu Njokweni and worked shoulder-to-shoulder with Mr Njokweni at the bench during the two months and together they have made exceptional progress. Several papers will emanate from the collaboration. Prof Weimer will visit the Department in 2019 and 2020 for extended periods.

Bioconversion of food waste to value-added products

Dr Rosemary Cripwell, a postdoctoral fellow hosted by Prof Emile van Zyl, started a three-year collaboration with Dr Lorenzo Favaro a researcher at the DAFNAE Department, Padua University, Italy. The project, entitled BIOwaste-to-ENERGY, investigates the bioconversion of food waste/waste streams to value-added products. They aim to use natural resources that can help both countries move towards a low-carbon economy. In June 2018, Dr Cripwell and MSc student Wessel Myburgh were hosted by Dr Favaro. Myburgh spent one month at Padua University, where he performed several experiments. The work generated from this exchange has already completed many of the initial objectives set out for the collaboration. In July 2018, Dr Favaro visited SU and presented some of his recent work at the second annual Yeast Colloquium. He was also joined by Mr Valentino Pizzocchero (a lab technician) and PhD student Nicoletta Gronchi. Ms Gronchi spent one month at SU working on industrial strain development for consolidated bioprocessing and Mr Pizzocchero offered valuable assistance regarding the analysis of fermentation samples.

RESEARCH ACTIVITIES

Service to the scientific community

Prof LMT Dicks is Chief Editor of the *SA Journal of Enology and Viticulture* (editor, since 2005), and a member of the editorial boards of *Probiotics and Antimicrobial Proteins* (associate editor, 2008 - present), *Beneficial Microbes* (associate editor, 2008 - present), *Annals of Microbiology* (2013 - present) as well as *Bioscience of Microbiota, Food and Health* (2011 - present). The latter is the joint scientific journal of the Japan Bifidus Foundation, the Japanese Association for Food Immunology and the Japan Society for Lactic Acid Bacteria.

Dr Rosemary Cripwell organised the annual one-day Yeast Colloquium held during July 2018. This one-day event was attended by more than 60 students and postdoctoral fellows from the groups of Profs Van Zyl and Botha in the Department of Microbiology, Prof Florian Bauer from the Institute for Wine Biotechnology, Dr Riaan Den Haan from the University of the Western Cape, Dr Rodney Hart from the Agricultural Research Council

Nietvoorbij, as well as researchers from Padova University, Italy. The goal of the Yeast Colloquium is to provide postgraduate students and postdoctoral fellows a unique platform to share their research and exchange valuable information on techniques, thus promoting collaboration between the yeast-based research groups in South Africa and especially in the Western Cape.

Prof Alf Botha is a member of the editorial board of *FEMS Yeast Research* (2008 – present); editor of the *Canadian Journal of Microbiology* (associate editor since 2011).

Prof Karin Jacobs is a member of the editorial boards of *Mycology: An International Journal of Fungal Biology* and *Bothalia* (AOSIS).

Dr Heinrich Volschenk serves as vice-president of the South African Society for Microbiology (2018-present).

AWARDS TO STAFF AND STUDENTS

In November 2017 **Prof Karin Jacobs** was the recipient of the SU Rector's Award for Excellence in Teaching. PhD student Edward Archer, supervised by Prof Gideon Wolfaardt, received second prize for his oral presentation, out of 142 candidates, at the International Water Association's (IWA) tenth Micropol and Ecohazard Conference 2017 in Vienna, Austria.

Prof Emile van Zyl was the recipient of the Havenga Award for Life Sciences (2018), awarded by the Suid-Afrikaanse Akademie vir Wetenskap en Kuns. He also received the SU Chancellor's Award for Research in December 2018.

PhD student Brandon Reyneke was awarded first prize in the Centre for Proteomic and Genomic Research's (CPGR) Core Lab Competition in 2018, with his project proposal for monitoring rainwater through metagenomic analysis, using Next Generation Sequencing. He received US\$10 000 and an opportunity to work with the CPGR at no cost. Postdoctoral fellow Dr Jayesh Ahire received the award for one of the most productive postdoctoral fellows at Stellenbosch University from the Vice-Rector: Research, Innovation and Postgraduate Studies.

Our students received a number of awards at the biennial congress of the South African Society for Microbiology that was held during February 2018: MSc student Jade Martin (first prize for the best MSc oral presentation, entitled "Improving heterologous gene expression via overexpression of two transcriptional activators in *Saccharomyces cerevisiae*"); PhD student Tersia Andrea Conradie (third prize for the best PhD oral presentation, entitled "The optimization, quantification and storage stability of an astaxanthin-producing bacterium, *Paracoccus* sp., and its application in poultry feed"); Dr Thando Ndlovu (second place in the best poster competition for his poster entitled "Antimicrobial activity of bio surfactant crude extracts produced by *Serratia* species"); Wessel Myburgh (third place in the best poster presentation, entitled "Coexpression of cellulase genes from a single transcript in *Saccharomyces cerevisiae* using a viral 2A peptide sequence").

Prof Emile van Zyl delivering his acceptance speech during the award ceremony of the *Suid-Afrikaanse Akademie vir Wetenskap en Kuns*.
Photo: SA Akademie vir Wetenskap en Kuns



NATIONAL AND INTERNATIONAL COLLABORATORS

Australia

CSIRO, Land and Water

Canada

University of Alberta, Division of Infectious Diseases

Germany

Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung

Namibia

Namibia University of Science and Technology

South Africa

Agricultural Research Council
Council for Scientific and Industrial Research
Elsenburg Agricultural College, Stellenbosch
EWSETA (Energy and Water Sector Education and Training Authority)
Sustainable Livelihoods Foundation
Tshwane University of Technology
University of Cape Town's Division of Medical Microbiology
Virtual Consulting Engineers

The Netherlands

Westerdijk Fungal Biodiversity Institute, Utrecht

Uganda

Makerere University

United Kingdom

Ulster University
University of Bath

FUNDING

Casidra
Cipla India
Cipla MedPro
Claude Leon Foundation
Department of Science and Technology, South Africa
East Rand Water Care Association (ERWAT)
European Commission Horizon2020
Energy and Water Sector Education and Training Authority (EWSETA)
FirstRand Foundation
Fraunhofer-Gesellschaft
Global Challenges Research Fund
National Research Foundation
NRF SARChI research chair for Biofuels
South African Biosystematics Initiative
South African National Energy Research Institute
Stellenbosch University
Technology Innovation Agency
Water Research Commission
Western Cape Government, Environmental Affairs and Development Planning

NRF-RATED RESEARCHERS

INTERNATIONALLY ACCLAIMED RESEARCHERS

- Prof Leon MT Dicks | probiotics and antimicrobial peptides of lactic acid bacteria; nano-biosensor point-of-care devices
- Prof Willem H van Zyl | yeast biotechnology with a focus on cellulosic ethanol and biorefineries (SARChI Chair)
- Prof Gideon M Wolfaardt | applied and environmental microbiology
- Prof Alf Botha | yeast ecology

ESTABLISHED RESEARCHERS

- Dr Heinrich Volschenk | functional bioinformatics for yeast biotechnology
- Prof Karin Jacobs | microbial ecology and taxonomy
- Prof Wesaal Khan | innovation in rainwater treatment and monitoring; biosurfactants as alternative antimicrobials and antifouling agents
- Prof Marinda Viljoen-Bloom | agrobioprocessing with microbial enzymes for the production of biofuels and high-value chemicals

ACADEMIC AFFAIRS

The Department has a large postgraduate student cohort. During 2017, there were 14 BScHons, 27 MSc and 17 PhD students registered, and during 2018 the numbers were 16 BScHons, 21 MSc and 17 PhD students.

SOCIAL IMPACT

Bucket loads of health

Prof Wesaal Khan and her research team collaborated with the Sustainable Livelihoods Foundation (SLF) on a Wellcome Public Engagement project called Bucket Loads of Health. The SLF team use participatory and creative methods to engage with two communities, Enkanini in Stellenbosch and Delft in Cape Town, with varied access to potable water sources. A series of interactive workshops between participants from these communities and water scientists at

Stellenbosch University enabled creative outputs to be shared, and fostered dialogue about the health risks associated with using alternative water sources – especially the storage and recycling of rainwater and grey water. The workshops also provided an opportunity for the scientific team to explain their research to a public audience, and inspired collective thinking about novel and practical measures to increase the safety of water recycling efforts that are appropriate for the different settings.



Prof Khan and her research group are also involved in a European Commission Horizon 2020 project titled “Water: Sustainable Point-of-Use Treatment Technologies (WATERSPOUTT)”. Eighteen research institutes based in Europe and Africa are collaborating to design and develop new integrated solar technologies for drinking water treatment in rural communities. Prof Khan’s research team is primarily involved in work package I which focuses on the design and construction of an enhanced SODIS batch system fitted with a compound parabolic collector (CPC) for the purpose of treating larger volumes (> 80 L) of harvested rainwater. The systems were installed on site in June 2018 and workshops were conducted with the participating households in Enkanini and on Bonfoi farm to discuss the maintenance and operation of the systems.

Prof Karin Jacobs and Casper Brink attended the *Landbouweekblad* conference in Reitz where they had an exhibit of the commercial venture from her lab, Sporotec. They were also invited to present a talk on soil microbiology for 150 farmers from the Rietpoel collective.

STAFF MATTERS

Towards the end of 2017 Dr Lydia-Marié Joubert, manager of the electron microscope unit at SU's Central Analytical Facilities, was appointed as an affiliated professor in the department. Prof Joubert, previously from Stanford University, is an expert in modern electron microscope methodology. During September 2018 Prof Paul J. Weimer, an expert in rumen metabolism from the University of Wisconsin, was appointed as Extraordinary Professor in Microbiology for a period of three years.

Staff list, as at the end of 2018:

ACADEMIC

Prof M Bloom

Prof A Botha (Departmental chair)

Prof LM Dicks (Distinguished Professor)

Prof K Jacobs

Ms T Jansen

Prof W Khan

Prof WH van Zyl (Distinguished Professor; Biofuels Research Chair)

Dr H Volschenk

Prof GM Wolfaardt (Director, Stellenbosch University Water Institute and ERWAT Chair in Water Research)

EXTRAORDINARY PROFESSOR

Prof P. Weimer

EMERITUS PROFESSOR

Prof Doug Rawlings

AFFILIATED

Prof TE Cloete (vice-rector: research and innovation)

Prof LM Joubert

SUPPORT STAFF

J Daniels

LJ Daniels

J de Kock

M Gey van Pittius

M Stuurman

T van der Merwe

L van der Westhuizen

W Wentzel

POSTDOCTORAL FELLOWS

Dr Jayesh Ahire

Dr Edward Archer

Dr Elanna Bester

Dr Kim Bester

Dr Marelize Botes

Dr Casper Brink

Dr Rose Cripwell

Dr Shelley Deane

Dr Maria Garcia

Dr Thando Ndlovu

Dr Lalie Kossatz

Dr Shaunita Rose

Dr Fransesco Salini

Dr Wendy Stone

Dr Lisa Warburg

CONTACT DETAILS

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The Department of Microbiology in 1966. At the back, Mrs J.H van Niekerk, Mr Martin J. Hattingh, Mrs M.L. Gerber, Ms A.A. Ackermann, Mr D.A. Hendry, Ms Breytenback. Seated, Ms M.F. Bekker, Mr N.F. Schoombee, Prof Hennie A. Louw, Mr J.S. Hahn, Ms E. Kotze, Dr M.H.V van Regenmortel (insert).



Photo: SU Archive

The Department of Microbiology in 2018.



Photo: Anton Jordaan



DEPARTMENT OF PHYSICS

RESEARCH INTERESTS

Ultrafast laser science
Spectroscopy and laser diagnostics
Laser development
Trapped ion quantum control
Biophotonics and imaging
Additive manufacturing, X-ray imaging and biomimicry
Solitons in field theory
Quantum phase transitions and exceptional points
Multiparty correlations and Bayesian physics
Condensed matter physics
Soft condensed matter and biological physics
Nuclear physics

RESEARCH HIGHLIGHTS

Chris Engelbrecht Summer School attracts researchers from various disciplines

The 2018 Chris Engelbrecht Summer School might have been one of the most interdisciplinary schools so far conducted within the series. The school, organised by Prof HC Eggers, was sponsored by the National Institute for Theoretical Physics. A total of 51 participants attended; of which 33 were students with backgrounds in physics, astrophysics and cosmology and the rest from computer science, engineering, machine learning and robotics, medicine, neuroscience and psychology. The 14 nonstudent participants and four speakers are active in physics, astrophysics/cosmology, statistics, engineering, computer science and applied mathematical modelling. The school also attracted interest and participants from researchers at IBM and the CSIR.

– Prof HC Eggers

R35 million for new nuclear spectrometer

A consortium of four universities, which includes Stellenbosch University, University of Zululand, University of the Witwatersrand, the University of the Western Cape and the iThemba LABS national facility, has been awarded R35 million by the National Research Foundation (NRF) to acquire a new nuclear spectrometer. The Gamma Ray Spectrometer for Knowledge in Africa, dubbed GAMKA — the Khoisan word for 'lion' — will be housed at iThemba LABS in Faure. It will be used to study a wide range of nuclear physics and nuclear astrophysics phenomena such as nuclear shapes, short nuclear lifetimes and gamma-ray strength functions.

– Prof Shaun Wyngaardt

Dedicated digital data acquisition system for A-line scattering chamber at iThemba LABS

Dr JJ van Zyl had the opportunity to spend six months (January to June 2018) on sabbatical leave to develop and implement a dedicated digital data acquisition system for the A-line scattering chamber at iThemba LABS. This system was successfully

used during the experimental investigation into the sensitivity of the pre-equilibrium (p, α) reaction mechanism to cluster preformation in several stable isotopes of Sn. It has subsequently been implemented in two other experiments at iThemba LABS, one of which is the extensive multi detector BaGeL-campaign which ran from 16 November to 14 December 2018.

– Dr JJ van Zyl

New research group for nuclear safety and security

The National Nuclear Regulator (NNR) requested the Nuclear, Radiation and Health Physics research group in the department to host one of the research units of the Centre for Nuclear Safety and Security (CNSS). The CNSS has been established to support the NNR through research and training. The unit will focus on providing research support on environmental radiation monitoring, and the training of postgraduate students in nuclear science and technology.

– Prof Shaun Wyngaardt

Investigating cytoskeletal and intra-cellular dynamics in cells

Prof Kristian Müller-Nedebock continued a collaboration with Professors Stanley Botchway and Anthony Parker, Drs Andy Ward and Jorge Bernardino de la Serna at the Rutherford Appleton Laboratory in the United Kingdom, supported under the SA-UK Newton fund. The project is studying the cytoskeletal and intra-cellular dynamics in cells by modelling and experimentation, leading to predictions about the geometry, alignment and arrangement of actin filaments or microtubules in cells.

– Prof KK Müller-Nedebock

High localization precision imaging modalities

The single molecule microscopy research group led by Dr GW Bosman focusses on developing imaging systems to locate and track fluorescent objects far below the optical diffraction limit. In essence, the group applies high localization precision imaging modalities to investigate, amongst others, diffusional mechanisms in polymeric and bio-photonics systems. During 2017 and 2018 the group presented their work at various local and international conferences

and extended their activities to developing light sheet microscopes due to collaborations with the Neuro Research Group (NRG), headed up by Prof Ben Loos in SU's Department of Physiological Sciences.

– Dr GW Bosman

Advances in multi-modal nonlinear microscopy techniques

As part of our focus on developing multi-modal nonlinear microscopy techniques, advances have been made in performing single beam Coherent Anti-stokes Raman Spectroscopy measurements of selected solvents. The research now focusses on comparing different implementations of the technique for use in microscopy.

– Prof E.G. Rohwer and Dr P.H. Neethling

New research field in spectroscopy

Resonant ionisation spectroscopy is a new research field started in 2017. We aim to contribute spectroscopic results, intellectual property and human resources to collaborations that will in the long term develop into a radioactive isotope facility and the production of medical radiopharmaceuticals in South Africa. International and South African collaborators from iThemba LABS and industry are involved.

– Dr C.M. Steenkamp

First ion-based q-bits achieved in Africa

The CSIR's trapped ion physics group joined the Department of Physics at SU in mid-2015. Since first trapping ions in early 2016, the group has worked hard to demonstrate quantum behaviour of the ions. In 2018 they observed so-called Rabi oscillations, a quantum version of classical bit flips. This heralds the first demonstration of stationary qubits in South Africa. Qubits are the information storing units in quantum computers and in various quantum sensing applications. This lays the groundwork for all their future investigations on quantum phenomena and applications.

– Prof Hermann Uys



Rabi oscillations are an unambiguous signature of quantum behavior and a critical first step to doing further coherent qubit manipulations.

Image: Hermann Uys

RESEARCH ACTIVITIES

Conferences, research outputs and workshops

Prof Herbert Weigel was invited for a plenary presentation at the seventh International Conference on New Frontiers in Physics which was held in Kolymbari, Greece from 4-12 July 2018. At this event he reported about his research on exotic baryons, particles with a non-standard composition in terms of the fundamental constituents of matter.

Prof Anton du Plessis wrote a comprehensive review paper on the use of X-ray microtomography in additive manufacturing, published in the journal *3D Printing and Additive Manufacturing* and a series of successful projects were also reported in publications in international journals and conferences during 2018. He presented some of this work in Austin, Texas at the Solid Freeform Symposium. He also presented his work at the annual conference of the Rapid Product Development Association of South Africa (Rapdasa), where he is now voted into the management committee. He acted as mentor at a recent workshop held in Bloemfontein on medical applications of additive manufacturing (Newton fund workshop). He published 22 journal papers this year in total, most notably in the journals *Gigascience*, *PlosOne* and *Acta Biomaterialia*.

International research visits

The Department received a significant number of international research visitors. Prof Günther Wunner from the University of Stuttgart, Germany, visited the theoretical physics research group in the first quarter of 2018 continuing his successful collaboration with Prof Dieter Heiss.

During 2017, Prof Herbert Stafast from the Institute for Photonic Technology, Jena, Germany, visited the Laser Research Institute for three weeks and collaborated on the investigation of and free carrier absorption in thin silicon membranes and charge carrier dynamics across the silicon-silicon dioxide interface under femtosecond laser irradiation.

Dr Rhoda Hawkins, from the University of Sheffield, United Kingdom, visited the group of Prof K.K. Müller-Nedebock in July and August 2018 to explore motility and the physical mechanisms involved in the invasion of the malaria parasite into a red blood cell.

Service to the scientific community

The Laser Research Institute (LRI) hosted two African Laser Centre (ALC) workshops during November and December 2017: the annual ALC Student Workshop and a Workshop on Laser Microscopy and Imaging. Prof Piet Walters, Dr Pieter Neethling, Dr Gurthwin Bosman and Prof Erich Rohwer have to be credited for these well-organised and well-received workshops.



Participants at the 10th African Laser Centre Student Workshop hosted by the Laser Research Institute in the Department of Physics during 2017. The workshop was attended by 65 delegates from 19 different countries.

In November 2018, the LRI hosted two African Laser Centre (ALC) workshops: the annual ALC Student Workshop and a workshop on laser tissue interaction and laser imaging. The local organisers were Dr Pieter Neethling, Dr Gurthwin Bosman and Prof Erich Rohwer. The LRI hosted a Photonics Winter School on the topic of "Precision measurement with light" at the 62nd annual conference of the South African Institute of Physics. Prof Hermann Uys was the organizer and there were two international speakers, five South African speakers and 52 participants.



Participants in the 11th African Laser Centre Student Workshop hosted by the Laser Research Institute in the Department of Physics in 2018. The workshop was attended by 43 delegates from 19 different countries.

Dr JJ van Zyl of the nuclear physics research group in the department hosted a summer school in advanced nuclear physics from 26 November to 7 December

2018. It was part of an international agreement between the University of Oslo, iThemba LABS, Lawrence Berkeley National Lab and Stellenbosch University, and is aimed at MSc and PhD students in nuclear physics from the participation institutions. The workshop was funded by the INTPART (International Partnerships for Excellent Education and Research) program. With excellent teachers from across the world, this year's hands-on course focused on shell model calculations, and the 25 participating students were given the opportunity to obtain a deeper understanding of the nuclear shell model and to learn how to do their own shell model calculations using codes like KShell.

– Dr JJ van Zyl



Participants in the summer school in advanced nuclear physics, hosted by the nuclear physics research group in the Department of Physics at SU.

Prof Shaun Wyngaardt of the nuclear physics research group co-organised a workshop for developers of the virtual laboratory platforms at the Department of Physics between 28 October and 2 November 2018. This workshop aimed to share expertise on software development of the virtual laboratory for nuclear physics. The event was co-funded by the Joint Institute for Nuclear Research, the InterGraphics company, and the Development and Research Institute for Virtual Engagement (DRiVE).

Prof Wyngaardt also organised the fifth South Africa-Joint Institute for Nuclear Physics (JINR) symposium on “Advances and Challenges in Physics by the JINR and South Africa” at the Erinvale Estate in Somerset West from 5 to 8 November 2018. Presentations covered topics such as applied and fundamental nuclear physics, underground physics, astrophysics, theoretical physics, environmental nuclear physics, high performance computing, as well as a special workshop on virtual laboratory development.

Prof Heinrich Schworer was elected onto the editorial board of the *IoP Journal of Physics B*. Dr J.J.

van Zyl served on the physics advisory committee of iThemba LABS and chaired the iThemba LABS physics users community in 2018. Prof Paul Papka and Prof Richard Newman of the Nuclear Radiation and Health Physics research group were seconded to manage the Instrumentation and Signal Processing division at the iThemba LABS facility and establish the South African Institute for Nuclear Technology and Science (SAINTS), respectively. The SAINTS program is a consortium of universities, which, in partnership with iThemba LABS, aims to jointly offer educational and training programmes to postgraduate students and professionals working in the nuclear sector.

AWARDS TO STAFF AND STUDENTS

The Suid-Afrikaanse Akademie vir Wetenskap en Kuns awarded the Havenga Prize for Physical Sciences to **Prof Hendrik Geyer**, Department of Physics and director of the Stellenbosch Institute for Advanced Studies (STIAS). Prof Geyer was honoured for his enormous contribution to aspects of quantum mechanics. He is considered a pioneer in the broad field of non-hermetic quantum physics, especially in relation to PT symmetric quantum mechanics. Prof Geyer's leading role in this field is supported by a long series of related publications with both local and overseas colleagues, and he is internationally recognised as one of the founders of this discipline.



Prof Hendrik Geyer (middle)

At the SOTL conference in October 2017 **Dr Christine Steenkamp** received a prize in recognition of her presentation on the research on particularly the first year teaching and learning effort, which focus on core concepts in learning.

Dr Pieter Neethling was the inspiration for the best Occupational Therapy first year student at Tygerberg campus, while **Dr Hannes Kriel** was the inspiration for the best BSc Physical Sciences first year student.



Dr Hannes Kriel

Scott Cameron received the Meiring Naudé Medal for the best BScHons student in Physics, as well as the Dean's medal for the best BSc student in 2017.

Philipp Uhrich received the John Todd Morrison medal for the best MSc student in Physics. **Anthonie de Beer** and **Deon Janse van Rensburg** received book prizes for the best third year students in Physics and the best marks in Physics, respectively.

PhD student **Stanard Mebwe Pachong** received an award for the best poster presentation, "Biophysics Methods to study Biomolecular interactions", at the Sao Paulo School of Advanced Science in 2017. As part of the award, she will attend the 2020 IUPAB Congress, which will be held in Rio de Janeiro in October 2020.

PhD student **Somiéalo Azote** was awarded the best poster prize for her poster on elastic properties of the cytoskeleton at the conference "Physics of Cells from Biochemical to Mechanical", Harrogate, UK, 2018.

Physics students performed exceptionally well at the 2017 Annual Conference of the South African Institute of Physics held in Stellenbosch: **Jason Webster**, the DPCMM MSc Student Presentation Award for the most outstanding oral presentation in the field of Condensed Matter Physics and Material Sciences; **Pelerine Tsobgni Nyawo**, the prize for the best PhD poster presentation in the division for Theoretical and Computational Physics; **Charmaine Sibanda** was awarded the Promising Young Researcher prize for Hons/MSc in the Photonics Division; **Ruan Viljoen**, for the best PhD poster presentation in die photonics division; **Wahsiu Yahya**, Runner up for Oral Presentation by a PhD student in Nuclear and Radiation Physics; **Bart Smit** and **Nancy Payne** jointly won the Photonics Spectroscopy Award for the best presentation on spectroscopy in the photonics division.

At the 2018 annual conference of the South African Institute of Physics held in Bloemfontein the following students won awards: **Kgashane Malatji** for the best PhD poster presentation in Nuclear and Radiation Physics; **Sandile Jongile** for the best Oral Presentation by a PhD student in Nuclear and Radiation Physics; **Charmaine Sibanda** for the best MSc poster presentation in the Photonics division; **André de Bruyn** for the best PhD presentation in the Photonics division; **Paul Williams** for the best presentation at PhD level in the division for Theoretical and Computational Physics.

Honours student in Laser, **Deon Janse van Rensburg** has been awarded the 2018 Meiring Naudé medal for the best Honours student in Physics.

The following top students in physics were awarded with book prizes in 2018: Jan Louw (best MSc student), Anthonie de Beer (best Honours student), and best third year students were Siann Bester, Emma King, Olivia Saffer and Unathi Skosana.

NATIONAL AND INTERNATIONAL COLLABORATORS

Belgium

KU Leuven
University of Antwerp

Bulgaria

Sofia University

China

Beihang University
Chinese Atomic Energy Agency
Peking University
Shandong University

Ethiopia

Addis Ababa University

Germany

Institut für Photonische Technologien (IPHT Jena)
Johannes Gutenberg University
University of Bayreuth
University of Giessen
University of Kiel
University of Konstanz
University of Stuttgart
University of Tübingen
University of Würzburg

Japan

Research Centre for Nuclear Physics

Norway

University of Oslo

Russia

Dubna International University
 Joint Institute for Nuclear Research
 Moscow State University

South Africa

ARMSCOR Alphonso Hendricks Institute for Maritime
 Technology
 Cape Peninsula University of Technology
 iThemba LABS
 Stellenbosch University, Departments of Physiological
 Sciences, Chemistry and Polymer Science, and Biochemistry
 University of Johannesburg
 University of KwaZulu-Natal
 University of the Free State
 University of the Western Cape
 University of the Witwatersrand
 University of Zululand

Sweden

University of Lund

Switzerland

University of Bern

United Kingdom

University of Bristol
 Rutherford Appleton Institute
 Sheffield University

United States of America

Georgia Tech
 Middlebury College
 National Institute of Standards and Technology (NIST)
 Syracuse University

Zimbabwe

National University of Science and Technology (NUST)

FUNDING

ARMSCOR, Virtual Defense Engagement
 Programme and Laser Defense Research Project
 (DESUP)
 CSIR, African Laser Centre and joint research
 chair
 ENSAR grant for first time participation in beam
 time at CERN
 National Research Foundation's (NRF) SA-China
 bilateral collaboration funding
 Newton Fund, Rutherford Appleton Laboratory
 NRF Unrated researchers funding
 African Laser Centre
 CSIR National Laser Centre, Rental Pool
 Programme
 SA-CERN Consortium travel grant
 SA-JINR travel grant
 Stellenbosch University, Faculty of Science and
 Subcommittee B

NRF-RATED RESEARCHERS

INTERNATIONALLY-ACCLAIMED RESEARCHERS

Prof Anthony Cowley	mechanism of proton-induced pre-equilibrium nuclear reactions, alpha-particle clusters in atomic nuclei, light-ion transfer reactions
Prof Hendrik Geyer	quantum mechanics, the quantum mechanical many-body problem
Prof Dieter Heiss	physical effects, significance of spectral singularities
Prof Hugo Touchette	theory of large deviations to predict and understand the response and fluctuations of many-particle systems driven away from equilibrium by forces or external reservoirs
Prof Herbert Weigel	quantum field theories and solitons
Prof Fredrick Scholtz	non-commutative quantum mechanics and quantum field theory
Prof Heinrich Schwoerer	ultrafast charge and energy dynamics in organic matter, organic photovoltaics, structural dynamics in strongly correlated materials
Prof Michael Kastner	quantum many-body physics; geometric and topological aspects of (quantum) phase transitions; magnetism and spin systems; quantum statistical physics applied to atomic physics

ESTABLISHED RESEARCHERS

Dr Fabio Cinti	quantum many-body problems: superconductivity, superfluidity, supersolidity and Bose condensation in condensed matter systems and ultra-cold quantum gases
Prof Erich Rohwer	laser development, laser techniques and applications, laser spectroscopy and microscopy
Prof Hermann Uys	closed loop quantum control and quantum simulation using trapped ions
Prof Hans Eggers	Bayesian analysis in physics, data analysis, experimental high energy physics

Prof Paul Papka	clustering in light $N=Z$ nuclei
Prof Brandon van der Ventel	nuclear scattering reactions; mathematical description of biological systems; technology in education
Prof Richard Newman	radionuclide metrology, environmental radioactivity, dosimetry, radiation transport modelling, radiation safety, elemental analysis, physics education
Prof Anton du Plessis	micro X-ray computed tomography, X-ray imaging, laser spectroscopy, technology and applied sciences
Dr Christine Steenkamp	laser spectroscopy of atoms and molecules, nonlinear optics, laser sources and laser spectroscopy in the vacuum ultraviolet, surface second harmonic generation, laser cooling of atoms and ions
Dr JJ van Zyl	reaction mechanisms governing the emission of light alpha and He-3 clusters; alpha-particle clustering in nuclei such as Ne-20 by means of an array of detectors at iThemba LABS
Prof Shaun Wyngaardt	clustering phenomenon in nuclear matter; relativistic formulation of spin polarized proton induced nuclear reactions; development of a low level underground radiation facility in the Huguenot tunnel

PROMISING YOUNG RESEARCHERS

Dr Hannes Kriel	condensed matter physics with a focus on interacting quantum systems and closed quantum systems out of equilibrium
Dr Pieter Neethling	linear and nonlinear spectroscopic techniques

ACADEMIC AFFAIRS

In December 2017, Prof Kristian Müller-Nedebock and Dr Gurthwin Bosman received a grant for innovation in teaching from the Centre for Teaching and Learning at SU for the project entitled “Fast identification of and response to conceptual, mathematical, background, and terminological problems in first-year physics to redefine future physics assistantships”. The project commenced in 2018 and the results were presented at the SOTL Conference held in November 2018 at the Lord Charles Hotel, Somerset West.

An intervention in the first year modules driven by Dr Christine Steenkamp and Prof Kristian Müller-Nedebock led to a conference contribution at the International Conference on Physics Education, Johannesburg, October 2018.

In 2017 the Department successfully graduated 11 BScHons, 5 MSc and 8 PhD students in physics. In 2018 there were 9 BScHons, 1 MSc and 2 PhD students who successfully graduated.

SOCIAL IMPACT 2017

Postgraduate students' annual outreach roadtrip
The postgraduate student cohort in the Department of Physics is very active in outreach activities. Every year the SU student chapter of the Optical Society of America (OSA) and the International Society for Optical Engineering (SPIE) organise the annual physics outreach initiative. This highly successful outreach initiative is aimed at making high-school learners aware of the enriching opportunities of a career in optics/photonics and physics in general.



The 2017 road trip team. Ruan Viljoen (PhD Laser), Ishmael Takyi (PhD Theoretical), Jason Webster (PhD Laser), Riyaadh Jamodien (MSc Theoretical), Frederik Waso (PhD Laser), Paul Williams (PhD Theoretical), Somiéalo Azote (PhD Theoretical) and Monica Farrell (Hons Nuclear).

In 2017 the outreach group presented a range of interesting and exciting physics experiments and demonstrations to 320 learners and their teachers at high schools in Grabouw, Villiersdorp, Worcester and Paarl in the Western Cape. The learners were divided into smaller groups to enable them to physically interact with the equipment. The smaller groups also allowed the road trippers to interact with the learners and cater their explanations to the learners' level of understanding. During the visits, 500 diffraction glasses donated by SPIE, were handed to the learners.

In 2018 the outreach initiative reached more than 120 learners and their teachers from four high schools in and around Stellenbosch.

Visiting specialists

During July 2017 the SU Chapter of OSA/SPIE invited Dr Robert Lieberman as an invited speaker at the photonics winter school, which were part of the annual conference of the SA Institute of Physics (SAIP). During August 2018 the SU Chapter of OSA/SPIE, in collaboration with the Stellenbosch University Postgraduate Office, invited the science communications specialist Alaina G. Levine to present a workshop aimed at PhD students in STEM. The workshop included themes such as research-life balance, communicating your value as a researcher, and networking. The visit included a dinner for Ms Levine with some of the laser physics supervisors in the Department of Physics. Ms Levine also gave a guest lecture to BSc, and a session on elevator pitches to members of the OSA/SPIE SU chapter.



At the back, Nancy Payne (PhD Laser), Jason Webster (MSc Laser), Frederick Waso (MSc Laser), Ruan Viljoen (PhD Laser). Front: Anneke Erasmus (PhD Laser), Mrs Alaina Levine (visiting science communication specialist), Brandon Hattingh (MSc Laser) and André de Bruyn (PhD Laser).

National Science Week activities

As part of South Africa's National Science week in 2017, the SU Chapter of OSA/SPIE participated in events coordinated by the Physics Department, including several outreach events. Outreach teams performed an hour-long physics demonstration for Grade 9 to 12 learners at Delft Technical High and Kayalitsha High School, with specific emphasis on considering physics as a field of study or career. The cost for this outreach was covered by SPIE/OSA. During National Science Week we organised a Pizza Social to promote the interaction of postgraduate students in the different laboratories in the Department.

The Final year recruitment evening on 19 October 2017 aims to encourage third year students to pursue a BScHons and further postgraduate studies in laser physics. During this event an academic and industry speaker talked about their careers in academia and industry, followed by presentations by an MSc and PhD student. Funding from SPIE and OSA was used for catering purposes.

On 8 August 2017 postgraduate and undergraduate students participated in an interactive quiz evening where topics in Mathematics and Physics in everyday life and at South African national facilities were explored. The event was attended by 23 students.

The final year recruitment event was repeated in September 2018, with Prof Anton du Plessis, an alumnus of the Department, giving a physics-in-industry talk.

The annual Quiz night took place in April 2018 and are aimed at encouraging first year and other undergraduate physics students to follow physics subjects in the field of optics and photonics. The event was funded by grants from SPIE and OSA. The prize winners were Paul Williams, Shane Smith, Timothy Carolus and André de Bruyn from the Department of Physics.

SU Physics Outreach Initiative

As part of the SU Physics Outreach Initiative (SUNPOI) on 12 August 2017, 92 Grade 12 learners and their teachers from Kylemore High School, Cloeteville High School, Kayamandi High School and Masiyile High School were invited to the department. The event included demonstrations of how physics is useful in everyday life, after which they visited the labs where they could perform, with assistance, one of the required practicals in their curriculum.



Learners were given the opportunity to perform one of their prescribed practicals in the department's laboratories.

On 18 November 2017 SUNPOI presented a teachers' workshop to a group of about 40 high school science teachers. During this workshop new teaching techniques were demonstrated and teachers were equipped to perform the required experiments that is prescribed in the CAPS curriculum.

During 2018 the SUNPOI workshops for teachers and learners were repeated. On 4 August 2018 SUNPOI hosted 73 Grade 12 learners from Cloeteville High School, Kayamandi High School, Kylemore High School and Masiyile High School. During the event the learners were granted access to the Department's undergraduate laboratories in order to conduct their CAPS aligned practical experiments. Their experimental results were used for formal assessment purposes. Apart from the experiments, a short recap lecture on physics-based concepts and the correct use of the measurement systems related to the practical were held. The learners were also treated to a 30-minute show, highlighting interesting physical phenomena. This year funding was sourced from the Department of Physics and the South African Agency for Science and Technology Advancement-SAASTA (grant holder: Dr P Neethling).



Physical science teachers from four local high schools attended the annual SUNPOI teachers' workshop on 18 November 2017.

Lectures about the Nobel prizewinners

The departments of Physics, Physiological Sciences and Chemistry and Polymer Science hosted the second annual lecture on the work of the 2017 Nobel prizewinners. Prof Joseph Indekeu from KU Leuven presented a talk on the discovery of gravitational waves (Nobel prize in Physics), Prof Anna-Mart Engelbrecht on the molecular mechanisms controlling circadian rhythms (Nobel prize in Physiology) and Dr Lydia-Marie Joubert on Cryo-electron microscopy (Nobel prize in Chemistry). The evening was very well attended by academics, students and members of the general public.

The very successful third iteration of lectures explaining the work of the 2018 Nobel prizewinners was organised by Dr Pieter Neethling. Dr Neethling spoke about the physics prize, while Dr Carl Albrecht and Prof Dirk Bellstedt spoke about the Physiology and Medicine, and Chemistry prizes, respectively. The event is a collaborative effort between the Departments of Physics, Physiological Science and Chemistry and Polymer Science, and the third event had the largest audience thus far.

Annual Physics Open Day

The Department of Physics hosted the annual open day on 15 August 2017 as part of the department's National Science Week celebrations. Prof Kristian Müller-Nedebock gave a public lecture entitled "Dancing and marching for molecules and other particles".

During 2018 the Open Day was held on 31 July as part of our National Science Week celebrations. Dr Hermann Uys gave a public lecture entitled "How to train your atom and what tricks to teach it".

Catch them when they are still young!

Every year Dr JJ van Zyl entertains a group of five-year olds from Die Wingerd Pre-Primary School in Somerset West. On 28 November 2017 about 30 of them were treated to some interesting and exciting science phenomena. The motto was "feel it, see it, do it". Each had an opportunity to feel the static electricity jump from the charged Van de Graaff generator onto their fingers or raise their hair, taste the shrunken marshmallows once swollen in the vacuum chamber, hear the tin can implode as the atmospheric pressure squashed it and see the brittle roses, frozen in minus 179 °C liquid nitrogen, shatter when touched. After a short picnic break, the kids assembled their own simple electromagnetic motor - something they could take home to remember their science experience. The morning ended with a laser maze through which the kiddies had to navigate without interrupting the many laser beams that kept the music playing.

A group of 30 children from Die Wingerd Pre-Primary School in Somerset West visited again on 4 December 2018. They were shown interesting physics phenomena such as static electricity, the power of atmospheric pressure and the effects of sub-zero temperatures on everyday objects.



A group of five-year-olds from Die Wingerd Pre-primary school in Somerset West attended a "feel it, see it, do it" session at the Department of Physics, organized by Dr JJ van Zyl.

Student Active Learning workshop

The Department hosted an advanced Nuclear Physics summer school as part of an international agreement between University of Oslo, iThemba LABS, Lawrence Berkeley National Lab and Stellenbosch University. The workshop is funded by the INTPART (International Partnerships for Excellent Education and Research) program. Part of the Oslo-Stellenbosch partnership is a focus on skills development in Teaching and Learning. With this in mind, and based on the excellent training during the 2017 summer school, we arranged a short interactive workshop on 4 December 2018 about student active learning for the broader lecturing staff from Stellenbosch and neighbouring universities. Dr Cathrine Tellefsen from the University of Oslo presented an engaging session on “Active learning: Tools and Techniques”.

Celebrating the 2018 International Day of Light

On 16 May 2018 the OSA/SPIE Student Chapter at SU celebrated the International Day of Light through a variety of optics- and light-based events, such as public lectures and an open day. The event formed part of the Faculty of Science's centenary celebrations.

During the Open Day, the OSA/SPIE student chapter also hosted 25 high school learners from Charleston Hill Secondary School, Bergvliet High School, and Paarl Boys High School. After a talk by the Faculty of Science's recruitment and marketing officer, the learners were assisted to build their own spectrometers using paper and a CD. SPIE diffraction glasses were also distributed to the schools as part of learning about spectroscopy. After this they were taken on a tour of the labs in the Laser Research Institute. This gave the learners the opportunity to interact with postgraduate students, ask questions and learn more about what physics research is at a University. We showed students what the average optics lab looks like as well as what lasers can be used for in a research setting, such as ion-trapping and microscopy.

The learners could also explore the demonstrations on their own time, giving them the opportunity to discover different phenomena of light first hand.

The International Day of Light activities concluded with a public lecture by Prof Andrew Forbes from the University of the Witwatersrand, titled “Quirky Quantum Light”.



Learners from three different schools came to the physics building to take part in various hands-on activities. They build their own spectrometers using paper and a CD and look at the spectra of different light sources such as SPIE bulbs of monochromatic light or mercury lamps.

2018 Women in Physics South Africa (WiPISA)

The Department organised a Women in Physics meeting on 20 September 2018 with the aim of getting the female students together and encouraging them to stay in physics by discussing their concerns and worries for their future, and building a sense of community and support within the Department. Several senior staff members and postgraduate students gave short talks on their own experiences, to offer some inspiration and possible role models for female undergraduate and postgraduate students. Another key aim of the event was to identify the issues that students may face, to help the department improve the climate for female students in physics. The speakers were Dr Gillian Arendse, Deputy Director: Division for Student Access at SU, Dr Christine Steenkamp, laser physicist and senior lecturer in the Department of Physics, Dr Daphney Bucher, nuclear physicist at SU and iThemba LABS, postgraduate student Tarryn Baily and “nuclear physicist at SU and iThemba Labs” and PhD student Nancy Payne.

Mandela Day outreach

The Department took part in the 2018 Mandela Day outreach at Kylemore High School, organised by Dr Rehana Malgas-Enus from the Department of Chemistry and Polymer Science as part of the Faculty's centenary celebrations. About 200 Grade 8 learners were treated to an interactive science show, highlighting science in their everyday lives.

STAFF MATTERS

Dr F Azaïez and Dr P Kotze were appointed as extraordinary academic staff members from July 2017 and January 2018 respectively, while Dr Phillip Southey was appointed as a lecturer from April 2018, Mr Gary Andrews as a junior lecturer from September 2018, and Ms Ursula Isaacs as administrative officer BI from August 2017.

Dr Hermann Uys and Dr Anton du Plessis were promoted to associate professors from January 2018.

Staff list, as it was on 2018:

ACADEMIC

Prof EG Rohwer (executive Head 2017)

Mr G Andrews (joined in 2018)

Dr GW Bosman

Dr D Bucher

Prof A du Plessis

Prof HC Eggers

Mr D Geduld (left 2017)

Prof HB Geyer

Dr H Kriel

Prof KK Müller-Nedebock (executive head August 2018)

Dr PH Neethling

Prof RT Newman

Prof P Papka

Prof FG Scholtz

Prof HPH Schwoerer (left 2017)

Dr O Shirinda

Dr CM Steenkamp

Prof H Uys (promoted 2018)

Prof BIS van der Ventel

Dr JJ van Zyl

Prof H Weigel

Prof SM Wyngaardt

EXTRAORDINARY PROFESSORS

Dr F Azaïez

Prof A Forbes

Prof WD Heiss

Dr P Kotze

Dr N Mkhaza

Prof J Meng

Prof T Parker

Dr E Ronander

Prof H Stafast

PROFESSORS EMERITUS

Prof PE Walters

Prof PR de Kock

Prof AA Cowley

Prof HM von Bergmann

SUPPORT STAFF

Ms C April

Mr C Pool

Ms U Isaacs

Ms E Bosch

Mr SH February

TECHNICAL STAFF

Mr P Benting

Mr J Burns

Mr PC Cornelissen

Mr JM Germishuizen

Mr GJ Louwrens

Mr DP Pool

Mr EJ Shields

Mr MC Botha

POSTDOCTORAL FELLOWS

Dr P Adsley

Dr AJ Anslyn

Dr NB Khanyile

Dr SNT Majola

Dr WI Ndebeka

Dr D Nickelsen

Dr OO Olaoye

Dr C Rigby

Dr D Spangenberg

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Web: www.sun.ac.za/physics



Photo: SU Archive

The Department of Physics in 2018. At the back, Prof E.G. Rohwer, Mr H. Esterhuizen, Mr S.H. February, Mr P. Cornelissen, Mr M.C. Botha, Dr O. Shirinda. Third row from the front, Prof H. Weigel, Mr E. Shields, Mr D. Pool, Mr P. Benting, Dr P.H. Neethling, Dr J.J. van Zyl. Second row from the front, Prof S.M. Wyngaardt, Dr J.N. Kriel, Prof W.D. Heiss, Prof K.K. Müller-Nedebock, Dr G.W. Bosman, Dr D. Bucher. In the front, Prof H.C. Eggers, Me C. April, Me U. Isaacs, Dr C.M. Steenkamp, Me E. Bosch.



Photo: Anton Jordaan



DEPARTMENT OF PHYSIOLOGICAL SCIENCES

RESEARCH INTERESTS

Cancer research

Cardio-metabolic research

Cardio-oncology research

Chemotherapeutic resistance in breast cancer and type 2 diabetes

Clinical haemorheology and coagulation research

Metabolic physiology and health

Multidisciplinary stress biology

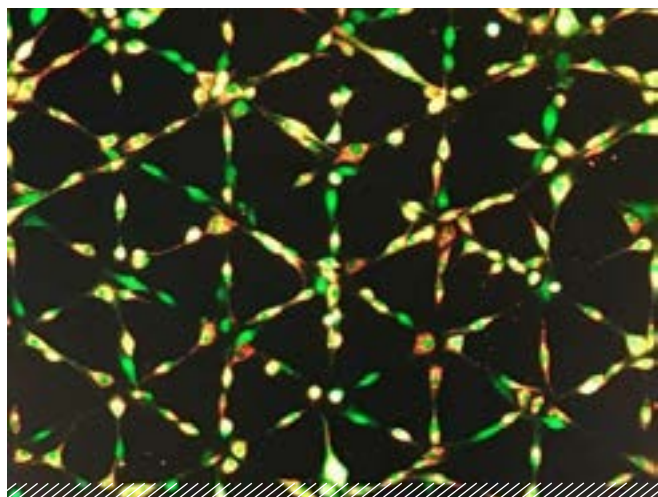
Muscle physiology research

Neuro research

RESEARCH HIGHLIGHTS

Implementing micropatterning

A new technique, micropatterning, has been successfully established in the lab of Prof Ben Loos, allowing precision control of cellular shape and the design of specialized model systems, such as neuronal networks. This allows the generation of unique morphometric analyses.

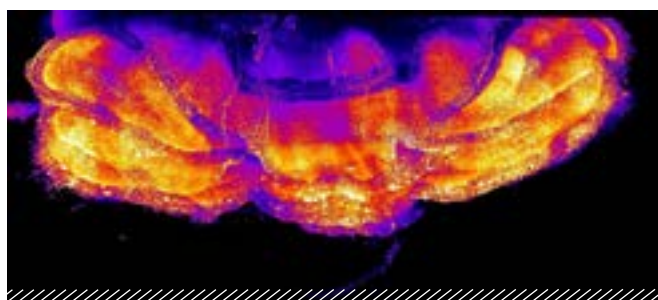


Micrograph: Glioma cell network micropatterned.
Image: André du Toit

Furthermore, a 3D glioma sphere model has been successfully implemented, allowing to study glioma cell death mechanisms and resistance to chemotherapeutic interventions in a more clinically relevant model system.

Postgraduate students André du Toit and Jurgen Kriel attended a workshop on the tissue clearing method CLARITY at Stanford University in 2017, and Dr Ben Loos attended the same workshop in 2018. They have now successfully set up the method here at Stellenbosch University, allowing to prepare (brain) tissue for fluorescence microscopy/imaging approaches.

– Prof Ben Loos



Micrograph: CLARITY processed mouse cerebellum indicating NISSL substance. Image: André du Toit

Implementation of cancer organoids harvested from tumour-bearing mice

It has been proposed that cancer associated fibroblasts (CAF's) play a role in enhancing tumourigenicity and the metastatic capability of cancer cells. However, the mechanisms underlying the interactions between epithelial cancer cells and surrounding stromal fibroblasts remain to be elucidated. Megan Mitchell, a PhD student of Prof Anna-Mart Engelbrecht, investigated the interaction of cancer cells with other cells in their environment, and how these cancer cells manipulate its environment for its growth and survival.

– Prof Anna-Mart Engelbrecht



Representative phase contrast time-lapse images of epithelial organoids harvested from C57BL/6 mice.
Images: Megan Mitchell, 2018

New research area harnesses pathogen practices for immune evasion

We have incorporated microbiology and the study of host-pathogen interaction, but with a significant paradigm shift from the conventional focus, which is to study host-pathogen interaction with the aim of eradicating the pathogen. My group studies these interactions with the purpose of harnessing pathogen “practices” for immune evasion, for therapeutic purposes, such as drug delivery. This novel direction also incorporates polymer science in collaboration with researchers from the University of the Western Cape.

– Prof Carine Smith

First study on exosomes completed

In 2017, we completed our first study on exosomes. Exosomes are nano-sized extracellular vesicles that are released from cells into the circulation. Of importance is that they carry a biologically active cargo that is protected by their double membrane. MSc student Jason Lovett gained a distinction for his research and is now continuing with his PhD in the same field.

Visual inspection of exosomes is only possible with electron microscopy. In 2018 our exosome research was published in a highly ranked physiology journal with an impact factor of 4.1. More remarkable is that it is only the second study of original research on exosomes that has been published by a South African research group. We discovered that a specific microRNA that inhibits the translation of genes that keep muscle progenitor cells “silent” is released in exosomes to a greater extent after muscle-damaging exercise in human volunteers. Since exosome cargo is specifically selected by the cell for export, this indicates that this particular MyomiR has physiological significance. The Department of Physiological Sciences organised the first Western Cape Inter-University Exosome Interest Group Seminar Day. The event was attended by researchers from the Department of Physiological Sciences, SU's Faculty of Health and Medicine, and the universities of the Western Cape and Cape Town.

– Prof Kathryn Myburgh

RESEARCH ACTIVITIES

Research funding and grants

Prof Carine Smith received an NRF competitive grant for rated researchers (2018-2020): The purpose of this study is to cross boundaries of disciplines in science in order to elucidate the origins of chronic disease with a component of inflammation and anxiety. This project combines genetics and physiology. She also received NRF seed funding for a second grant in the prestigious Blue Skies programme, awarded for “out of the box” innovative projects. With this study, the aim is to synthesise an artificial microbe drug delivery system, with which highly toxic drugs may be delivered to specified host sites using manipulated macrophages as drug carriers. A complex sequential, synchronised multi-step uptake and release system will be designed to enable drug delivery with minimal risk to the patient. Third stream income was obtained via a research contract with a company in the natural products industry.

Prof Ben Loos has been awarded the CAN Crick African Network grant, as one of six African partner institutions, shared with Prof Gerhard Walzl in the Faculty of Medical and Health Sciences at SU. This award will enable the training of postdoctoral fellows, in collaboration with the Francis Cricks Institute, London.

Special bursaries were awarded to Mrs Carola Mahachi, a PhD student from Zimbabwe with Prof Kathryn Myburgh as supervisor. She was also a recipient of the L'Oreal Young Scientist Fellowship in 2017. Her research focuses on blood biomarkers for early detection of renal tissue damage. In 2017

Dr Gustav van Niekerk, a postdoctoral fellow in Prof Anna-Mart Engelbrecht's research group, was awarded the prestigious Claude Leon Foundation Postdoctoral Fellowship. In 2018, **Dr Kim Martin** also received the Claude Leon Foundation postdoctoral fellowship. Her research focuses on creating three-dimensional muscle fibres in culture and creating a system for mechanical manipulation and assessment of this tissue constructs.

Prof Anna-Mart Engelbrecht filed two patents: “A method and composition for treating breast cancer” (PCT/IB2015/057392) (Inventors: Anna-Mart Engelbrecht, Nokwanda Magunga); and “Methods, systems and devices for detecting inflammation” (1718708.9 / GB priority founding application)

(Inventors: Resia Pretorius, Anna-Mart Engelbrecht, Willie Perold, Wim de Villiers).

Prof Resia Pretorius is working with a number of collaborators in the fields of biomechanical engineering, cheminformatics, machine learning, nanosensor development, animal models and the internet of things, to form a systems physiology research focus. She also filed a patent: "Methods, systems and devices for detecting platelet activation" (P3492ZA00) in 2018.

MSc student **Martin J Page** received a BBSRC grant from UK Research and Innovation to visit the University of Manchester from March to June 2018 and to attend the ESCHM-ISCH-ISB Conference (2-6 July 2018) in Poland.

BScHons student **Lesha Pretorius** visited the Pediatric Hematology Unit at the Emek Medical Center in Afula, Israel, during two weeks in October 2018 to work with Dr Carina Levin, a pediatric haematologist, to prepare samples for study in South Africa and Israel.

SERVICE TO THE SCIENTIFIC COMMUNITY

Prof Anna-Mart Engelbrecht is a member of the Governing Board and Management Committee of the African Cancer Institute (ACI).

Prof Faadiel Essop is President of the Physiology Society of Southern Africa and vice-president of the African Association of Physiological Sciences. He is chair of the Research and Advisory Committee of the Heart and Stroke Foundation of South Africa and serves as board member of the General Assembly of the International Union for Physiological Sciences. He was an invited speaker at the seventh World Congress on Oxidative Stress, Calcium Signaling and TRP Channels, 20-23 April 2018, Alanya, Turkey; and a plenary speaker at the RAAS Satellite Meeting with a talk entitled "Emerging trends in the endocrinology of cardiovascular disease", preceding the 18th International Congress of Endocrinology, 28-30 November 2018.

Prof Ben Loos hosted the South African Bioimaging symposium in October 2018 at STIAS, as a result of his involvement with Global BiImaging "Exchange of Experience" meetings in 2017 and 2018.

Prof Kathryn Myburgh was a member of the 2018 organizing committee for the Intersociety Meeting for Integrative Physiology of Exercise, a four-yearly international conference organised by the American College of Sports Medicine and the American Physiology Society. She was a keynote speaker at the 2018 Student Sports, Therapy and Rehabilitation Conference, at Marjon University in the United Kingdom; and an invited speaker and session chair at the symposium and workshop on "Skeletal muscle research - from cell to human 2017" hosted by the Institute of Pathophysiology, Faculty of Medicine, University of Ljubljana, Slovenia. Her PhD student Kirankumar Gudagudi attended the World Congress of the Tissue Engineering and Regenerative Medicine International Society, Japan, where he co-chaired one of the oral presentation sessions. Another PhD student, Josh Nederveen from the University of McMaster, Canada, visited the Muscle Research Group in 2017. His travel was funded by an NRF Knowledge Interchange grant. He exchanged significant expertise in multi-colour fluorescence immuno-histochemistry of skeletal muscle biopsy

samples. In 2018, he was awarded a prestigious Canadian postdoctoral fellowship and they are currently collaborating on a research project on skeletal muscle satellite cell responses to high intensity training.

Prof Resia Pretorius gave an invited talk, entitled “Eryptosis or the death of a rigidified erythrocyte” at the joint conference of three societies, the European Society for Clinical Hemorheology and Microcirculation, the International Society of Biorheology, and the International Society for Clinical Hemorheology (ESCHM-ISCH-ISB 2) which took place on 6 July 2018 in Poland. She presented another invited talk, entitled “Investigating the Use of Novel Research Technologies with particular reference to Diabetes and Cardiovascular Disease”, at the First Synexus Symposium on Clinical Research, 14 March 2018, Midrand, South Africa. She was chair of a symposium on “The novel discovery of amyloid formation in fibrin(ogen) and how it affects hemorheology and blood coagulation” at ESCHM-ISCH-ISB 2, July 2018. She presented papers and a poster at a number of conferences:

- ESCHM-ISCH-ISB 2, July 2018;
- Platelets 2018 tenth International Symposium, Israel, 21-25 April 2018;
- Oral presentation with Prof Willie Perold, entitled “Biosensing devices for the early detection of cancer and the presence of inflammatory conditions”, at the fifth SMEOS Conference (Sensors, MEMS and Electro-Optical Systems), 8-10 October 2018, South Africa.

Prof Carine Smith was chair of the local organising committee for the annual conference of the Physiological Society of Southern Africa (PSSA), Stellenbosch, October 2018. This year, the PSSA had their annual conference as part of an inaugural joint meeting with several other science societies – the First Conference of Biomedical and Natural Sciences and Therapeutics (CoBNeST). She also represented the PSSA on the main organising and scientific committees for CoBNeST. Prof Smith is a registered Medical technologist with HPSCA registration.

Dr Theo Nell was part of local organizing committee for the annual conference of the Physiological Society of Southern Africa (PSSA) during October 2018. Dr Nell is a registered Medical Biological Scientist at the HPCSA.

EDITORIAL ACTIVITIES

Prof Kathryn Myburgh is editor in Chief of *BMC Physiology*.

Prof Carine Smith was guest editor for a special issue in *Oxidative Medicine and Cellular Longevity*. She is a member of the editorial boards of *Inflammopharmacology* and *Frontiers in Pharmacology*.

Prof Resia Pretorius is associate editor of the *Journal of Holistic and Integrative Medicine*. She is a member of the editorial boards of the *American Journal of Immunology*, *Ultrastructural Pathology*, *Applied Cell Biology*, and *Medical Archives*.

Prof A-M Engelbrecht is a member of the editorial boards of the journals *Frontiers Journals*, *International Journal of Biomedical Sciences*.

Prof Faadiel Essop is academic editor of *PLOS ONE* and member of the editorial boards of the *American Journal of Physiology* (Heart and Circulation Physiology), *Physiology*, and *Physiological Reports*.

AWARDS TO STAFF AND STUDENTS

Prof Resia Pretoria was the recipient of the National Science and Technology Forum's (NSTF) award for an established researcher (2018).

Postgraduate students fared well at the inaugural meeting of the Conference of Biomedical and Natural Sciences and Therapeutics (CoBNeST) held at Spier in October 2018. PhD student Yigael Powrie won the best student poster award and postdoctoral fellow Dr Ayodeji Oyenihi won the best non-student poster award. Two MSc students, supervised by Prof Anna-Mart Engelbrecht, won second and third prizes for best posters at the same meeting.



From left to right, Dr Ayodeji Oyenihi, PhD student Yigael Powrie, Daleen Conradie, Tracy Ollewagen and Carla Fourie. Cameron Sugden was absent when the photo was taken.

Photo: Wiida Fourie-Basson

PhD student Tracey Ollewagen, supervised by Prof Kathryn Myburgh, was awarded a special International Student Travel Grant by the American College of Sports Medicine to attend and present a poster at the 2018 annual congress in Minneapolis, USA.

Prof Faadiel Essop received a SU Media Excellence Award for thought leadership, as well as a SU Teaching Excellence Award and first prize for best practice-based paper at the 11th annual SOTL Congress.

New research infrastructure

In 2018 the Muscle Research Group, under the leadership of Prof Kathryn Myburgh, acquired Nanotracking Analysis (NTA) equipment that is specialised to analyse nano-sized particle numbers in biological samples (30 to 500 nm in diameter). Previously, samples were sent to the CSIR for the exosome number and sizes to be analysed.

NATIONAL AND INTERNATIONAL COLLABORATORS

Austria

Medical University of Vienna

Brazil

Universidade Estadual de Campinas (Unicamp), Instituto De Biologia

Canada

University of British Columbia
University of Toronto

France

University of La Réunion
University of Montpellier

Germany

University of Heidelberg

India

Jawaharlal Nehru University, School of Biotechnology

South Africa

Cape Peninsula University of Technology
National Aquatic Bioassay Facility, Northwest University
North-West University
Stellenbosch University
University of Cape Town
University of KwaZulu-Natal
University of Pretoria
University of South Africa

Spain

University of San Jorge, Zaragoza

Tunisia

Pasteur Institute of Tunis

United Kingdom

Bath University
John Moores Liverpool University
University of Coventry
University of Liverpool
University of St Mark and St John
University of Manchester

Zimbabwe

University of Zimbabwe

FUNDING

Cancer Association of South Africa (CANSA)
 European Union Marie Curie Grant
 Medical Research Council
 National Research Foundation (NRF)
 National Research Foundation: South African
 Research Chair Initiative grant.
 Stellenbosch University Sub-committee B
 Technology Innovation Agency

NRF-RATED RESEARCHERS

INTERNATIONALLY ACCLAIMED RESEARCHERS

Prof Kathryn Myburgh | skeletal muscle physiology,
biology and biotechnology

Prof Resia Pretorius | clinical haemorheology and
coagulation research

ESTABLISHED RESEARCHERS

Prof Anna-Mart Engelbrecht | tumour micro-
environment and
chemotherapy resistance

Prof Faadiel Essop | cardio-metabolic diseases

Prof Carine Smith | multidisciplinary research
to elucidate the role
of inflammation in
chronic disease – both
systemic inflammation and
neuroinflammation

PROMISING YOUNG RESEARCHERS

Prof Ben Loos | Autophagy in
neurodegeneration and
gliomas, molecular imaging
techniques

ACADEMIC AFFAIRS

Prof Kathryn Myburgh acts as mentor for Dr Mari van de Vyver from the Department of Medicine. In 2017, Dr van de Vyver's postdoctoral fellowship and research contract came to an end and in 2018 she was appointed as a research associate with a permanent position. This mentor-mentee relationship is part of SU's Early Career Academic Development (ECAD) programme.

SOCIAL OUTREACH

Prof Ben Loos and postgraduate students Jurgen Kriel and Sholto de Wet participated in the WeCode24 Hackfest event at Bernadino Heights High School, Kraaifontein. They exhibited their Virtual Reality system that is used to interrogate complex biological samples such as labelled cells in 3D. The Virtual Reality approach is based on a collaboration with Prof Thomas Niesler from the Department of Electrical Engineering and is aimed at developing tools for precision sample analysis in 3D.

Prof Resia Pretorius participated in the NSTF's Share and Dare program, visiting rural schools in KwaZulu-Natal during September 2018.

Prof Anna-Mart Engelbrecht, Dr Theo Nell, Prof Resia Pretorius and Dr Greame Ellis participated in a Science Café Stellenbosch at Woordfees 2018, with a panel discussion on "Sugar and Stress". Prof Engelbrecht is also a member of the Science Café Stellenbosch organising committee since 2015.



"Sugar and stress: here comes trouble" was the theme of a Science Café at Woordfees 2018, with speakers Prof Anna-Mart Engelbrecht, Dr Theo Nell, Prof Resia Pretorius and Dr Graham Ellis.

Photo: Stefan Els

On 25 April 2018 Prof Engelbrecht participated in a public seminar, organised by the Faculty of Law and Innovus, to mark World IP Day, with the theme “Powering change: Stellenbosch woman in innovation and creativity”.

Prof Faadiel Essop’s postgraduate students played a key role to organize World Heart Day on SU’s main campus on 29 September 2018. This was in conjunction with Campus Health and the Heart and Stroke Foundation of South Africa.

STAFF LIST

as at the end of 2018:

ACADEMIC

Prof A-M Engelbrecht

Prof MF Essop

Prof B Loos

Prof KH Myburgh

Dr T Nell

Prof E Pretorius (departmental head)

Dr B Sishi

Prof C Smith

Dr JADW Strauss

EXTRAORDINARY PROFESSORS

Prof DB Kell

Prof I Laher (University of British Columbia)

RESEARCH FELLOW

Dr G Ellis

SUPPORT STAFF

Dr D Joseph

Dr A Krygsman

Mrs G Simon

POSTDOCTORAL FELLOWS

Dr T Davis

Dr G Deshpande

Dr K Martin

Dr A Oyenihi

Dr G van Niekerk

Dr D van Staden

Dr N Woudberg

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Department of Anatomy and Histology in 1970s.



Photo: SU Archive

Department of Physiological Sciences in 2018.



Photo: Wiida Fourie-Basson

