

Report
2007

Faculty of
Natural and Agricultural Sciences



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Faculty of Natural and Agricultural Sciences

Report 2007

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Preface

From the Dean's Office



Prof. Herman van Schalkwyk

The faculty positioned itself in 2007 through world-class research and community service as a faculty where there is no substitute for excellence. This included areas as diverse as parasitology, environmental and water management, physics, chemistry, microbiology and food technology, building sciences and construction management, sustainable agriculture and the development of new crops.

Research outputs were strengthened by the extension of a purposeful strategy to acquire high quality scientists and researchers, purchasing expensive laboratory equipment and investing in infrastructure. A number of agreements were reached with suppliers of equipment, making it more affordable for the faculty.

The faculty's research outputs are still on the increase. In 2006, 252 articles appeared in accredited journals. This figure increased to 275 in 2007 – an average increase of 1%. This is mainly thanks to the dedication of the faculty's researchers.

Six of the faculty's researchers increased their evaluation status with the National Research Foundation (NRF). Three researchers applied to the NRF for first-time evaluation and were successful.

Research in the faculty received a further boost with a grant of R13.7 million from BioPAD to the Department of Microbiology, Biochemical and Food Biotechnology's Biochemical division to conduct research on pre-historic organisms. BioPAD is a South African biotechnology company that forms partnerships between researchers, entrepreneurs, businesses, government and other role-players in order to advance innovation and develop sustainable biotechnological companies. The contract entails the establishment of a Platform for Metagenomics – a technique which enables researchers to extract DNA from microbes for further investigation in a laboratory.

A project of more than R40 million to upgrade the facilities of the Department of Chemistry continued, despite a fire which destroyed four of the research laboratories and caused several millions of rand worth of structural damage as well as damage to the apparatus. When this upgrading is completed the department will be reckoned under the best chemistry departments in the world.

The faculty's student numbers showed a steady growth from 4 179 under-, postgraduate and occasional students in 2006, to 4 727 in 2007. There is also a strong representation of foreign students with more than 400 students from mainly Africa, but also Europe and Asia studying at the faculty.

A Marketing Manager for the faculty, Mr Nelis Maeder, was appointed in 2007 to especially assist with writing business plans and proposals and to handle the marketing thereof to external investors.

Two successful contracts were signed with the Southern African Development Community (SADC) and the Mangaung Local Municipality.

In its pursuit of quality and excellence and to improve its through flow rates, the faculty appointed Mr Johan Kruger as

Learning and Teaching Manager at the beginning of 2007. His initial focus is on courses in the first year of the extended and general programmes. The faculty is looking at new learning and assessment methods for both the general and extended undergraduate programmes in order to improve throughput rates and quality teaching.

The faculty increased its involvement at school level with the development of a project that will assist with the development of learning material in mathematics and sciences and to assist teachers with the use of their learning material.

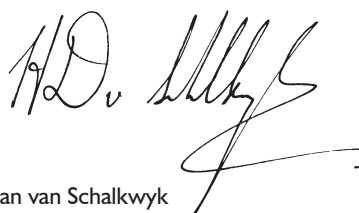
Several staff members from the faculty were named on national committees and councils. Prof. Kobus Laubscher from the Department of Agricultural Economics was appointed as chairperson by the National Productivity Institute's Social Plan and Productivity Advisory Council, and Ms Sheila Vrahimis from the Department of Geography was appointed on the Free State Naming Committee.

Where community service learning is concerned, the faculty is still making its mark. The Lengau Agricultural Development Centre continued with its activities in 2007 and many outreach activities, among others farmers' days and training, followed.

The latest addition to the programme is the HIV/Aids initiative among farm workers to inform them about the disease, how to deal with it and how to prevent it.

To be dynamic and excellent requires innovative thinking and commitment. It requires the delivering of excellent teaching and learning opportunities to students. It also requires a willingness to build partnerships, and a multi-disciplinary and practical approach to the South African tertiary education environment.

This report covers the activities of the faculty in 1007. It is a reflection of a years' commitment on the part of a team of skilled and motivated academics and support staff.



Prof. Herman van Schalkwyk
Dean: Faculty of Natural and Agricultural Sciences
University of the Free State

Faculty and Free State Department of Agriculture take hands

Mr Casca Mokitlane, Member of the Executive Council (MEC) for Agriculture in the Free State, visited the Faculty of Natural and Agricultural Sciences and had investigative discussions with Prof. Herman van Schalkwyk, Dean of the faculty, on how a more focused strategic leadership for the development of agriculture in the Free State province can be established. Important agricultural issues between the faculty and the department were identified in order to build a more vibrant and sustainable agricultural industry in the province. Mr Mokitlane was also informed about the research done at the faculty, training programmes offered and the roles currently played by the different divisions in terms of community service. Both parties were in agreement that the one cannot function without the other and that, in the interests of agriculture, they must move closer to each other to face the challenges ahead.



Here are, from the left: Mr Mokitlane, Prof. Van Schalkwyk, and Mr Tshepiso Ramarakane, Head of the Department of Agriculture in the Free State.

Faculty hosts exchange students from Virginia Tech



A group of 13 exchange students from Virginia Tech in the United States of America (USA) visited the faculty as part of an Ecology course. Attending the welcoming function are, from the left, front: Rockey Warren, Katie Lottinville, Ashley Wright, Prof. Leon van Rensburg, Professor in the Department of Soil, Crop and Climate Sciences at the UFS; back: Prof. Herman van Schalkwyk, Dean: Faculty of Natural and Agricultural Sciences at the UFS.

Links with Dronten University strengthened

The Faculty of Natural and Agricultural Sciences and the CAH Dronten Professional Agricultural University in the Netherlands, expanded and strengthened the relationship between the two institutions with the signing of a letter of undertaking between Dr Will Beckering from Dronten and Prof. Herman van Schalkwyk, Dean of the faculty. The letter paved the way for the establishment of a memorandum of understanding and implementation agreements between the two institutions. Both institutions share an interest in the training of emerging farmers, the carrying out of an agricultural skills development project, short-term visits of staff for consultations and lecturing, and formulating and implementing projects on capacity development to broaden access to professional education. They also share an interest in the exchange of students for study programmes, placement projects, curricular development, more especially the possibilities of developing a joint master's degree programme, and the identification of possibilities of the use of e-learning in joint educational programmes.



Signing the letter of undertaking are, from the left, front: Dr Bechering, and Prof. Van Schalkwyk, back: Dr Aldo Stroebel, Head: Internationalisation at the UFS, and Prof. Izak Groenewald, Director: Centre for Sustainable Agriculture and Rural Development at the UFS.

Faculty facilitates historic meeting between NAFU and Free State Agriculture



Here are, from the left: Mr Louw Steytler, President of Free State Agriculture, Prof. Van Schalkwyk, and Rev Otto Mbongula, President of NAFU in the Free State.

A significant breakthrough in the agricultural sector took place when Prof. Herman van Schalkwyk, Dean: Faculty of Natural and Agricultural Sciences facilitated a meeting between Free State Agriculture and the National African Farmers Union (NAFU). During the meeting the two parties decided to work together in future in various areas to achieve collective objectives for the agricultural sector. The parties agreed to talk to each other regularly and to identify differences and similarities to the advantage of the province's economy. The parties also agreed to involve other role players in the discussions in due course, and communication with the Provincial Government was highlighted as an important point of departure.

Courses of SADC's regional training programme presented by the faculty



The first module in a series of three service contracts of the Southern African Development Community's (SADC) Promotion of Regional Integration (PRINT) programme, entitled Delivery of a Regional Training Program in Livestock Marketing and Trade was presented by the Department of Agricultural Economics on the Main Campus in Bloemfontein. The module is part of a short course in Livestock Marketing and Trade sponsored by SADC PRINT and the European Union (EU). The course was attended by 14 participants from 11 member countries. From the left are: Mr Gerard Oosterwijk, Training Advisor, SADC PRINT, Dr Welbourne Madzima, PRINT Livestock Co-ordinator, Prof. Herman van Schalkwyk, Dean: Faculty of Natural and Agricultural Sciences at the UFS, and Ms Temana Johny, Administrative Assistant, SADC PRINT.

Faculty publishes report



In June 2007 the faculty published a report in which the various departments and centres highlighted their activities for 2005/06. Pictured here are some of the departmental chairpersons during the launch of the report.

Dean's office excels



Prof. Neil Heideman

Prof. Neil Heideman, Vice-Dean of the Faculty of Natural and Agricultural Sciences at the UFS, was awarded a Fulbright Senior Researcher Fellowship. He returned from the United States (USA) at the end of April 2007 after a six-month visit to the laboratory of Prof Jack Sites, a fellow herpetologist at Brigham Young University, Utah. Prof Heideman used the opportunity to apply microsatellites (short repetitive sequences in DNA molecules) to population genetics questions in threatened legless skinks from the Cape West Coast. In recent years microsatellites have become the marker of choice for measuring genetic variability in populations. Prof. Sites has extensive experience in the application of the technique and was therefore an ideal candidate to spend time with. Although not new to South Africa, the country's capacity in the use of microsatellites is still very limited, being essentially non-existent among herpetologists.

Prof. Herman van Schalkwyk, Dean of the faculty, was appointed by the national Minister of Agriculture as non-executive director on the Council of the Land Bank and as member of the National Agricultural Marketing Council (NAMC).





Prof. James du Preez

Department of Microbial, Biochemical and Food Biotechnology

Overview

One of the highlights of the year for the Department of Microbial, Biochemical and Food Biotechnology was the inauguration of the BioPAD Platform for Metagenomics in March 2007, which forms part of a network of specialist platforms for research in South Africa. BioPAD is a Biotechnology Regional Innovation Centre established by the national Department of Science and Technology (DST).

This biotechnology research contract, worth R13.7 million and which includes equipment, student bursaries and postdoctoral fellowships awarded by the BioPAD Board of Trustees, is one of the biggest research contracts awarded to the UFS in recent years. The platform is managed by Dr Esta van Heerden, who also leads the research together with her two colleagues, Prof. Derek Litthauer and Dr Lizelle Piater. The steering committee includes representatives from BioPAD and the UFS. The focus of the research is the screening of mostly unculturable extremophiles and their (meta)genomes, since these are constantly exposed to ever-changing micro-environments that necessitate their perception of and adaptation to such conditions in order to survive.

Successful micro-organisms, probably better described as specialist communities, are believed to have evolved a variety of mechanisms, specifically genes and gene products, in this regard. Bioprospecting of these extreme biodiversities through the construction of metagenomic libraries presents infinite possibilities of unearthing extraordinary and unique micro-organisms and genes or gene products (especially extremozymes) that, ultimately, may contribute significantly to industrial processes, improved products, bioremediation of contaminated sites and, ultimately, the economy of the country. This research will also contribute to our understanding of the significance of our own extreme ecosystems. It is further anticipated that the research project will contribute to the preservation of biological and genetic material that is unique to South Africa.

The research infrastructure of the department for molecular biology was further improved as a result of Prof. Koos Albertyn's successful application for R760 000 from the National Research Foundation's (NRF) National Equipment Programme towards the purchase of a DNA sequencer, namely an ABI PRISM 3130XL-16 Capillary Genetic Analyser. The department also acquired a Molecular Dynamics GenePix4000B

microarray slide scanner and a Bio-Rad Pharos Plus two-dimensional proteomics gel scanner, funded by an NRF National Equipment grant awarded to Prof. Hugh Patterson in 2007. In addition, an Applied Biosystems QTRAP 4000 hybrid ion-trap mass spectrometer fitted with an Agilent 1200 Nanoflow High Performance Liquid Chromatography system was acquired with partial funding from the Strategic Cluster initiative of the university. These items, housed in the departmental Facility for Genomics and Proteomics, provides a platform for modern, high-throughput biological research.

Another highlight in October was the start of construction of a Bioinformatics laboratory that will include a 30-workstation lecturing facility for bioinformatics and related teaching, adjacent to the Biotechnology building. This is the final result of a grant to Prof. Patterson for the establishment of a bioinformatics node at the UFS as a faculty facility that will link with the National Bioinformatics Network. The aim of the university's node is to perform internationally competitive research in bioinformatics, contribute to capacity building in bioinformatics by the training of students at under- and postgraduate levels, and to host training workshops for students and staff. The bioinformatics node will also be involved in providing computational support to projects that include bioinformatics components.

Planning has also started for upgrading the Biotechnology building, which will make provision for the increased demand for laboratory space by adding a wing that will include new undergraduate laboratories so that the existing undergraduate laboratories may be converted to research laboratories to accommodate the increase in research activities in the department.

The department has 11 NRF-rated academics, including four B-rated scientists. In the 2007 *Evaluation and Rating Facts and Figures* publication of the NRF, the university is listed in second place under the top performing higher education institutions in terms of the number of rated researchers (11) in the specialist field of Microbiology and Plant Pathology. Eight of these 11 rated scientists are members of the department.

The department is represented on the editorial boards of several international journals. Prof. Bennie Viljoen serves on the editorial board of the journal *Food Microbiology* and Prof. James du Preez, Departmental Chairperson, is an associate editor of



Some of the foreign postgraduate students and postdoctoral fellows in the department during 2007 are front, from the left: Mss Kulsum Kondiah, Kenya, Kasweka Kakoma, Zambia, Mai Nguyen, Vietnam, Chikondi Mattaka, Malawi, Dr Khajamohiddin Syed, India, and Mr Simbarashe Mabwe Zimbabwe; back: Messrs Rudolf Schäfer, Germany, Joseph Katongole, Uganda, Mss Ji-Yun Lee, South Korea, Limpho Ramorobi, Nthabiseng Matsoha, both from Lesotho, Prof. James du Preez, Departmental Chairperson, Mr Olukayode Kulooy, Ms Elizabeth Ojo, both from Nigeria, and Dr Antonio García- Moyano, Spain. Mr Schäfer is a chemical engineering undergraduate from the Mannheim University of Applied Science in Germany participating in a research programme to gain practical experience in fermentation biotechnology as part of his course requirements.

the *World Journal of Microbiology and Biotechnology* and serves on the editorial boards of *FEMS Yeast Research* and the e-journal *Biotechnology for Biofuels*.

The department was well represented at international congresses. Prof. Lodewyk Kock and six of his postgraduate students from the Lipid Biotechnology Group presented their research at the Asian Mycology Congress (AMC2007) and 10th International Marine and Freshwater Mycology Symposium held on the island of Penang in Malaysia. At this congress Mr Desmond Ncango, a Ph.D. student, was awarded first prize in the Biochemistry and Industrial Mycology section for his poster presentation and Mr Olihile Sebolai presented a lecture. These students were fully sponsored by the South African Fryer Oil Initiative (SAFOI), which is part of the Lipid Biotechnology Group. The 26th International Specialised Symposium on Yeasts (ISSY 26), held in Sorrento, Italy, was attended by Profs Kock, Du Preez (both members of the International Commission for Yeasts, which convened during the symposium), and Betty Lodolo (of the South African

Breweries Limited (SAB) and also affiliate associate professor in the department) who presented a keynote lecture with Prof. Kock as co-author. The other members of the group were Profs Albertyn, Viljoen, Ms Chantal Smith, Ms Andri van Wyk and Ms Olga de Smidt who presented a paper from her Ph.D. thesis at this symposium. Prof. Kock also served on the International Scientific Committee of this symposium and acted as chair of one of the sessions. In addition, SAFOI partly sponsored ISSY 26.

Prof. Du Preez attended the 13th European Congress on Biotechnology held in Barcelona, Spain. Dr Van Heerden, Prof. Litthauer and Mr Dirk Opperman, a Ph.D. student, attended the 9th International Thermophiles Conference held in Bergen, Norway. Mr Opperman received a travel grant from the Oppenheimer Trust and the faculty contributed towards his conference registration. Participation in other congresses included the Deutsche Gesellschaft für Fettwissenschaft (DGF) Symposium in Hamburg, Germany attended by Dr Manjusha Joseph, Biocatalysis-2007, Moscow, St. Petersburg, Russia attended by Prof. Martie Smit, BIOTRANS

2007 in Oviedo, Spain attended by Prof. Smit and the World Veterinary Poultry Association Congress in Beijing, China where Prof. Rob Bragg presented seven lectures and chaired one of the sessions at the congress.

Other overseas visits included that of Prof. Litthauer and Dr Van Heerden to the Department of Biology at the University of Bergen to discuss collaboration on phage diversity in the environment. Dr Van Heerden, who is a member of the local organising committee for the international Extremophiles 2008 conference, also met with the international organising committee for the conference and visited the Department of Georadiochemistry at the Institute for Interdisciplinary Isotope Research in Leipzig, Germany to discuss collaborative projects. Prof. Smit visited the group of Dr Vlada Urlacher at the Institute for Technical Biochemistry in Stuttgart, Germany and attended a three-day workshop to determine priorities for a South Africa-UK Science Network in Catalysis in Cardiff, Wales.

Profs Du Preez and Viljoen were invited to the University of Lund in Sweden

and the Norwegian University of Life Sciences in Norway, respectively, as the opponents in a Ph.D. defence. Prof. du Preez also presented a lecture on the role and regulation of alcohol dehydrogenases in *Saccharomyces cerevisiae* at the University of Lund. Prof. Patterson visited the Joliot-Curie Laboratory of the *Ecole Normale Supérieure de Lyon* as invited professor from April to May and presented invited seminars at the Joliot-Curie Laboratory, CNRS in Lyon (with Dr Philippe Bouvet as his host), the Laboratoire de Biologie Moléculaire Eucaryote, CNRS in Toulouse (with Dr Michael Georgiev as his host), the Institut André Lwoff, CNRS in Paris (with Dr Ali Hamische as his host), and at the Université Joseph Fourier in Grenoble (with Dr Stefan Dimitrov as his host).

Members of the department participated in various collaborative research programmes. The Food Biotechnology group under the leadership of Prof. Viljoen was successful in obtaining a South Africa/Norway collaborative project based on a project entitled: *Prospecting probiotics and antimicrobials in indigenous fermented milks*. An amount of more than R2 million was allocated over a three-year period. The project on indigenous fermented foods in Southern Africa was expanded to include researchers from Zambia, Mozambique, Swaziland, Zimbabwe and Lesotho. Part of this work is sponsored by the Norwegian Council of Universities Committee for Development, Research and Education (NUFU). Prof. Viljoen is currently the external programme co-ordinator for the Institute of Food, Nutrition and Family Sciences at the University of Zimbabwe, and the School of Agricultural Sciences at the University of Zambia.

The department is also involved in the international National Earthquake Laboratory in South African Mines project (NELSAM) and has active contracts with GFZ (GeoForschungs Zentrum Potsdam) and the Oklahoma University in the United States of America (USA) for a five-year period to facilitate expertise transfer, student bursaries and equipment donations to the department.

Collaborative research projects are in place with the Laboratoire de Génétique des Microorganismes of the Institut National Agronomique, Paris-Grignon in France on the non-conventional yeast *Yarrowia lipolytica*, and with the Institute of Technical Biochemistry at the University of Stuttgart in

Germany on the engineering of self-sufficient cytochrome P450 monooxygenases. Future collaboration with the department of Botany and Microbiology at the University of Lagos in Nigeria on the cloning of alkane degrading P450s from polluted environments is being investigated. Prof. Bragg has research agreements with Ewabo (Germany) and Mercordi (Belgium) for product testing.

Other research collaboration includes the Obihiro University of Agriculture and Veterinary Medicine in Japan and the University College of Cork in Ireland.

Prof. Philippe Bouvet from the Laboratoire de Biologie Moléculaire de la Cellule at the Ecole Normale Supérieure de Lyon visited the department at the end of March as part of the CNRS/NRF collabo-



The "international" team that was the winner of the UFS section of the National Innovation Fund competition for students are, from the left: Ms Kasweka Kakoma, Zambia, Mr Lehlohonolo Mathengtheng, South Africa, Prof. Rob Bragg, mentor, and Ms Ji-Yun Lee, South Korea.



Some of the guests attending the launch of the BioPAD Platform for Metagenomics research contract are: Drs Siyabulela Ntutela, Deputy Director: Biotechnology at the Department of Science and Technology, Godfrey Netswera, Manager of Thuthuka and the Support Programme at the National Research Foundation (NRF), Esta van Heerden, Platform Manager and lecturer at the department, Mr Butana Mboniswa, Chief Executive Officer of BioPAD, and Mr Vuyisele Phehani, Portfolio Manager for BioPAD.

rative exchange programme. Prof. Bouvet, who obtained his Ph.D. from Harvard University in the USA and completed postdoctoral training at the National Institute of Health, gave a seminar on the role of nucleolin in chromatin structure and gene expression and also met with several research groups in the department. Prof. Judy Narvhus (Norway), Dr Tony Mutukumira (Swaziland) and Dr Henry Gadaga (Lesotho) again visited the department in December as part of the Food Biotechnology programme. Prof. Bärbel Hahn-Hägerdal of the University of Lund in Sweden was appointed as Professor Extraordinary in the department. Prof. Edgar Da Silva from Paris, a current Professor Extraordinary in the department and former director of the United Nations Educational, Scientific, and Cultural Organisation's (UNESCO) Division of Life Sciences, visited the department in September and presented several lectures. Sadly, he passed away shortly afterwards while on a visit to India. This tragic loss was compounded by the death of Prof. Santosh Nigam, also a Professor Extraordinary in the department, in Berlin about a month earlier.

On national level the department collaborated on research with Onderstepoort Biological Products, ICA International Chemicals (Pty) Ltd., Mintek, Agave Distillers (Pty) Ltd., the NRF-DST Centre of Excellence in Catalysis hosted by the University of Cape Town (UCT), Stellenbosch University, the Tshwane University of Technology, the University of Fort Hare and Tiger Brands. Prof. Patterson collaborated with the National Bioinformatics Network on the development of bioinformatics in South Africa. Prof. Bragg of the Veterinary Biotechnology research group has an ongoing collaborative project with Prof. Ed Rybicki's group at UCT on the development of vaccines for the control of the Psittacine Beak and Feather disease virus. This virus is currently one of the major threats to the highly endangered and endemic Cape parrot. An experimental DNA vaccine has been successfully developed and testing in birds will start in January 2008.

Dr Arno Hugo undertook a project on Nguni meat quality in collaboration with researchers from the University of Fort Hare and the Nutrition and Food Science department of the Agricultural Research Council (ARC). In September, Dr Hugo presented the 32nd workshop on meat processing at the UFS. Also in September, Prof. Kock, Dr. Manjusha Joseph and students Ms Ntsoaki Leeuw

and Ms Vernita Reid, all from the Lipid Biotechnology Group, presented a workshop for the North West Department of Health at their headquarters in Vryburg. Prof. Kock participated in a *Carte Blanche* television programme on food labelling in April. He also served on the NRF's assessment panel for Microbiology and Plant Pathology, while Prof. Viljoen served on the NRF's project panel for Microbiology and Plant Pathology.

Apart from international research collaboration, the department also has a significant number of foreign postgraduate students and postdoctoral fellows from various countries. At the 2007 graduation ceremonies, two Ph.D., 12 M.Sc. and 17 Honours degrees were conferred. One student who excelled was Ms Ané van Heerden, who received her M.Sc. with distinction and was awarded the Van der Walt Prize, the Sasol Prize, the S₂A₃ bronze medal and university academic colours at the faculty prize-giving ceremony. A team from the Veterinary Biotechnology Research group was the winner of the UFS section of the National Innovation Fund competition for students, with their business plan on the use of bacteriophages to combat specific bacterial infections in poultry. This team comprised Ms Kasweka Kakoma, Ms Ji-Yun Lee and Mr Lehloholo Mathengtheng. The team will now submit their project proposal to the national competition, which will be adjudicated early in 2008.

The department comprises three divisions, namely Microbiology and Biochemistry, Food Science and Consumer Science. Within these divisions there are various research groups. Although the overall research theme of the department is the broad field of microbial, biochemical and food biotechnology, the heterogeneous departmental composition causes some activities to fall outside this field. Activities of these research groups not reported above are indicated below.

In the **Food Science division**, Dr Hugo focuses his research on the manipulation of meat quality by nutrition. He presented his research on nutrition and meat quality of pork in South Africa at the 53rd International Congress of Meat Science and Technology in Beijing, China. His observations of a seasonal variation in fatty acid composition of pork attracted great interest from a large number of congress participants. Prof. Garry Osthoff is researching milk from wild animals in order to improve our understanding of milk as food in the broader animal king-

dom. Not all compounds in milk are utilised for growth or energy. The oligosaccharides, for instance, have a prebiotic function, and are very important in some species. To research these molecules, Prof. Osthoff has entered into cooperation with a research group at the Obihiro University of Agriculture and Veterinary Medicine in Japan, where he spent some time during the year isolating and partially characterising oligosaccharides from elephant milk.

The **Lipid Biotechnology Group** led by Prof. Kock and Dr Carlien Pohl in collaboration with Prof. Pieter van Wyk (of the Centre for Confocal and Electron Microscopy at the UFS) and Prof. Lodolo (from SAB) concentrated on the uncovering of novel antifungals and antifloculants with antimitochondrion activity. This finds application in the brewing industry where the control of flocculation is important in beer clarification and in the termination of fermentation. This research is also of special medical importance since fungal infections annually contribute towards many deaths worldwide, including in South Africa. It was uncovered that inexpensive acetylsalicylic acid acts as a potent antimitochondrial antifungal in a large number of yeasts with potential for human application. This research resulted in seven articles published and accepted in ISI-accredited scientific journals and three students successfully completing their M.Sc. studies (all with distinctions). This work was also published as a review in one of the foremost specialised yeast journals, *FEMS Yeast Research* (2007;7:1207-1217). Dr Pohl is currently also investigating the effect of unusual non-methylene interrupted fatty acids, specifically sciadonic acid, on the opportunistic yeast pathogens *Candida albicans* and *Candida dubliniensis*. Sciadonic acid is an arachidonic acid homologue, but unlike arachidonic acid it cannot be metabolised to form prostaglandins – important virulence factors of these yeasts. This research will provide a better understanding of lipid metabolism in these yeasts and may also lead to the development of sciadonic acid as a novel antifungal agent against pathogenic yeasts.

The **Biocatalysis research group** of Prof. Smit participates in the DST-NRF Centre of Excellence in Catalysis, hosted by UCT and the High Throughput Biology Research Niche Area of the Advanced Biomolecular Research Cluster of the UFS. The main focus is on the terminal hydroxylation of alkanes and alkylben-

zenes by cytochrome P450 monooxygenases, but benzylic hydroxylation of alkyl phenols by vanillyl alcohol oxidases is also receiving attention. Previous work mainly involved the cloning of yeast P450s into the yeast *Yarrowia lipolytica* followed by whole cell biotransformations in shake flasks.

During 2007 the group ventured into a number of new activities that included P450 enzyme assays with cell free extracts and microsomal fractions; expression of P450s in *E. coli*; cloning of P450s into *Pseudomonas* strains; cloning and expression of bacterial P450s as well as enzyme modelling. Molecular biology projects are done in collaboration with Prof. Albertyn (**Molecular Biology research group**). During 2007 the group also commissioned an InFors Sixfors multireactor which was acquired during 2006 with funding from the UFS, the DST-NRF Centre of Excellence in Catalysis and the NRF. This multireactor system makes it possible to simultaneously run six small-scale bioreactor experiments with online monitoring of pH and oxygen and control of pH, stirring and substrate feed. A second postdoctoral fellow, Dr Rama Krishna Gudimanchi, joined the group in August.

In the **Fermentation Biotechnology research group**, led by Profs du Preez and Stephanus Kilian, work on the production and application of prebiotics continued. Previous work of Prof. Kilian, focusing on the prebiotic sugar neokestose, was extended to determine its potential to stimulate the growth of a known probiotic yeast strain and a number of other yeasts with potential probiotic properties. The resistance of neokestose to intestinal conditions and enzymes and the comparison of the properties of neokestose in this regard to inulin, a commercial prebiotic, is also under investigation. The research project of Prof. Du Preez together with Dr Carlien Pohl-Albertyn and Mr Piet Botes on the fermentation of Agave juice extract was continued. This research was undertaken in collaboration with Agave Distillers (Pty) Ltd., the only company in the world outside Mexico that produces Agave spirit (known in Mexico as tequila). A number of *Saccharomyces cerevisiae* yeast strains were evaluated in terms of their temperature-ethanol tolerance profiles and fermentation performance. A strain of *Kluyveromyces marxianus* was isolated from the juice and shows promise for use in the



Departmental delegates at the 26th International Specialised Symposium on Yeasts (ISSY 26) held in Sorrento, Italy are, from the left: Ms Olga de Smidt, Ph.D. student, Prof. Bennie Viljoen, Ms Chantal Smith, researcher, Profs Bettie Lodolo, Affiliate Associate Professor, Koos Albertyn, Lodewyk Kock and James du Preez, Departmental Chairperson, with Mount Vesuvius in the background.

process to improve the efficiency of the fermentation. The collaborative project of Prof. Albertyn (**Molecular Biology research group**) and Prof. Du Preez on the regulation and physiological role of the alcohol dehydrogenase (ADH) isozymes in *S. cerevisiae* has turned up some interesting results. The effect of multiple *adh* deletions in strains of *S. cerevisiae* on its phenotype is under further investigation, using aerobic glucose-limited continuous cultures.

Large numbers of new genes have become available due to the progress of various genome projects. This necessitates the development of highly efficient expression systems for the production of heterologous proteins, for both industrial and academic purposes. The **Molecular Biology research group**, led by Prof. Albertyn, is currently analysing the expression potential of three yeast hosts in collaboration with Prof. Gotthard Kunze of the Institut für Pflanzengenetik und Kulturpflanzenforschung in Germany. In this study a xylanase is expressed using an integration plasmid based on the conserved 26S rDNA locus which allows a single plasmid to be transformed in all three yeast hosts. These will subsequently be compared to the expression levels using host-specific plasmids. These include plasmids developed in a previous study

expressing epoxide hydrolase genes in *Y. lipolytica*. Analysis of the expressed protein will be performed to determine expression levels (on both mRNA and protein level) and glycosylation levels. Furthermore, this research group is in the process of developing a series of plasmid-based vectors to allow the transformation of and heterologous expression in various yeasts.

The Epigenomics and DNA Function research group of Prof. Patterson continued work on the role of chromatin structure on the regulation of gene expression on a genome-wide scale. Work showing that the linker histone H1 was absolutely required for compaction of chromatin in the stationary phase was completed. The surprising finding was made that H1 did not act as a general transcriptional repressor in the semi-quiescent state, despite its central structural position in the nucleosome. Instead, strong evidence was found for H1 being displaced by transcriptional activity. These findings suggested that in lower eukaryotes, such as *Saccharomyces cerevisiae*, the primary role of compaction of chromatin in the stationary phase may not be for gene shutdown, but may be related to an inhibition of homologous recombination, thus maintaining the genome integrity over extended periods of time during semi-quiescence.

Staff

Division Microbiology and Biochemistry:

Professors: Profs James du Preez, Rob Bragg, Stephanus Kilian, Lodewyk Kock, Derek Litthauer, Martie Smit, Bennie Viljoen

Associate Professors: Profs Koos Albertyn, Hugh Patterson

Senior Lecturers: Drs Esta van Heerden, André van Tonder

Lecturers: Drs Lizelle Piater, Carlien Pohl-Albertyn

Researcher: Ms Laurinda Steyn

Professors Extraordinary: Profs Edgar DaSilva, Bärbel Hahn-Hägerdal, Santosh Nigam

Affiliate Associate Professors: Profs Mary DeFlaun, Bettie Lodolo

Secretary: Ms Millie Cohen

First Professional Officer: Mr Piet Botes

Senior Professional Officer: Dr Manjusha Joseph

Professional Officers: Mss Mapula Maropola, Suzanne Brandt, Andri van Wyk, Anita de Necker, Yvette Makaum, Nel-Marie Agenbag, Dalene van den Berg

Senior Officer: Ms Leonie Myburgh

Officer: Ms Carin Badenhorst

Assistant Officer: Ms Ezelle van den Heever

Storeman: Ms Merriam Mogopodi

Technical Help: Mss Susan Leeuw, Lydia Mazwi, Mr Stanford Isaac, Petrus Mereko, Jack Mvula, Prince Shwapane

Division Food Science:

Associate Professor: Prof. Garry Osthoff

Senior Lecturers: Drs Arno Hugo, Cecilia Hugo, Koos Myburgh, Mr Neels Bezuidenhout

Lecturers: Dr Maryna de Wit, Ms Carina Bothma,

Secretary: Ms Anita van der Westhuizen

Senior Officer: Ms Rosalie Hunt

Professional Officer: Ms Eileen Roodt

Assistant Professional Officer: Ms Nonnie Heyman

Technical Help: Mss Tinah Mkololo, Sarah Senokoane

Cleaner: Mr Edward Mtshotana

Division Consumer Science:

Associate Professor: Prof. Hester Steyn

Lecturer: Ms Ismarie van der Merwe

Junior Lecturers: Mss Sonia van Zyl, Petro Swart, Minnie Ras

Assistant Professional Officer: Ms Doretha Jacobs

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Research outputs

Research articles

Botes, E., Van Heerden, E. & Litthauer, D. 2007. Hyper-resistance to arsenic in bacteria isolated from an antimony mine in South Africa. *South African Journal of Science* 103: 279-285.

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Theron, C., Syed, K., Shiningawamwe, A., Setati, E., Obiero, G., Van Rooyen, N., Ramorobi, L., Mabwe, S., Albertyn, J., Nicaud, J.-M. & Smit, M.S. 2007. *Yarrowia lipolytica* as a host for heterologous expression of cytochrome P450 monooxygenases. Poster presented at the 8th International Symposium on Biocatalysis and Biotransformation: Biotrans 2007, Oviedo, Spain. 8-13 July.

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Visser, D.F., Hennessy, F., Brady, D., Chhiba, V.P., Rashamuse, K.J., Jordaan, J., Louw, M.L., Nthangeni, B., Lakay, F.M., Litthauer, D., Van Heerden, E., Piater, L. & Möller, C. 2007. Application of metagenomics for isolating biocatalysts from deep terrestrial environments. Poster presented at the 8th International Symposium on Biocatalysis and Biotransformation: Biotrans 2007, Oviedo, Spain. 8-13 July.

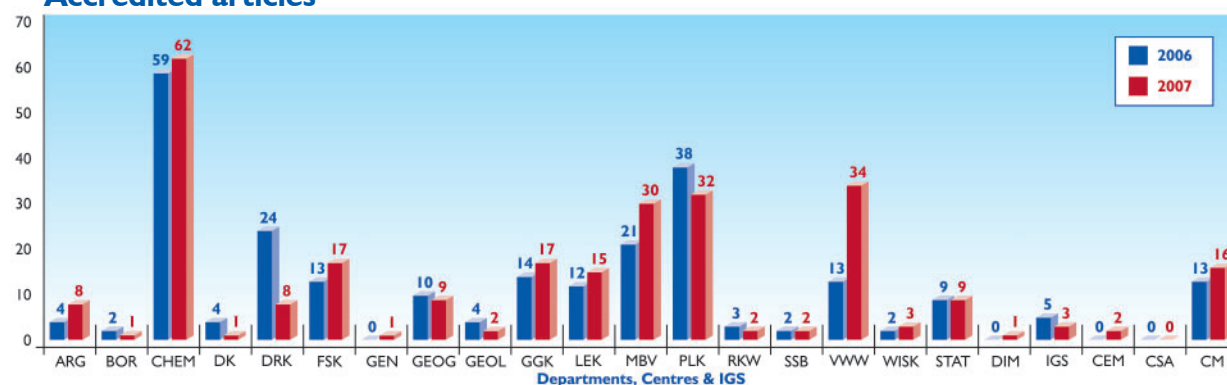


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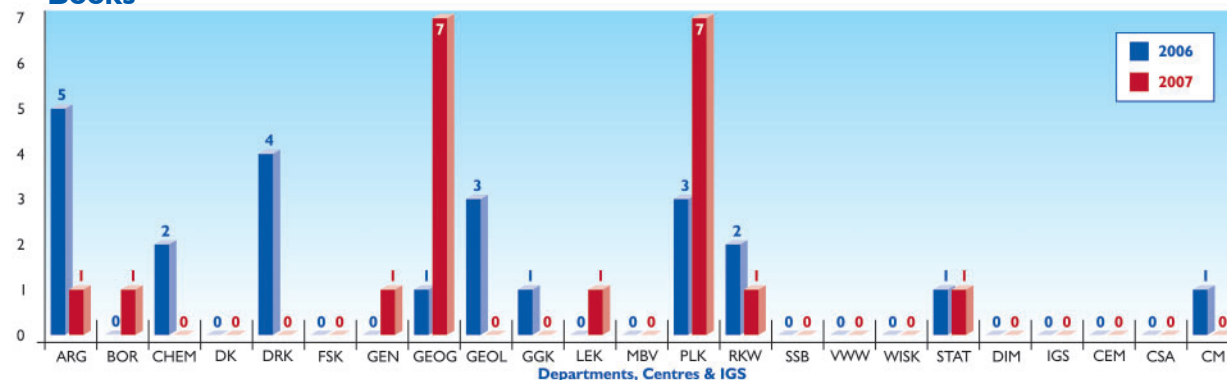
List of abbreviations

| Abbreviation | Description | Abbreviation | Description |
|--------------|---|--------------|---|
| ARG | - Department of Architecture | GEOL | - Department of Geology |
| BOR | - Department of Quantity Surveying and Construction Management | GGK | - Department of Soil, Crop and Climate Sciences |
| CEM | - Centre for Environmental Management | IGS | - Institute for Groundwater Studies |
| CHEM | - Department of Chemistry | LEK | - Department of Agricultural Economics |
| CM | - Centre for Confocal and Electron Microscopy | MBV | - Department of Microbial, Biochemical and Food Biotechnology |
| CSA | - Centre for Sustainable Agriculture and Rural Development | PLK | - Department of Plant Sciences |
| DIM | - Disaster Management Training and Education Centre for Africa (DiMTEC) | RKW | - Department of Computer Science and Informatics |
| DK | - Dean's Office | SSB | - Department of Urban and Regional Planning |
| DRK | - Department of Zoology and Entomology | STAT | - Department of Mathematical Statistics |
| FSK | - Department of Physics | VWW | - Department of Animal, Wildlife and Grassland Sciences |
| GEN | - Department of Genetics | WISK | - Department of Mathematics and Applied Mathematics |
| GEOG | - Department of Geography | | |

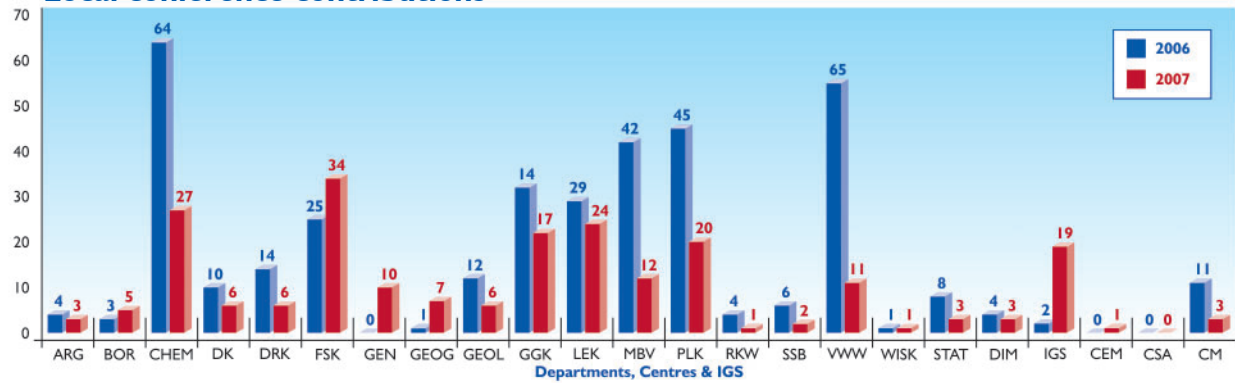
Accredited articles



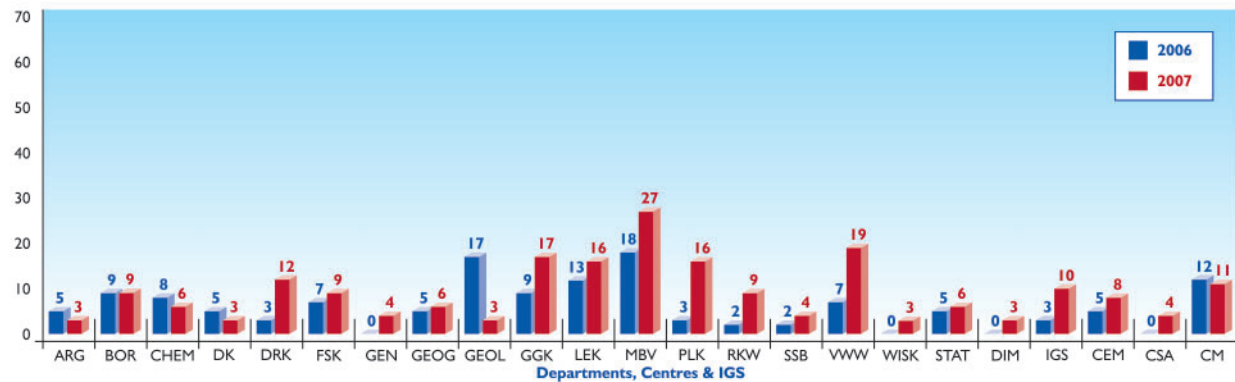
Books



Local conference contributions



Overseas conference contributions

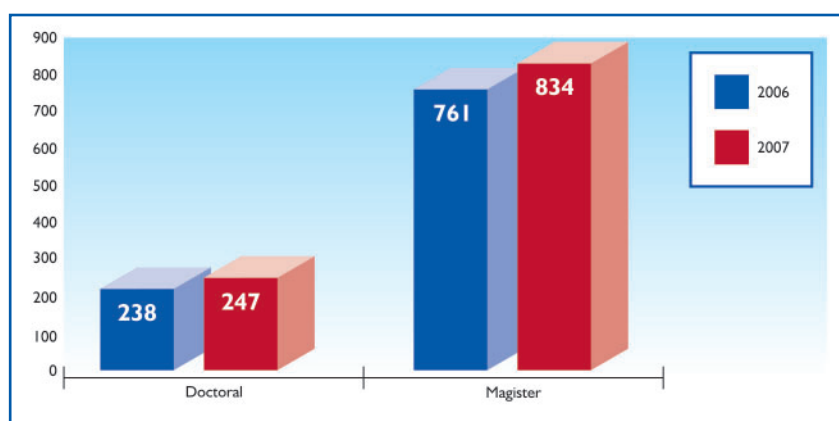
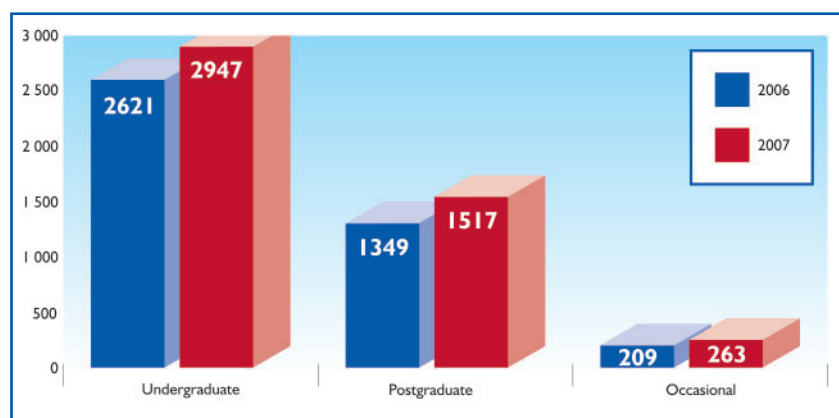


Students figures: 2006-2007

Student figures

| Year | Description | Total | | | |
|---------------|---------------|-------------|------------|-----------|-------------|
| | | Black | Coloured | Asian | White |
| 2006 | Undergraduate | 1358 | 62 | 39 | 1162 |
| | Postgraduate | 619 | 35 | 33 | 662 |
| | Occasional | 164 | 4 | 4 | 37 |
| Total | | 2141 | 101 | 76 | 1861 |
| 2007 | Undergraduate | 1555 | 69 | 41 | 1282 |
| | Postgraduate | 727 | 43 | 41 | 706 |
| | Occasional | 238 | 6 | 1 | 18 |
| *Total | | 2520 | 118 | 83 | 2006 |

Comparison for the Faculty of Natural and Agricultural Sciences: 2006-2007



International students

| Nationality | Year | |
|-------------------------|-------------|-------------|
| | 2006 | *2007 |
| Asian countries | 18 | 21 |
| Botswana | 19 | 16 |
| European countries | 6 | 8 |
| Lesotho | 141 | 123 |
| Malawi | 1 | 3 |
| Mauritius | 2 | 2 |
| Mozambique | 7 | 4 |
| Namibia | 40 | 58 |
| North America | 4 | 15 |
| Other African countries | 48 | 51 |
| South Africa | 3853 | 4325 |
| South America | 1 | 2 |
| Swaziland | 13 | 6 |
| Zambia | 6 | 8 |
| Zimbabwe | 20 | 48 |
| Unknown | | 37 |
| *Total | 4179 | 4727 |

*2007 Final HEMIS figures not available



Glossary

A

| | |
|---------|---|
| AACC | American Association for Cereal Chemists |
| ADF | Amsterdam Density Functional Programme |
| ADRA | Adventist Development and Relief Agency |
| AEASA | Agricultural Economics Association of South Africa |
| ALPRU | African Large Predator Research Unit |
| AMI | Advanced Metals Initiative |
| ARC | Agricultural Research Council |
| ARMSCOR | Armaments Corporation of South Africa |
| ASAQS | Association of South African Quantity Surveyors |
| ASOCSA | Association of Schools of Construction of Southern Africa |
| ASREML | Arthur's Restricted Maximum Likelihood |
| ASSA | Actuarial Society of South Africa |

B

| | |
|-----|------------------------|
| BMF | Black Management Forum |
|-----|------------------------|

C

| | |
|-----------|---|
| CANSA | Cancer Association of South Africa |
| CCEM | Centre for Confocal and Electron Microscopy |
| CePHMa | Centre for Plant Health Management |
| CfPB - SA | Centre for People and Buildings - South Africa |
| CIDB | Construction Industry Development Board |
| CIOB | Chartered Institute of Building |
| CIOB | Chartered Institute of Building |
| CMW | Cape Mohair and Wool |
| CPU | Central Processing Unit |
| CSIR | Council for Scientific and Industrial Research Organisation |
| CUT | Central University of Technology |

D

| | |
|--------|--|
| DiMTEC | Disaster Management Training and Education Centre for Africa |
| DMISA | Disaster Management Institute of Southern Africa |
| DST | - Department of Science and Technology |
| DWAF | Department of Water Affairs and Forestry |

E

| | |
|------|--|
| EAAP | European Association for Animal Production |
|------|--|

| | |
|------|---|
| EBS | Electron Backscatter Diffraction |
| ECA | European Crystallographic Association |
| ECAP | Equal Channel Angular Pressing |
| EGIC | Economic Growth and International Competitiveness |
| EMS | Economics and Management Sciences |
| EPWP | Expanded Public Works Programme |
| ESR | Educational Standards and Research Committee |
| EU | European Union |
| EUG | European Union of Geologists |
| FET | Further Education and Training |

F

| | |
|--------|--|
| FM | Facility Management |
| FMP | Facilities Management Programme |
| FNBG | Free State National Botanical Gardens |
| FOTIM | Foundation of Tertiary Institutions of the Northern Metropolis |
| FSRDPP | Free State Rural Development Partnership Project |

G

| | |
|------|--|
| GET | General Education and Training |
| GIS | Geographical Information Systems |
| GMBA | Gauteng Master Builders Association |
| GSSA | Grassland Science Society of Southern Africa |
| GPS | Global Positioning System |
| GWD | Ground Water Division |

H

| | |
|-------|--|
| HCI | Human-computer Interaction |
| HEQC | Higher Education Quality Committee |
| HESS | High Energy Stereoscopic System |
| HIV | Human Immunodeficiency Virus |
| HOORC | Harry Oppenheimer Okavango Research Centre |

I

| | |
|-------|---|
| IATED | International Association of Science and Technology for Development |
| ICEC | International Cost Engineering Council |
| ICMR | International Centre for Material Research |

| | |
|-----------|---|
| IDC | Industrial Development Corporation |
| IEEE | Institute of Electrical and Electronics Engineers |
| IFAC | International Federation of Automatic Control |
| IFMA | International Farm Management Association |
| IGS | Institute for Groundwater Studies |
| INCRoP | Insects on New Crops Programme |
| INTSORMIL | International Sorghum and Millet Research Support Programme |
| IOFOS | International Organisation for Forensic Odonto-Stomatology |
| IPMP | Intensive Project Management Programme |
| IRDP | Institutional Research and Development Programme |
| IRWH | In-field Rainwater Harvesting |
| IUCr | International Union of Crystallography |

M

| | |
|-------|---|
| MEC | Member of the Executive Council |
| MOU | Memorandum of Understanding |
| MUCPP | Mangaung University Community Partnership Programme |

N

| | |
|--------|---|
| NAFU | National African Farmers Union |
| NAMC | National Agricultural Marketing Council |
| NASSP | National Astrophysics and Space Science Programme |
| NCEE | National Council for Economic Education |
| NDMC | National Disaster Management Centre |
| NECSA | South African Nuclear Energy Corporation |
| NELSAM | Natural Earthquake Laboratory in South African Mines |
| NGO | Non-Governmental Organisation |
| NLC | National Laser Centre |
| NMR | Nuclear Magnetic Resonance |
| NRF | National Research Foundation |
| NUFU | Norwegian Council of Universities Committee for Development, Research and Education |
| NWGA | National Wool Growers' Association |

P

| | |
|-------|--|
| PAMO | Pan African Mathematics Olympiad |
| PAQS | Pacific Association of Quantity Surveyors |
| PARSA | Parasitological Association of Southern Africa |
| PEC | Power electronic converter |
| POE | Post-occupancy evaluation |
| PPRI | Plant Protection Research Institute |
| PRF | Protein Research Fund |
| PRINT | Promotion of Regional Integration |
| PRT | Protein Research Trust |

R

| | |
|--------|---|
| REDIBA | Research Development Initiative for Black Academics |
| RICS | Royal Institute of Chartered Surveyors |
| RIEP | Research Institute of Education Planning |
| RNA | Research Niche Area |
| RPO | Red Meat Producers' Organisation |
| RTPI | Royal Town Planning Institute |

S

| | |
|-------|---|
| SA | South Africa |
| SAAB | South African Association of Botanists |
| SAACE | South African Association of Consulting Engineers |
| SAAO | South African Astronomical Observatory |
| SAATA | South African Agricultural Teachers Association |
| SAB | The South African Breweries Limited |
| SABI | South African Biosystematics Initiative |
| SACAP | South African Council for the Architectural Professions |

| | |
|---------|--|
| SACPLAN | South African Council of Planners |
| SACPVP | South African Council for the Property Valuation Profession |
| SACQSP | South African Council for the Quantity Surveying Profession |
| SADC | Southern African Development Community |
| SAFEFE | South African Foundation for Economic and Financial Education |
| SAFOI | South African Fryer Oil Initiative |
| SAIA | South African Institute of Architects |
| SAICE | South African Institute for Civil Engineers |
| SAIP | South African Institute of Physics |
| SAISC | Southern African Institute of Steel Construction |
| SANBI | South African National Biodiversity Institute |
| SANI | South African Nanotechnology Initiative |
| SANPAD | South Africa-Netherlands Research Programme on Alternatives in Development |
| SAPI | South African Planning Institution |
| SAPOA | South African Property Owners' Association |
| SAPS | South African Police Services |
| SAQA | South African Qualifications Authority |
| SASAS | South African Society for Animal Science |
| SASPP | Southern African Society for Plant Pathology |
| SASQUA | Southern African Society for Quaternary Research |
| SASS | South African Scoring System |
| SAWMA | South African Wildlife Management Association |
| SCB | Society for Conservation Biology |

| | |
|--------|---|
| SEM | Scanning Electron Microscope |
| SFS | Sustainable Fibre Solutions |
| SGA | Society of Geology applied to Ore Deposits |
| SIDA | Swedish International Development and Cooperation Programme |
| SMME | Small, Medium and Micro Enterprises |
| SPALHE | Short Programme on Assessment of Learning in Higher Education |
| SPDG | Sustainable Projects Development Group |

T

| | |
|-------|---|
| TEM | Transmission Electron Microscope |
| THRIP | South African National Research Foundation Thrust for Industry-Related Projects |

U

| | |
|--------|--|
| UCT | University of Cape Town |
| UEC | Unit for Earth Construction |
| UFS | University of the Free State |
| UJ | University of Johannesburg |
| UK | United Kingdom |
| UN | United Nations |
| UNESCO | United Nations Educational, Scientific and Cultural Organisation |
| UNLV | University of Nevada, Las Vegas |
| UP | University of Pretoria |
| USA | United States of America |
| USAID | United States Agency for International Development |
| USGS | United States Geological Survey |
| UWC | University of the Western Cape |

W

| | |
|------|-------------------------------------|
| WITS | University of the Witwatersrand |
| WPSA | World's Poultry Science Association |
| WRC | Water Research Commission |