

# University of Pretoria Research Report 2008



**100**  
1908 - 2008



UNIVERSITEIT VAN PRETORIA  
UNIVERSITY OF PRETORIA  
YUNIBESITHI YA PRETORIA

Denkleiers • Leading Minds • Dikgopolo tša Dihlalefi

## Vision

The University of Pretoria strives to be:

- a leader in higher education that is recognised internationally for academic excellence, with a focus on quality;
- a university that is known for international competitiveness and local relevance through continuous innovation;
- the university of choice for students, staff, employers of graduates and those requiring research solutions;
- a university with an inclusive and enabling, value-driven organisational culture that provides an intellectual home for the rich diversity of South African academic talent; and
- the premier university in South Africa that acknowledges its prominent role in Africa, is a symbol of national aspiration and hope, reconciliation and pride, and is committed to discharging its social responsibilities.

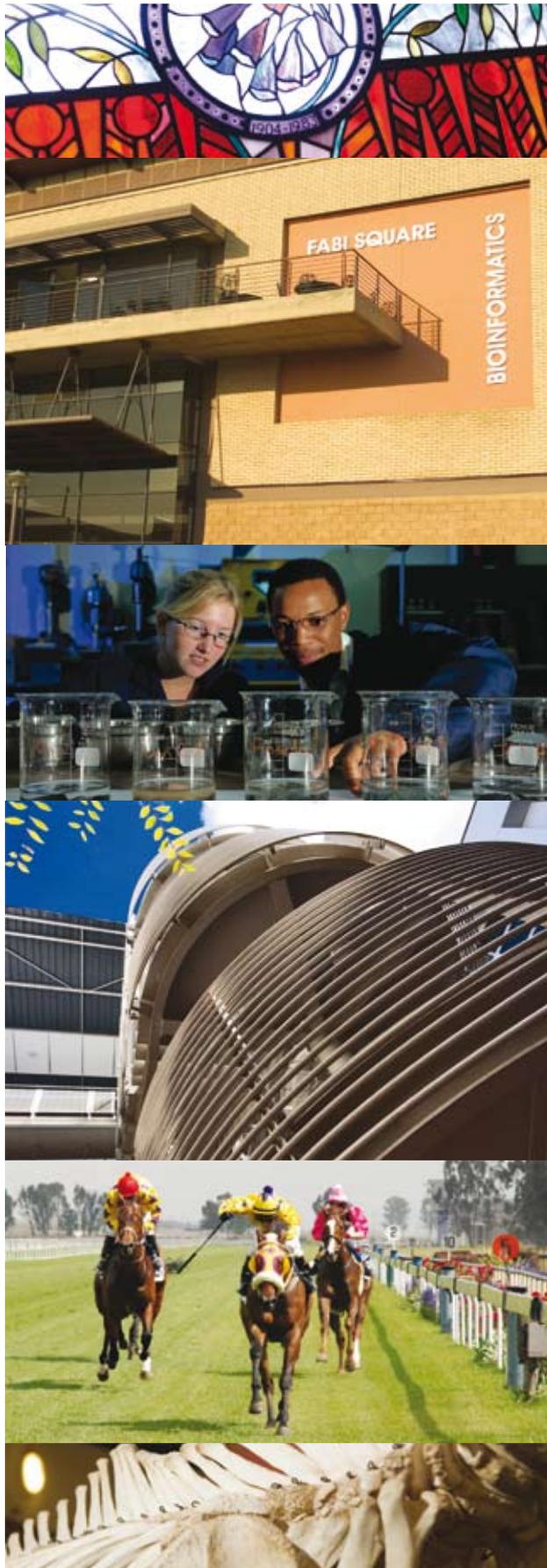


## Mission

The mission of the University of Pretoria is to be an internationally recognised South African teaching and research university and a member of the international community of scholarly institutions that:

- provides excellent education in a wide spectrum of academic disciplines;
- promotes scholarship through:
  - the creation, advancement, application, transmission and preservation of knowledge;
  - the stimulation of critical and independent thinking;
- creates flexible, lifelong learning opportunities;
- encourages academically rigorous and socially meaningful research, particularly in fields relevant to emerging economies;
- enables students to become well-rounded, creative people, responsible, productive citizens and future leaders by:
  - providing an excellent academic education;
  - developing their leadership abilities and potential to be world-class, innovative graduates with competitive skills;
  - instilling in them the importance of a sound value framework;
  - developing their ability to adapt to the rapidly changing environments of the information era;
  - encouraging them to participate in and excel in sport, cultural activities, and the arts;
- is locally relevant through:
  - its promotion of equity, access, equal opportunities, redress, transformation and diversity;
  - its contribution to the prosperity, competitiveness and quality of life in South Africa;
  - its responsiveness to the educational, cultural, economic, scientific, technological, industrial, health, environmental and social needs of the country;
  - its active and constructive involvement in community development and service;
  - its sensitivity to the demands of our time and its proactive contribution towards shaping the future;
- creates an intellectually stimulating and culturally vibrant, pleasant and safe environment in which its students and staff can flourish; and
- is committed to effective, efficient, caring and innovative approaches to teaching, research and community service, client-centred management and administration, and good governance.

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# 1. Introduction



## 1.1 Message from the Vice-Chancellor and Principal

The centenary year offered a unique opportunity to highlight the progress that the University has made in achieving its strategic goal of being an internationally recognised, research-led university.

In looking back over the last century, I asked that we identify the hundred leading minds who have made significant contributions to their disciplines, had distinguished careers and helped to create the research ethos for which the University has become known.

With the assistance of Prof Theuns Erasmus, a former Vice-Principal for Research, the publication records and archives of the University were scoured to identify those scholars who would be recognised for their outstanding contributions. A combination of criteria was used to identify these individuals. The criteria were adapted for the period during which the scholars were active, from early in the 20<sup>th</sup> century to the current period for active members of staff. Some contemporary young scholars who had excelled in their research fields were also included. The outcome of this process was the identification of a group of individuals who were honoured at a ceremony entitled *Honouring our Leading Minds (1908 to 2008)*, where medals were presented to

the researchers or to their relatives by the Nobel prize winner, Sydney Brenner. The occasion was one of celebration and epitomised for me the kind of scholars the University should aspire to nurture in the future.

The unfolding of the Research Strategy of the University is again clearly reflected in this report. The University has maintained its pre-eminent position in the production of research publication units, has sustained growth in the number of NRF-rated staff members and produced the largest number of doctoral graduates in the higher education sector. The fostering of a research and innovation culture that produces work of the highest impact is the cornerstone of our current and future efforts. The feature articles and faculty reviews that follow provide clear evidence of current achievements and future directions.



Prof Calie Pistorius:  
Vice-Chancellor and Principal

## 1.2 Message from the Vice-Principal: Research and Postgraduate Studies

During the centenary year, the University of Pretoria instituted a series of lectures designed to highlight major developments in the diverse disciplines reflected in its faculties.

The speakers ranged from a Nobel prize winner in science to leading businessmen. All demonstrated the breadth of scholarly activity taking place in our institution and demonstrated a vibrant engagement with new fields of research and development.

The University has continued with the format of its research report, which highlights specific research from a diversity of disciplines. All demonstrate the degree to which the University is engaged with local issues of economic development, while at the same time showing the impact of world-class research.

The Fact File demonstrates that the University's research performance has continued to show growth, particularly in

relation to the indices that are used to measure research performance for the Council. Research outputs (research master's graduates, doctoral graduates and publication units) have been sustained at a level that is higher than the benchmark set by the national Department of Education.

Furthermore, the reports from the faculties show increased levels of research participation in all cases. This is establishing a foundation for future growth and enhanced impact that will allow the University of Pretoria to develop in stature as a research-led university.



Prof Robin Crewe: Vice-Principal:  
Research and Postgraduate  
Studies

## 1.3 The Fact File

The University retained its number one position nationally as the university that received the highest number of research output credits from the Department of Education in 2007 (the latest audited figures).

The statistics of the Department of Education are important in the context of the University of Pretoria maintaining its quest towards reinforcing its position as an internationally recognised research-intensive university in South Africa. The contributions of the University's active researchers and their collaborators are highly appreciated with a special word of mention to the 18 members of the UP research community who produced more than ten papers in 2008. The UP research output had the benefit of 811 instances of local collaboration and 805 instances of international collaboration. The largest number of international collaborations was with partners in the Southern African Development Community (SADC) region, followed by the European Union and the USA.

UP has also achieved the Institute for Scientific Information (ISI) field ranking in six fields: plant and animal sciences, clinical medicine, environment/ecology, engineering, agricultural sciences and – for the first time – social sciences. This analytical tool ranks scientists, institutions, countries and journals in 22 specific fields of research by the number of papers published, citations received and citations made per paper over a 10-year period.

An examination of the research output on a five-year rolling average since 1998 indicates a strong and consistent increase both with regard to the number of papers produced by UP, as well as the number of citations. The number of NRF-rated researchers at UP reached an all-time high in 2008 with 251 rated researchers, an increase from the 223 rated researchers in 2007.

During 2008, the University retained its leading position as the South African University with the highest output of accredited research publication units, based on credits received from the Department of Education. This fact file provides a brief overview of interesting research facts and figures with the following highlights.



Mr Dhesigen Naidoo: Director: Research and Innovation Support

### Research outputs

According to the latest audited figures (2007) that were released by the Department of Education, the University of Pretoria is still the top producer of accredited research outputs (see Figure 1).

### Accredited publications

A total of 1 084.11 units were awarded for articles, of which 63 percent was published in journals that appear on international indices such as the ISI and the International Bibliography of the Social Sciences (IBSS). This represents an increase of 6 percent in comparison to 2006. The University was also awarded 28.42 units for outputs in books and chapters in books and 43.30 units for publications in recognised conference proceedings. The Faculty of Natural and Agricultural Sciences contributed 233.30 research units, followed by the Faculty of Engineering, Built Environment and Information Technology with 173.53 and the Faculty of Humanities with 151.75 (see Table 2 on page 6).

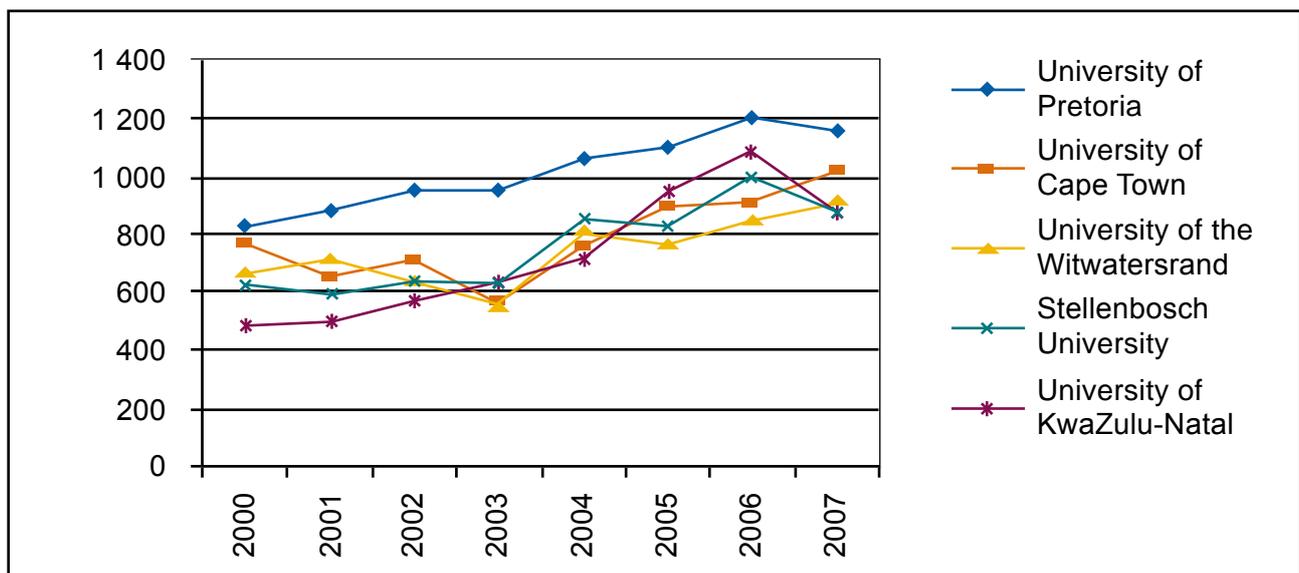


Figure 1: Research outputs of universities since 2000, as accredited by the Department of Education

Table 1: Researchers who published more than ten articles in 2008

Researcher	Number of articles
Prof MJ Wingfield, Genetics	29
Prof NC Bennett, Zoology and Entomology	20
Prof L Pretorius, Engineering and Technology Management	18
Prof JJM Meyer, Plant Science	17
Prof AP Engelbrecht, Computer Science	16
Prof N Lall, Plant Science	16
Prof GF Smith, Plant Science	15
Dr AC Brent, Engineering and Technology Management	14
Prof DG Kourie, Computer Science	14
Prof BD Wingfield, Genetics	14
Prof E Pretorius, Anatomy	12
Prof E Jongejan, Veterinary Tropical Diseases	12
Prof JG Maree, Curriculum Studies	12
Prof FD Auret, Physics	11
Prof MN Bester, Zoology and Entomology	11
Prof MS Oliver, Computer Science	11
Prof MW van Rooyen, Plant Science	11
Prof SW Nicolson, Zoology and Entomology	11

Table 2: Publication units earned in 2007 for articles in accredited journals

Faculty	Number of articles
Economic and Management Sciences	68.45
Education	51.52
Engineering, Built Environment and Information Technology	173.53
Health Sciences	138.17
Humanities	151.75
Law	72.33
Natural and Agricultural Sciences	233.30
Theology	130.00
Veterinary Science	62.73
Executive/interfaculty research	2.33
<b>Total</b>	<b>1 084.11</b>

There was an increase in the audited research output submitted to the Department of Education based on articles published in accredited journals in 2008 (see Table 3).

Table 3: Publication units audited and submitted to the Department of Education for accreditation in 2008

Faculty	Number of articles
Economic and Management Sciences	62.24
Education	42.81
Engineering, Built Environment and Information Technology	153.49
Health Sciences	121.59
Humanities	150.75
Law	72.00
Natural and Agricultural Sciences	303.79
Theology	117.08
Veterinary Science	81.58
Executive/interfaculty research	2.45
<b>Total</b>	<b>1 107.96</b>

## Students

The student statistics of the University of Pretoria for 2008 were as follows:

- 57 418 students studied at the University during 2008; of this number, 38 934 were contact and 18 484 were distance education students.
- 34 969 contact students studied full-time, while 3 965 contact students studied part-time; these contact student numbers were made up of 16 141 black and 22 793 white students.
- 46.5% of the contact students were male and 53.5% were female.
- 10 484 (contact) and 7 603 (distance) postgraduate students studied at UP; of these, 3 342 (contact) and 7 603 (distance) were honours students, while 5 080 (contact) were master's and 1 251 (contact) were doctoral students.
- 2 855 international students studied at the University, of which 44.6% were postgraduate students; of this number, 59.9% of the students came from SADC countries, 19.2% from elsewhere in Africa, 8.9% from Europe, 4.5% from the Americas and 4.1% from Asia.

## Postgraduate qualifications

The graduate throughput for 2008 was as follows:

Table 4: Postgraduate qualifications for 2008

Qualification	Number of graduates
Certificates	1 080
Postgraduate diplomas	245
Honours degrees	1 139
Master's degrees	1 789
Doctorates	180

## NRF ratings

The number of individuals rated by the National Research Foundation (NRF) as at December 2008 was as follows:

Table 5: NRF ratings as at December 2008

Ratings	A	B	C	P	Y	L	Total
Number	5	57	148	4	33	4	251

## Intellectual property

The statistics for intellectual property disclosures and patents for 2008 were as follows:

- Six disclosures of potential inventions were recorded.
- Two patents were provisionally filed.
- Two South African patents were registered.
- One international patent family was registered.
- Two licences were awarded to industry.

## Funding

### External funding

More than R350 million was made available for research from external funding sources, including the following:

- R84.1 million from government sources other than the Department of Education. This included R52.4 million from the NRF. As part of the NRF funding, UP received R19 million from the Technology and Human Resources for Industry Programme (THRIP)
- R32.7 million from international funders
- R60.1 million from research contracts
- R106.5 million from research grants

### Internal funding

Approximately R72 million was allocated to the research budget from internal funds. This amount was utilised as follows:

- R41.3 million for the upgrading and maintenance of the University's research capacity and equipment
- R2.86 million for congresses and visiting scientists
- R19.5 million for research publications
- R2 million for postdoctoral fellowships
- R1 million for research fellowships
- R1.7 million for the Research Development Programme (RDP)
- R500 000 for the rewarding of creative outputs.

## Collaborations

The following national and international research collaborations took place in 2008:

Table 6: National and international research collaborations in 2008

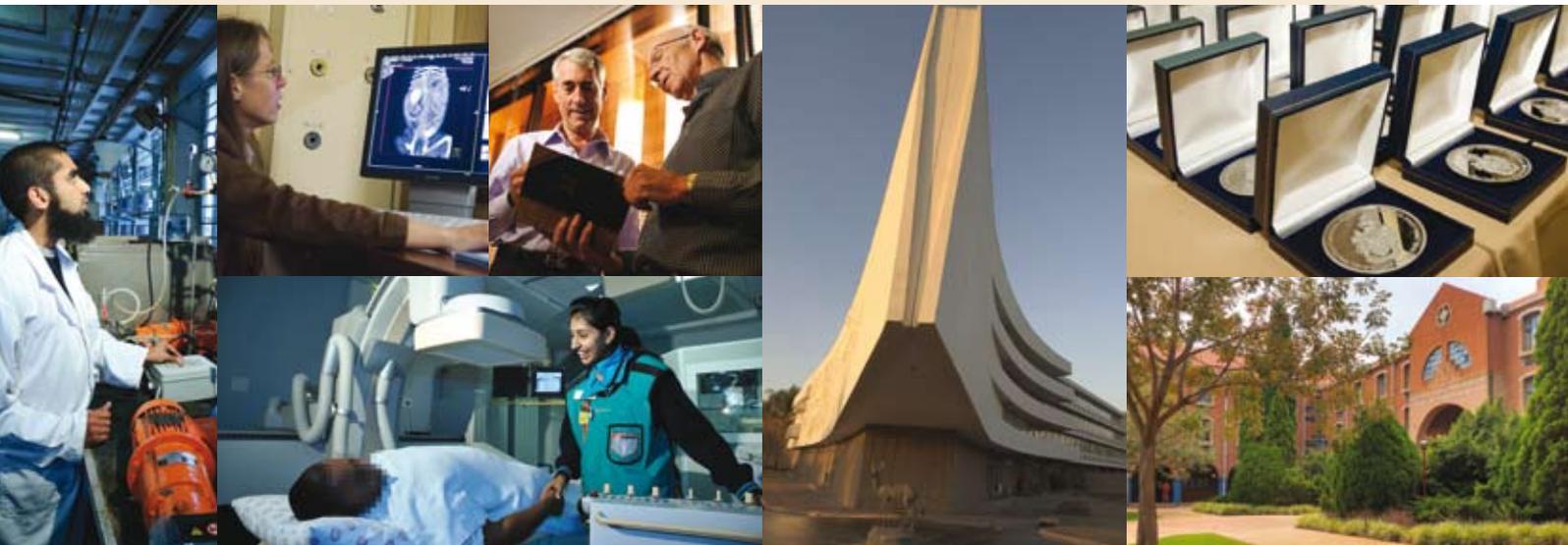
Type of collaboration	National	International
Private sector: multinational companies	37	19
Private sector: national companies	126	9
Private sector: associations	75	5
Government: science, engineering, technology and innovation organisations and parastatals	137	25
Government: national	58	23
Government: provincial	20	
Government: local	7	
Higher education: universities	260	622
Higher education: universities of technology	33	8
Higher education: other	3	9
Non-governmental organisations/non-profit organisations/interest groups	32	32
International organisations	3	51
Other: Southern African conservation organisations	20	2

The greatest number of instances of collaboration was with the SADC countries (52 percent). The European Union was second (24.8 percent), followed by the USA (12.5 percent) and Oceania (2.8 percent). The rest are made up of collaborations with Central Africa, Canada, the Far East, Europe, South America, Asia, the Middle East, Eurasia, North Africa, Eastern Europe and Central American and Caribbean countries.

There is a positive correlation between UP's collaborations and the international student cohort in that the highest proportion of the international student population comes from SADC/Africa, followed by the European Union/Europe and then the Americas and Asia.



## 2. Awards and achievements



## Awards and achievements

A number of researchers at the University of Pretoria received national and international recognition for their work during 2008.

### Outstanding research contributions

**Bennett NC (Zoology and Entomology):** Zoological Society of Southern Africa (ZSSA) gold medal for his service to the ZSSA

Prof Bennett's research focus is mammalian behavioural ecology and physiology. He has published over 150 peer-reviewed papers in predominantly leading international journals, is the editor-in-chief of *Journal of Zoology* (London) and serves on the editorial board of *Proceedings of the Royal Society of London*. He is a fellow of the Royal Society of South Africa and fellow of the Zoological Society of London. His contribution to the Council of the ZSSA spans service as a committee member, newsletter editor, Vice-President and finally President.

**Chimimba C (Zoology and Entomology):** National Science and Technology Forum (NSTF) TW Kambule Award for the best senior black researcher over the last five to ten years (Category H)

Prof Chimimba's research centres around four major themes: biosystematics, conservation biology, invasive species biology and management, and the potential influence of climate change on biodiversity and ecosystem functioning.

**Eloff I (Educational Psychology), Dean:** Honorary medal for the promotion of science awarded by the Suid-Afrikaanse Akademie vir Wetenskap en Kuns

Prof Eloff received the medal in acknowledgement for her contribution to developing the scientific field of education through her research. Her research focus area is positive psychology, which includes strength-based approaches in



Prof Ivan Horak receives the Arnold Theiler Memorial Trust Award for Excellence in the field of Veterinary Science from Elizabeth Theiler Martin, the granddaughter of Sir Arnold Theiler, at the centenary celebrations of the Onderstepoort Veterinary Institute.

the fields of education and psychology. She received the award at a ceremony held on 25 September 2008 at the North-West University in Potchefstroom.

**Engelbrecht FA, Rautenbach CJ de W, McGregor JL (Geography, Geoinformatics and Metereology):** The South African Society for Atmospheric Scientists Award for the best article contributing to the atmospheric and oceanic sciences in South Africa

The title of their paper was "On the development of a new nonhydrostatic atmospheric model in South Africa". It was published in the *South African Journal of Sciences* in 2007.

**Horak IG (Veterinary Tropical Diseases):** The Arnold Theiler Memorial Trust Award for Excellence in the field of Veterinary Science by the Theiler Memorial Trust Advisory Board

The award was presented to Prof Horak by Sir Arnold Theiler's granddaughter during a gala dinner held by the Faculty of Veterinary Science at Onderstepoort to celebrate the centenary of the Onderstepoort Veterinary Institute. The President was the guest of honour at the dinner. Prof Horak's research focus area is the endo- and ectoparasites of domestic and wild animals in Southern Africa. Prof Horak was also awarded a DSc by the University of the Free State, based on a 934-page treatise entitled *Ixodid ticks of domestic and wild animals in South Africa* and some neighbouring countries. This treatise incorporated his published research on ticks during the past 20 years. Prof Horak already holds two DVSc degrees from UP and a PhD degree from the University of Natal.

**Lotz S (Chemistry):** Recognition from Elsevier Publishers for one of the 25 most cited articles during the period 2005 to 2008 in the *Journal of Organometallic Chemistry*

**Markotter W (Microbiology and Plant Pathology):** The L'Oréal South Africa Fellowship for Women in Science awarded by the United Nations Education, Scientific and Cultural Organization (Unesco), in association with the Department of Science and Technology (DST) and L'Oréal

The award is made based on outstanding academic achievement in life or material sciences. Dr Markotter's research focus areas are Lyssavirus epidemiology and pathogenesis. She won the award for her dissertation entitled *Molecular epidemiology and pathogenesis of Lagos bat virus*, a rabies-related virus specific to Africa. She received her award on 8 August 2008 at a ceremony held at the Hilton Hotel in Sandton. The Minister of Science and Technology and the Managing Director of L'Oréal South Africa presented the awards.

**Thantsha M (Microbiology and Plant Pathology):** The Excellence in Water Research Award: Young Researcher of the Water Institute of Southern Africa (WISA)

She received the award for her research project entitled *Electrochemically activated water for the treatment of biofilms*. She received the award at a ceremony held at the Council for

Scientific and Industrial Research (CSIR) Convention Centre on 16 October 2008. The award was presented to her by the CEO of the Water Research Commission, Dr Rivka Kfir.

**Thobejane F (Microbiology and Plant Pathology):** NSTF Award in the Promising Scientist Category

The prize is a bursary allocation from the NRF. Ms Thobejane was a BSc Microbiology student when she won the award. Recipients had to come from Limpopo or the Northern Cape. They also had to be undergraduate students, black or female, in the science or engineering fields. They must not be in receipt of another bursary, must be in their second year or higher, and must have passed all subjects.

**Wingfield BD (Genetics/FABI):** DST Distinguished Woman Scientist Award

Women in Science was created by the DST in association with L'Oreal and the National Commission for Unesco to profile the achievements of leading women scientists in the South African science system. Prof Wingfield is internationally recognised for her research in molecular biology and is the programme leader of the DST/NRF Centre of Excellence in Tree Health Biotechnology. She received her award from the Minister of Science and Technology on 8 August 2008 at a ceremony held at the Hilton Hotel in Sandton.

**Wingfield MJ (Genetics/FABI):** Gold medal of the Academy of Science of South Africa (ASSAf)

This medal is awarded for research excellence and the contribution that has been made to the application of research to the benefit of society. Prof Wingfield is director of FABI, the Mondi Professor of Forest Pathology, director of the Tree Protection Cooperative Programme (TCP) and the director of the DST/NRF Centre of Excellence in Tree Health Biotechnology (CTHB). One of his special interests is to better understand the origin and patterns of global movement of insect pests and pathogens of trees.

### Awards/prizes at international conferences

**Ayo-Yusuf OA, Postma TC, Van Wyk PJ (Community Dentistry):** The Lion Dental Research Award in recognition of outstanding and innovative research for the improvement of public health

The award was presented to the team by the president of the International Association for Dental Research, Prof Bob ten Cate, at the opening of its 86<sup>th</sup> General Session on 4 July 2008. The session was held in Toronto, Canada.

**Bezuidenhout DI (Chemistry):** Winner of the Chemistry division at the annual national Student Symposium of Gauteng held by the Suid-Afrikaanse Akademie vir Wetenskap en Kuns

Participation is open to all postgraduate students at science faculties. Participants had to deliver oral presentations. Ms Bezuidenhout is currently a PhD student and a member



Prof Brenda Wingfield (left) received the DST Woman of the Year Award and Dr Wanda Markotter (right) received the L'Oreal South African Fellowship for Women in Science.

of the organic metal research group. The award was made on 31 October 2008 at the University of Johannesburg.

**Cavanagh D, Steyn M, Wilkinson C (Anatomy, Health Sciences):** Best student presentation award at the 13<sup>th</sup> biennial meeting of the International Association for Craniofacial Identification

The title of their presentation was *Development of soft tissue thickness values for South African black females*. The meeting took place in Dundee, Scotland, from 14 to 18 July 2008.

**Cukrowski I (Chemistry):** The Magic Bullet Award for the best presentation at the 2<sup>nd</sup> Magic Bullet World Conference hosted in Nurnberg, Germany, from 2 to 5 October 2008

The conference was hosted by the German Association of Pharmaceutical Scientists and the International Society of Anti-infective Pharmacology. The title of his presentation was *Fundamental understanding on interactions of bisphosphonates with bone (by use of different techniques, including computational modelling)*. The award was presented to him at the gala dinner by the president of the conference, Prof Fritz Sorgel. Prof Cukrowski's research focus areas are the development of theories and methodologies (including dedicated software) for the study of metal-ligand systems in solution to establish what complexes (species) are formed, as well as their thermodynamic properties (stability constants). He also focuses on fundamental and theoretical studies focused on understanding physical properties (at atomic and molecular level) that control affinity of ligands towards metal ions. He further concentrates on the design, synthesis, characterisation and computational modelling of

bisphosphonates with potential use in bone cancer treatment, fundamental studies involving commercially available bisphosphonates aimed at understanding their modes of action on atomic and molecular level.

**De Klerk HM, Donoghue S (Consumer Science):** Best article published in the *Journal of Family Ecology and Consumer Sciences* for the article "Dissatisfied consumers' complaint behaviour concerning product failure of major electrical household appliances – a conceptual framework"

The authors received the award at the opening of the 9<sup>th</sup> International Conference of the South African Association for Family Ecology and Consumer Sciences, which was held from 13 to 16 May 2008 in Pretoria.

**Pretorius L (Engineering and Technology Management):** Outstanding paper award at the 4<sup>th</sup> Institute of Electrical and Electronics Engineers (IEEE) International Conference on Management of Innovation and Technology held in Bangkok, Thailand, from 21 to 24 September 2008

The title of his paper was *Technology forecasting: The case of computational fluid dynamics*.

**Van Wyk PJ (Community Dentistry):** Award for the best abstract by the Institute of Medical Statistics and Biometrics at the 3<sup>rd</sup> International Meeting on Methodical Issues in Health Research hosted by the University of Milan in Gargnano del Garda, Italy, from 16 to 18 April 2008

The focus of this meeting was clinical trials and evidence-based dentistry. The title of his abstract was *Trends in dental caries prevalence and severity in South Africa*. Prof Van Wyk's research focus area is the epidemiology of oral diseases in South Africa. The award was presented to him by Prof Adriano Decarli of the University of Milan.



Prof John Taylor (left), one of the recipients of the Chancellor's Award for Research, together with Dr Janet Taylor.

## Awards/prizes at national conferences

**Anderson R, Theron AJ, Gravett CM, Steel HC, Tintinger GR, Feldman C (Immunology):** Best presentation at the South African Thoracic and Critical Care Societies Congress, held in August 2008 in Cape Town

The title of their presentation was *Montelukast inhibits neutrophil pro-inflammatory activity by a cyclic AMP-dependent mechanism*. Prof Anderson's research focus areas are immunopathogenesis and therapy of acute and chronic diseases of infective and non-infective origin.

**Crole MR (Veterinary Anatomy and Physiology):** The Fiona Graham Award for the best abstract

The title of her abstract was *The histological structure of the tongue of the emu (Dromaius novaehollandiae)*. Dr Crole received the award at the 46<sup>th</sup> Conference of the Microscopy Society of Southern Africa, held in Botswana from 23 to 25 July 2008. The award was presented to her by the president of the society, Prof Jan Neethling. Dr Crole's research focus area is the upper digestive tract of ratites.

**L'Abbe EN, Keough N (Anatomy, Health Sciences):** Bob Symington Award for the Best Young Presenter at the 38<sup>th</sup> Annual Conference of the Anatomical Society of Southern Africa

The title of the presentation was *Application of FORDISC 3.0 to South African crania*. Dr L'Abbe's research focus area is anthropology/skeletal biology. The conference was held at the Kruger Park Lodge, Mpumalanga, from 20 to 23 April 2008.

**Loots M (Anatomy):** The Hanno Boon Award for the Best Educational Contribution

The award was presented to Mr Loots at the 38<sup>th</sup> Annual Conference of the Anatomical Society of Southern Africa, which was held at the Kruger Park Lodge, Mpumalanga, from 20 to 23 April 2008. The title of his presentation was *Digital imaging techniques for beginners*.

**Myburg AA (Genetics/FABI):** South African Genetics Society (SAGS) silver medal for outstanding achievement in the field of genetics by a young researcher

**Smit S (Biochemistry):** Best poster award at the 2<sup>nd</sup> South African Proteomics and Genomics Conference, which was held in Cape Town from 3 to 5 March 2008

The conference was presented by the University of the Western Cape's Department of Biotechnology. The title of her poster was *Analysis of the malaria parasite proteome after inhibition of S-adenosylmethionine decarboxylase resulting in polyamine depletion*. Ms Smit's research focus area is malaria proteomics.

**Terblanché SE (Agricultural Economics, Extension and Rural Development):** The AgriSA award for a passionate and valuable contribution to the AgriSA Annual Conference, which was held in Midrand on 9 and 10 October 2008

The title of his presentation was *The role of mentorship in land reform projects*. Prof Terblanché's research focus is land reform and mentorship.

**Van Rooyen M (Family Medicine):** The best poster award at the 1<sup>st</sup> National Health Sciences Education Conference hosted by the Stellenbosch University from 19 to 21 June 2008 in Cape Town

The title of the poster was *Prof, I'm tired and stressed!!!* Prof Van Rooyen's research focus is medical education, with specific reference to professionalism, student support and assessment.

### Prestigious fellowships

**Bishop JM (Computer Science):** Computer Society of South Africa Fellowship Award

**Eriksson PG (Geology):** Geological Society of South Africa Fellowship Award

**Taylor JRN (Food Science):** Fellow of AACC International (formerly the American Association of Cereal Chemists) in recognition of outstanding contributions to the profession of grain science

**Wingfield BD (Genetics/FABI):** Fellow of the Royal Society of South Africa

**Wingfield MJ (Genetics/FABI):** American Phytopathological Society (APS) Fellowship

### Internal UP awards

The University annually pays tribute to the achievements of its academic personnel in a number of ways. The most prestigious of these are the Chancellor's Awards for Research and Education, the Outstanding Academic Achievers and the Exceptional Young Researchers Awards.

#### Chancellor's Award: Research

- Eriksson, PG (Geology)
- Scholtz, CH (Zoology and Entomology)

#### Chancellor's Award: Teaching and Learning

- Fraser WJ (Curriculum Studies)
- Coetzer, JAW (Veterinary Tropical Diseases)

### Exceptional Academic Achievers

These awards are granted annually to senior academics who have already achieved professional status and who have maintained a high standard of excellence in the field of undergraduate and postgraduate teaching and learning, research, community engagement and administration. The awards are granted for a three-year cycle. Any academic who has been evaluated by the NRF as an A-rated researcher automatically attains the status of exceptional academic achiever for as long as he or she retains such status.



Dr Cheryl de la Rey, the University's designated new Vice-Chancellor and Principal, was the guest speaker at the Exceptional Academic Achievers function for 2008.

- Bester MN (Zoology and Entomology)
- Boraine A (Procedural Law)
- Cukrowski I (Chemistry)
- Greeff JM (Genetics)
- Hassan R (Agricultural Economics, Extension and Rural Development)
- Joubert J (Electrical, Electronic and Computer Engineering)
- Kiberger RM (Companion Animal Studies)
- Korsten L (Microbiology and Plant Pathology)
- Lotz S (Chemistry)
- Odendaal JW (Electrical, Electronic and Computer Engineering)
- Plastino AR (Physics)
- Scott TJ (Private Law)
- Van der Watt JG (New Testament Studies)

## Exceptional Young Researchers

One nomination per school or per faculty is submitted annually to the senior awards committee for consideration. Awards are presented on the grounds of exceptional achievements in research and reviewed against the broad strategic objectives of the University. The number of candidates who receive this award is limited to a maximum of ten persons per annum. The award is only granted to researchers who have not yet achieved full professorial status with the provision that a specific person can only receive this award once. Any person who has been evaluated by the NRF as a P-rated researcher automatically attains the status of Exceptional Young Researcher.

- Gupta R (Economics)
- Joubert F (Biochemistry)
- Pretorius E (Anatomy, Health Sciences)
- Schoeman JP (Companion Animal Clinical Studies)
- Slippers B (Genetics)
- Wolff E (Philosophy)
- Woolman S (Public Law)



To celebrate the University's centenary in 2008, commemorative research medals were presented to the 100 leading minds of the past 100 years.

## Commemorative centenary research medals

In 2008, the University celebrated its 100<sup>th</sup> birthday. To commemorate this special occasion and the role that its researchers have played in establishing the University as an internationally recognised research institution, a project was launched, entitled *Honouring our Leading Minds (1908 to 2008)*. The medals were presented to the following researchers on 26 March 2008 by the winner of the 2002 Nobel Prize for Medicine, Prof Sydney Brenner, and the Vice-Chancellor and Principal, Prof Calie Pistorius.

- Alexander RA (Infectious Diseases): 1899 – 1965
- Allsopp BA (Parasitology)
- Auret FD (Physics)
- Bennett NC (Zoology and Entomology)
- Best PB (Mammal Research Institute)
- Bishop JM (Computer Sciences)
- Boeyens JCA (Chemistry)
- Bonsma JC (Nutrition and Animal Breeding): 1909 – 1992
- Bütow K-W (Maxillo-Facial and Oral Surgery)
- Carter RM (Physics)
- Chown SL (Zoology and Entomology)
- Cloete TE (Microbiology and Plant Pathology)
- Coetzee JN (Bacteriology): 1922 – 2003
- Crewe RM (Zoology and Entomology)
- Du Plessis M (Electrical, Electronic and Computer Engineering)
- Du Toit PJ (Veterinary Science): 1888 – 1967
- Du Toit RM (Parasitology): 1904 – 1988
- De Waal SA (Geology)
- Eicker A (Botany)
- Eloff JHP (Computer Sciences)
- Eriksson PG (Geology)
- Falkson G (Oncology)
- Focke WW (Chemical Engineering)
- Findlay GH (Dermatology): 1924 – 1989
- Fouché L (Archaeology): 1880 – 1949
- Franz RC (Surgery)
- Franzsen DG (Economics): 1918 – 2008
- Friedland EKH (Physics)
- Gemser B (Old Testament Studies): 1890 – 1962
- Greeff JM (Genetics)
- Grobbelaar N (Botany)
- Groenewald EP (New Testament Studies): 1905 – 2002
- Grové AP (Afrikaans/Dutch): 1918 – 2004
- Haarhoff PC (Mechanical Engineering): 1938 – 1990
- Heymann FG (Electrical Engineering): 1922 – 1980
- Heyns AM (Physical Chemistry)
- Heyns CH (Law/Centre for Human Rights)
- Heyns JA (Dogmatics and Christian Ethics): 1928 – 1994
- Horak IG (Veterinary Tropical Diseases)
- Huismans H (Genetics)
- Jansen BC (Bacteriology): 1921 – 1987
- Labuschagne JMT (Private Law): 1941 – 2004
- Le Roux TH (Modern Languages): 1883 – 1970
- Ligthelm AJ (Dentistry)
- Loader JA (Semitic Languages)
- Lombard JA (Economy)



Prof Callie Pistorius, Vice-Chancellor and Principal, receives his centenary award from Prof Sydney Brenner (seated). Overseeing the proceedings (in the background) are Prof Robin Crewe, Vice-Principal: Research and Postgraduate Studies (left), and Mr Dhesigen Naidoo, Director; Research and Innovation Support.

- Louw JP (Greek)
- Mathews EH (Aeronautical Engineering)
- Malherbe JAG (Electrical, Electronic and Computer Engineering)
- Malloch-Brown JM (Animal Physiology): 1929 – 2004
- McNamara DA (Electrical Engineering)
- Majazi T (Chemical Engineering)
- Meester JAJ (Zoology and Entomology): 1931 – 1994
- Mes MG (Botany): 1905 – 1959
- Meyer BJ (Atomic Medicine): 1919 – 2008
- Miller H (Physics)
- Modro TA (Chemistry)
- Mönnig HO (Parasitology): 1897 – 1978
- Myburg AA (Genetics)
- Naudé TW (Pharmacology)
- Neitz WODM (Protozoology and Virology): 1906 – 1997
- Nel BF (Education): 1905 – 1975
- Pistorius CWI (Electronics Engineering and Innovation Management)
- Pistorius PC (Material Science and Metallurgical Engineering)
- Pont D (Roman-Dutch Law): 1895 – 1991
- Pretorius V (Physical and Theoretical Chemistry): 1928 – 1989
- Prinsloo DJ (African Languages)
- Prozesky OW (Medical Virology)
- Reinecke RK (Parasitology): 1924 – 1993
- Reynders HJJ (Economics and Political Sciences): 1923 – 2007
- Robinson TJ (Zoology and Entomology)
- Rosinger EE (Mathematics and Applied Mathematics)
- Sauer N (Mathematics and Applied Mathematics)
- Seevinck E (Microelectronics)
- Scholtz CH (Zoology and Entomology)
- Schweikerdt HGWJ (Taxonomy and the Morphology): 1903 – 1977
- Sharpe MR (Geology)
- Skinner JD (Veterinary Wildlife Studies)
- Smit P (Demographics)
- Snyman JA (Mechanical and Aeronautical Engineering)
- Steyn DG (Veterinary Pharmacology and Toxicology): 1898 – 1988
- Taylor JRN (Food Science)
- Theiler A (Veterinary Science): 1867 – 1936
- Van de Venter HA (Botany)
- Van der Merwe JH (Physics)
- Van Jaarsveld FA (History): 1922 – 1995
- Van der Merwe SW (Immunology)
- Van der Watt JG (New Testament Studies)
- Van Heerden WFP (Oral Pathology and Oral Biology)
- Van Onselen C (Unit for Advanced Studies)
- Van Rooyen GT (Metallurgical Engineering)
- Van Selms A (Semitic Languages): 1906 – 1984
- Van Zyl J (Agricultural Economics)
- Verwoerd DW (Molecular Biology)
- Viljoen HJ (Chemical and Biomolecular Engineering)
- Vlegaar R (Organic Chemistry)
- Von Gruenewaldt G (Geology)
- Walton CR (Music)
- Wingfield MJ (Plant Protection)

## Medals of the South African Association for the Advancement of Science

**Eriksson PG (Geology):** South African Association for the Advancement of Science (S<sub>2</sub>A<sub>3</sub>) gold medal

Prof Eriksson is an internationally recognised expert on Precambrian sedimentation systems, particularly clastic sediments and how they have changed over Precambrian time, due to continental growth (also the freeboard concept), mantle plume activity, and supercontinent amalgamation and dispersal, and how they relate to atmospheric-climate-hydrosphere changes. The gold medal is awarded to a scientist who has made an exceptional contribution to the advancement of science, either on a broad front or in a specialised field. The South Africa medal is one of the most prestigious awards for scientific merit in Southern Africa. Prof Eriksson is also an A-rated researcher of the NRF.

**Majozi T (Chemical Engineering):** S<sub>2</sub>A<sub>3</sub> British Association silver medal

Prof Majozi's research focus is process integration, including the design of production systems, and aims to optimise these systems by enhancing their efficiency, limiting waste and minimising the release of harmful by-products into the environment. The silver medal is awarded to a scientist under the age of 40 at the closing date for this award. The scientist should be actively engaged in scientific research and should have provided evidence of outstanding capability and achievements by way of publications, discoveries or special skills, in particular when measured against international scientific standards. The British Association Medal is one of the highest awards to young scientists for original research in Southern Africa.

**Zander C (Physics):** S<sub>2</sub>A<sub>3</sub> bronze medal for the best master's dissertation

Ms Zander won the award for her dissertation entitled *Information measures, entanglement and quantum evolution*, in which she investigated the connection between information measures, entanglement and the 'speed' of quantum evolution.



Prof Thoko Majozi (left) receives recognition for his NRF-rating from the Vice-Chancellor and Principal, Prof Calie Pistorius.

## Faculty awards

Each year, the faculties of Economic and Management Sciences, Health Sciences and Veterinary Science acknowledge the contributions of their top researchers. In 2008 the following staff members received faculty awards:

### Faculty of Economic and Management Sciences

The awards are made in each category to researchers with the most publications in accredited journals.

- **Ijeoma E (School of Public Management and Administration):** Best overall researcher in the category of lecturer
- **Gupta R (Department of Economics):** Best overall researcher in the category of professor/associate professor

### Faculty of Health Sciences

The research contributions of academic staff in the Faculty of Health Sciences are recognised annually. A gala event was held on 22 November 2008, during which awards were presented to winners in the different categories. Nominations are received, which are reviewed internally by at least three senior faculty members. Finalists in each category are then subjected to an external review process by at least three recognised independent scientists from other academic institutions in South Africa. Criteria include the quality and impact of the research.

- **Aneck-Hahn NM, Schulenburg GW, Bornman MS, Farias P, de Jager C (School of Health Systems and Public Health):** best overall publication: clinical for the article "Impaired semen quality associated with environmental DDT exposure in young men living in malaria areas in the Limpopo Province, South Africa". The article appeared in the *Journal of Andrology*, 2007: 28(3), pages 423-434. The article also won an award for best overall publication from a team effort.
- **Leech R (Nursing Science):** best overall publication: qualitative research for the article "The management of infant developmental needs by community nurses: Part 1: Description of the responsibilities of community nurses with regard to the management of infant developmental needs". The article appeared in the journal *Curationis*, 2007: 30(2), pages 91-103.
- **Pretorius E (Anatomy):** best publication: non-clinical for her article "Comparative ultrastructural analyses of platelets and fibrin networks using the murine model of asthma". The article appeared in *Experimental and Toxicologic Pathology*, 2007: 59 (17), pages 105-114.
- **Seedat F (Psychiatry):** best publication by a young researcher for the article "Prevalence and clinical characteristics of obsessive-compulsive disorder and obsessive compulsive symptoms in Afrikaner schizophrenia and schizoaffective disorder patients". The article appeared in the *African Journal of Psychiatry*, 2007: 10 (4), pages 219-224.

- **Stander BA (Physiology):** best publication by a young researcher: non-clinical for the article "Influence of Sutherlandia frutescent extracts on cell numbers, morphology and gene expression in MCF-7 cells". The article appeared in the *Journal of Ethnopharmacology*, Volume 112 (2), pages 312-318.
- **Venter JME (Medical Virology):** best publication by a young research: non-clinical for the article "Hepatitis A virus in surface water in South Africa: what are the risks?" The article appeared in the *Journal of Water and Health*, 2007: 5 (2), pages 229–240.

#### Faculty of Veterinary Science

The Faculty of Veterinary Science annually pays tribute to its top researchers. All publications are subjected to an internal evaluation process using the external research practices of research publication in the field. The following awards were made for 2008:

- **Nöthling JO (Production Animal Studies):** Researcher of the Year
- **Dvir E (Companion Animal Clinical Studies):** Young Researcher of the Year

The top achievers were as follows:

- Boomker JDF (Anatomy)
- Botha CJ (Paraclinical Sciences)
- Kirberger RM (Companion Animal Clinical Studies)
- Madekurozwa M-C (Anatomy)
- Naidoo V (Pharmacology and Toxicology)
- Penzhorn BL (Veterinary Tropical Diseases)

- Schoeman JP (Companion Animal Clinical Studies)
- Thompson PN (Production Animal Studies)
- Venter EH (Veterinary Tropical Diseases)

#### Professional recognition

- **Bishop JM (Computer Science):** South African representative to IFIP TC2 (Software)
- **Coetzee SM (Computer Science):** Chairperson of the Programme Maintenance Group: ISO/TC 211 Geographical Information/Geomatics
- **Crewe RM (Executive Management):** President of the Academy of Science of South Africa
- **Delport R (Family Medicine):** Secretary of the South African Association of Clinical Biochemists
- **De Wet FA (Odontology):** Chairperson: Distinguished Scientist Selection Committee of the International Association for Dental Research
- **Donkin EF (Animal and Wildlife Sciences):** Vice-President of the Board of Directors, IGA
- **Myburg AA (Genetics/FABI):** President of the South African Genetics Society (SAGS) for 2008 to 2010
- **Sinclair JD (Private Law):** Vice-President of the International Society of Family Law
- **Thomas PJ (Legal History, Comparative Law and Legal Philosophy):** President of the Southern African Society of Legal Historians
- **Van Staden V (Genetics):** Secretary of the South African Genetics Society for 2008 to 2010
- **Webb EC (Animal and Wildlife Sciences):** President of the South African Society for Animal Sciences



Guests at the Exceptional Achievers function (from left): Prof Niek Grové, Prof Henk Potgieter, Mr Russel Loubser, Council member, and Prof Eugene Cloete.



### 3. Centenary Lecture Series



In celebration of the University's centenary in 2008, a number of specialists were invited to deliver keynote lectures in their fields of expertise.

"Our University is about the future. This is the essence of our new strategic plan. Its central theme is that of positioning the University of Pretoria as an internationally recognised research university in South Africa." This statement in the preamble to UP's strategic plan, *The Innovation Generation: Creating the Future, 2007-2011*, clearly sets out the important role that internationalisation will play in all future endeavours undertaken by the University.

Collaboration between universities worldwide has been steadily increasing since the early 1990s. In a study undertaken by the French company Noir sur Blanc in 1999, 41 percent of the 150 universities from the 47 countries that took part in the survey indicated that internationalisation is an 'absolute priority', while 52 percent believed it to be 'important', compared with only 7 percent who thought that it was only 'relatively important' and none who believed that it is 'not at all important'.

According to a survey published in the September 2005 issue of *The Economist*, universities have become much more businesslike, but they are still doing the same old things. The journal reported that "the most important recent development in the world of higher education has been the creation of a super-league of global universities".



Prof Sydney Brenner, Nobel prize winner for Medicine in 2002.

The University had the good fortune of being addressed by internationally renowned personalities – both South African and non-South African – as part of the centenary celebrations. They all offered their congratulations to a university that has, in its 100 years of existence, become an internationally renowned South African university. More importantly, they all shared their thoughts on various global and local challenges that will help shape UP's research agenda for its second century.

Included on the following pages is a sample of the inputs of various participants in the 2008 UP Centenary Lecture Series.

### Prof Sydney Brenner

Prof Brenner, winner of the 2002 Nobel Prize for Medicine and renowned geneticist, shares the view that science and technology can provide answers to the challenges that the world will face in future.

In his UP Centenary Lecture, *Adventures in biotechnology: lessons from the future*, Dr Brenner said that life sciences, which include medicine, biomedicine, biochemistry, molecular chemistry, genetics, and all the biological disciplines and their applied offspring, biotechnology, will play a key role in finding solutions.

According to Prof Brenner, biotechnology can be defined as the technology that brings [life sciences] knowledge into action. He said that genetics and biotechnology would play a crucial role in the treatment of chronic diseases and the combating of infectious diseases. However, there are a number of problems that first have to be solved, one of which is the fact that "biotechnology is powered by strictly commercial objectives".

Essentially, if a line of research can lead to the making of more money, then it is pursued. That is why most biotechnology funding is directed into medical research, and why other promising fields such as genetics and biotechnology suffer as a result of financial neglect. "The venture capitalists do not support them, because the aim of the venture capitalist is not to improve technology or health; his aim is to improve his own financial health."

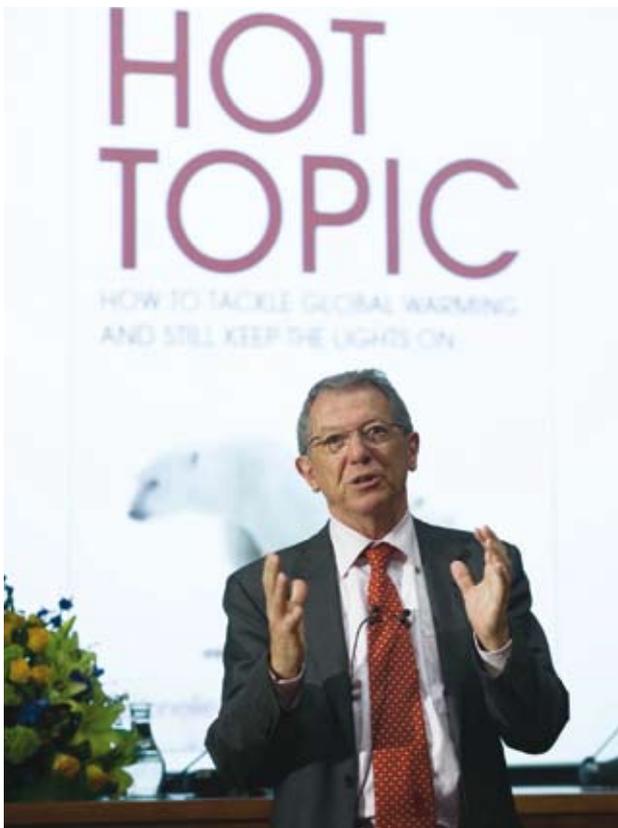
It is therefore essential to create other mechanisms to fund less or non-commercial areas of genetics and biotechnology. The intersection of research and business puts emphasis on intellectual property and patenting. "There are very few patents in the biotechnology field that have earned large amounts of money," he cautioned. Moreover, patenting does not necessarily protect inventors. Major corporations have lots of money and many lawyers, and can, if they really want to, break a patent and get away with it. "Your patents are worth exactly the amount of money you have to defend them," said Prof Brenner. "If you are spending more on patenting than you are earning from your patents, then you are patenting too much."

## Sir David King

Global warming and the role of science in addressing its effects was the theme of Sir David King's UP Centenary Lecture, *21<sup>st</sup> century challenges for science and global policy*. Sir King is the director of the Smith School of Enterprise and Environment at the University of Oxford and former chief scientific advisor to the British government.

Sir King challenged researchers to use science and technology to tackle the major challenges that face the world. These challenges include an increase in the life expectancy of people in developed countries, an increase in the world population figure (approximately nine billion by the year 2050), food and water shortages and an increase in terrorism and conflict, because countries will have to compete for scarce natural resources. Other challenges include the lack of development in Africa and the most important: climate change.

Sir King firmly believes that science and technology already exist to address these challenges, but that the lack of cooperation between the researchers responsible for scientific discoveries and governments, who are responsible for policy developments, is a great stumbling block. "The only way in which we can address the key challenges of the 21<sup>st</sup> century is by making governments aware of scientific discoveries, increasing international cooperation and establishing international organisations or bodies that are tailor-made to address specific problems," he said.



Sir David King, Director of the Smith School of Enterprise and Environment, University of Oxford and former chief scientific advisor to the British Government.



Dr Mary Sue Coleman, President of the University of Michigan, USA.

## Dr Mary Sue Coleman

In her UP presentation, *Expanding the role of universities in a shrinking world: the University of Michigan in South Africa*, Dr Mary Sue Coleman, President of the University of Michigan, USA, stressed the importance of internationalisation and collaboration.

Research is the soul of scholarship, she said, and universities should make all information accessible to faculties, students and the public. To ensure that universities worldwide have access to shared knowledge, the University of Michigan launched the very successful Sakai project, the first global consortium of higher education institutions using the concepts and technologies of open educational resources.

These resources include, among others, textbooks, course materials and software that can be accessed and re-used at no charge. "More than 150 universities around the world are already making use of Sakai's resources," she said. "Our shrinking world is pushing us closer together and making us more aware of what makes each of our nations and cultures unique, while also revealing the bonds we share."

According to Dr Coleman, universities are by their very nature at the forefront of internationalisation and cooperation. "Collaboration among universities draws on the strengths of diverse perspectives to encourage the sort of cross-fertilisation that is the basis of creativity and innovation."

## The Honourable Senior Minister Goh Chock Tong

The Honourable Mr Goh Chock Tong, Senior Minister of the Republic of Singapore, delivered a Centenary Lecture on 18 October 2008 in acceptance of the honorary Doctorate of Business Administration (DBA), which the University of Pretoria conferred on him. The title of his acceptance speech was *Reflections on the growth of nations*.



The Honourable Mr Goh Chock Tong, Senior Minister of the Republic of Singapore.

The honorary degree was awarded to him at the Auditorium of the Yong Siew Toh Conservatory of Music of the National University of Singapore by the Vice-Chancellor and Principal, Prof Calie Pistorius.

The international stature of the senior minister and the auspicious nature of the occasion, combined with the relevance of his speech to South Africa and its focus on the challenges faced by all countries during the current worldwide economic crisis, justified its inclusion in the Centenary Lecture Series.

Senior Minister Goh is a highly regarded and well-respected statesman in South East Asia. He contributed to the transformation of Singapore from a low-income warehousing and trading centre to a vibrant first-world economy. He was elected to Singapore's parliament in 1976 and held various portfolios in cabinet until he became Prime Minister in 1990. He held this position until 2004. During his tenure as Prime Minister, the Honourable Mr Goh steered Singapore through the 1997 Asian financial crisis, threats of terrorism, the economic recession of 2001 to 2003 and other challenges facing his country.

As the architect of many free trade agreements between Singapore and other development countries, Senior Minister Goh has expanded Singapore's political and economic space, thereby enabling the country to transcend the limitations of its small size by linking up with other economies. He furthermore ensured that Singapore focuses its attention on international competitiveness as a benchmark for economic success.

## Mr Tito Mboweni

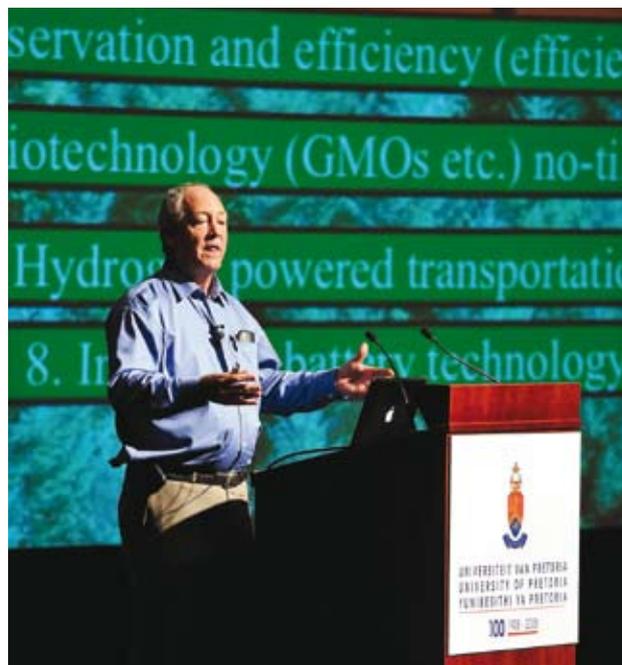
Mr Tito Mboweni, Governor of the South African Reserve Bank, was the keynote speaker at a closed meeting with the diplomatic fraternity of Pretoria on 18 August 2008.

His address to the diplomats, which qualified as a Centenary Lecture, took place in the Reception Hall of the Sanlam Conference Centre at the University of Pretoria. It was delivered at a formal luncheon to 90 members of the diplomatic corps, who were heads of foreign missions or representatives of the heads of foreign countries in South Africa.

The function was hosted by the Vice-Chancellor and Principal and the executive of the University of Pretoria.

As the luncheon was identified and arranged specifically as a closed function to which only ambassadors, high commissioners

and charges d'affairs of the various foreign missions had been invited, an opportunity was created for the heads of the foreign missions in Pretoria to be briefed personally by the Governor of the Reserve Bank on critical financial and economic matters in South Africa within the prevailing international economic climate.



World-renowned ecologist, Dr Patrick Moore.

## Dr Patrick Moore

"Nuclear energy is the future," said Dr Patrick Moore, a world-renowned ecologist and co-founder of the global environmental campaigning organisation, Greenpeace International. UP shares his view and is at the forefront of research aimed at developing alternative energy sources. In 2007, the University signed a memorandum of understanding with the Pebble Bed Modular Reactor (PBMR) Company (Pty) Ltd. The company was established in 1999 and since then has become a world leader in the development of safe and clean nuclear technology.

During his UP Centenary Lecture, *Global warming and the search for sustainable, clean energy*, Dr Moore criticised his erstwhile colleagues at Greenpeace for their strong opposition to the use of nuclear power to address the energy crisis that faces the world. "It is ironic that a conservation pressure group like Greenpeace is becoming a stumbling block in efforts to reduce greenhouse emissions."

He emphasised that the use of nuclear power as an alternative energy source is not as dangerous as some people claim. "There are currently approximately 440 nuclear plants worldwide and since 1986 there has been no serious accident at any of them," he said. According to Dr Moore, nuclear power is the only form of energy that does not emit greenhouse gasses, has the potential to replace fossil fuels and leaves a small environmental footprint.

The University's Centre for Environmental Economics and Policy in Africa (CEEPA) played a leading role in the Millennium Ecosystem Assessment (MEA) commissioned by the United Nations in 2001. The study focused on the impact of global warming and developed policies aimed at minimising its effects on the environment.

### Dr Anderson Smith

The saying that age is all in the mind might not be as far-fetched as some people might believe. According to Dr Anderson Smith from the Georgia Institute of Technology in the USA, the part of the brain that retains memory on how to ride a bicycle, drive a car or play the piano is immune to aging.

In his UP Centenary Lecture, *There are three major psychological changes with aging. The first is memory, but the other two I forget*, Dr Smith, remarked that studies have shown that elderly people often fare better than younger people in tests to measure their semantic memory (memory of meanings, understandings and other concept-based knowledge related to specific experience). However, he conceded, they experience difficulty when asked to recall events for which they have to rely on their working memory (the ability to remember pieces of information for a period and to manipulate and integrate them with other information).

Elderly people often have 'false memories', he said, and that is why they sometimes confuse personal memories with something that happened to somebody else. According to Dr Smith, there are only two scientific interventions that can staunch the aging process: exercise and diet. When asked about products that advertise eternal youth, he said that there is not enough data available to prove or disprove manufacturers' claims.



Dr Anderson Smith of the Georgia Institute of Technology, USA.



Prof Raghavendra Gadagkar, ecologist and sociobiologist from the Centre for Ecological Studies at the Indian Institute of Science.

### Prof Raghavendra Gadagkar

According to renowned ecologist and sociobiologist from the Centre for Ecological Studies at the Indian Institute of Science in Bangalore, India, Prof Raghavendra Gadagkar, various research methods can be combined to unravel the secrets of nature. Each method will provide a different answer. The method that one uses will depend on the questions – evolutionary or ultimate questions (why) or mechanistic or proximate questions (how) – that one wants to ask. "The way in which a question is asked and the answer will immediately lead to new questions," he said.

To demonstrate how an integrated research approach can be applied in practice, he explored the social structure of the species *Ropalidia marginata* (wasps). During his UP Centenary Lecture, *Interrogating an insect society*, he explained the methods that his team used to 'interrogate' the manner in which a new queen is selected in a wasp colony and the phenomenon of a potential queen or heir designate.

He cautioned that answers must be taken as tentative, because there are many more experiments that can be done and many more options that can be studied. "The important thing," he said, "is to keep on asking questions, because the answers ultimately lead to new knowledge."

### Prof Francis Hallé

"Hot air balloons, sledges, snow shoes and danger... This might sound like a scene from a James Bond movie, but it is in fact the way in which researchers from the canopy raft group go about collecting valuable specimens for their research," explained Prof Francis Hallé, a French botanist specialising in the study of tree canopies in tropical rainforests.

Prof Hallé is famous for his pioneering work on tree architecture and the biodiversity and ecology of canopies – the portion



Prof Francis Hallé, French botanist specialising in the study of tree canopies in tropical rainforests.

of the tropical rainforest that is between 40 and 50 metres above the ground – in tropical rainforests. “The most important attribute of canopies is their rich biodiversity,” said Prof Hallé in his UP Centenary Lecture, *Canopy exploration in tropical rainforests*. Prior to 1982, the number of species on the planet was estimated at around three million (animals and plants). However, in 1982, Terry Erwin from the Smithsonian Institute in the USA conducted research in the Panamanian rainforest in an attempt to quantify the biodiversity found in canopies. As a result of his findings, the number of species increased to an estimated thirty million.

Another important characteristic of tropical rainforest canopies is their richness in active molecules, which hold great medicinal value. “The reason why these molecules have as yet escaped the attention of phytochemists,” said Prof Hallé, “is because they focus their research on the more accessible plants in the undergrowth. However, most young trees are devoid of any molecular activities. They have to be at least 30 to 35 metres high before they start to produce active molecules.” As a result, forests’ potential in terms of biochemistry is greatly underestimated. “In future, when looking for new medicines and plants, it would make sense to give up the undergrowth and to look at the canopy instead,” he said.

## Dr Johan van Zyl

In his UP Centenary Lecture, *The future role of agricultural economists in establishing food security*, Group CEO of Sanlam, Dr Johan van Zyl, expressed his concern about the decline in “the relevance and respectability of agricultural economics.”

He said that the question about the value of agricultural economics is not new, but is exacerbated by five factors, which include the all-consuming ‘publish or perish’ syndrome promulgated by top universities, market factors that impact on the demand for education at the tertiary level, the quest for determinate solutions in research, the inability to comment on different distributions of wealth, welfare and power, and an over-reliance on market fundamentalism without properly accounting for market failure.

“Fortunately, all is not lost,” he said. “A ‘back to basics’ approach will go a long way to re-establish the relevance and respectability of this profession and agriculture. “However, there are three issues of vital importance to ensure that this happens. The first is a return to the universal values of logic, scientific deduction and rigour – in short, more



Dr Johan van Zyl, Group CEO of Sanlam and former Vice-Chancellor and Principal of the University of Pretoria.

‘common sense’. The second is the value of and return to an eclectic curriculum with proper grounding in the basic/mother disciplines, particularly economics, and the third is the strengthening thereof in training and practice, and a renewed focus on basic agricultural economic principles and practice, which includes aspects of the political economy.”

## Mr Johann Rupert



Mr Johann Rupert, well-known South African business leader.

*Africa’s children deserve better* was the title of the Anton Rupert Memorial Lecture, presented by his son and well-known business leader, Mr Johann Rupert. Mr Rupert highlighted the future of Africa’s children in terms of life expectancy at birth, infant mortality and the prevalence of HIV/AIDS. He emphasised the need to work together to secure a

better future for the continent's children, the importance of improved health care and education and the important role of agriculture in the economic revival of the continent.

According to Mr Rupert, South Africa has enough talent to solve the problems facing the country, but success would depend on respect for and compliance with the law, freedom of speech, protection of private property, and honesty and transparency in government actions.

## Dr Kavita Sharma

According to Dr Kavita Sharma, Principal of the Hindu College, University of Delhi, India, compensatory policies can be designed to correct persistent disparity and continuing discrimination in that country. In her UP Centenary Lecture, *Constitutional provisions pertaining to access and equity in education*, she said that compensatory policies could, over time, become highly contentious and might ultimately not reach the targeted groups.

There is also evidence to suggest that the current economic and social systems perpetuate patterns of group-based disparities in all spheres of life, including education, occupation, income and health. These disparities can be clearly seen in the link between access to schooling that the underprivileged have and their poor rates of success.

According to Dr Sharma, a diversity index generally becomes a set of secular indices to target the neediest and devise



Dr Kavita Sharma, Principal of the Hindu College, University of Delhi, India.

policies accordingly. She concluded that it could be more effective and more nuanced and also less contentious, as it targets needy individuals rather than groups merely based on caste or religion.

## Mr Clem Sunter



Mr Clem Sunter, futurist and author.

Mr Clem Sunter, futurist and co-author of the book *Mind of a Fox*, presented a Centenary Lecture to delegates attending the centennial convention of the Faculty of Economic and Management Sciences on 13 November 2008.

His presentation was entitled *Building tomorrow: most likely future scenarios*. It took place at the Sanlam Auditorium on the University of Pretoria's Hatfield Campus, and focused on topics such as competitiveness in a global business environment and future economic trends.

Mr Sunter is the current chairman of the Anglo American Chairman's Fund. He is well known in the field of scenario planning.

In the mid-1980s he offered a high-road scenario for South Africa, in which negotiation would lead to a political settlement, as opposed to the low-road scenario of confrontation, which would lead to a civil war and a wasteland.



## 4. Special focus





## 4.1 Developing an interdisciplinary approach to AIDS through collaborative research

HIV/AIDS is a complex social, medical, economic and political issue that requires a wide-ranging response from all sectors of society. According to the 2008 report on the global AIDS epidemic, published by the Joint United Nations Programme on HIV/AIDS (UNAIDS), sub-Saharan Africa, which has 11 percent of the world's population, carries over 60 percent of the world's HIV infections.

The HIV/AIDS epidemic is among the most fascinating social ruptures of our time and has heightened global consciousness of health disparities. It has inspired unprecedented action to confront some of the world's most serious development challenges. No disease in history has prompted a comparable mobilisation of political, financial and human resources. Due to the impact of HIV, people throughout the world have become more aware of the inequities in global health and economic status.

South Africa has one of the worst epidemics in the world. It has the highest number of people living with HIV/AIDS, but also one of the biggest testing and treatment programmes, although these reach only a small proportion of those who need them. Families and communities are affected through illness, death and loss of income. Many young people face the prospect of losing one or both parents, as well as other family members, to AIDS. The country's education and health services lose many members of staff to AIDS, as do many other government structures and the private sector.

The mass HIV treatment programmes that are currently being deployed in Africa and in South Africa make use of a range of

technologies to enrol, treat and monitor populations. However, research that develops ways of understanding the epidemic – notably by illuminating the way social structures and social forces shape vulnerability to HIV – is just as important as research that is focused on improving treatment of the disease.

Social theories are embedded in the way society understands and responds to the HIV epidemic, often as hidden assumptions about the nature of and the relationship between individuals, behaviour, cognition and society. Social theory can have a positive impact on how HIV is combatted, even as it continues to advance trenchant critiques of biomedicine.

The University of Pretoria is addressing the challenges posed by the HIV/AIDS pandemic through active field research and community engagement activities, and through research and teaching in many of its academic departments. The research that is being conducted varies from the development of medication or vaccines in the health and natural science-related disciplines to studies of behaviour change, stigmatisation and coping mechanisms in the social science and education-related disciplines, as well as the empowerment of vulnerable groups.

The work that is being undertaken ranges from law to theology, epidemiology to dentistry, biochemistry to psychology, social work and criminology to curriculum studies. It is focused on improving an understanding of the disease and the way it behaves in the body, the way it behaves in society, and the way the body and society respond to it. Whatever the nature of the research being conducted into HIV/AIDS, the search for answers will continue to expand society's knowledge as it attempts to deal with this disease.

The diversity and relevance of the research that is being conducted in the School of Medicine is focused on improving an understanding of HIV/AIDS. Research is also conducted into processes that could improve treatment, such as the use of cellphone technology as an aid to antiretroviral (ARV) adherence in the Department of Health Informatics.

The Department of Family Medicine is engaged in two studies with the Comprehensive Care, Management and Treatment (CCMT) Clinic at the Tshwane District Hospital: a study of the long-term morbidity and mortality outcomes of adults and children on ARV therapy, and an evaluation of biopsychosocial determinants of adherence to ARV treatment. It is also conducting research in collaboration with the departments of Immunology, Medical Virology, Microbiology, Pharmacology, Paediatrics and Child Health, and Obstetrics and Gynaecology, which are also conducting research into various aspects of the transmission and pathogenesis of HIV infection.

The Medical Research Council (MRC) Unit for Maternal and Infant Health Care Strategies (under the leadership of Prof Robert Pattinson) is involved in research to integrate the prevention of mother-to-child-transmission (PMTCT) and the ARV management of pregnant women and their exposed children into the district health care system in Mpumalanga. This project is being conducted in conjunction with the Mpumalanga Department of Health and the departments of Family Medicine, Paediatrics, and Obstetrics and Gynaecology at the University of Pretoria. Antenatal, intrapartum, postnatal and road-to-health cards form a continuum of record-keeping, and a Book of Health is being developed that contains constant messages relating to HIV/AIDS and all other aspects of pregnancy and child care. A postnatal card for maternal and child health is also being developed to improve communication between the site of delivery and the clinics. This is novel since it incorporates a checklist of activities that must be performed at discharge, within one week of birth and at six weeks. It also specifically delineates the HIV status and treatment of both the mother and baby and incorporates the testing required for the infant and mother at six weeks post-partum. The card has been piloted in local authority clinics in southwest Tshwane and is being implemented throughout the district. It also forms part of the integration of maternal and child health programme in Mpumalanga.

In the Department of Ear, Nose and Throat (ENT) Surgery, a specialist HIV ENT clinic is studying the specific effects and manifestations of HIV on these structures. In the School of Health Care Sciences, research is being conducted into developing skills in HIV/AIDS-related care and addressing the health promotion needs of children orphaned by HIV.

## Immunological studies

One of the most important concerns of biomedical researchers relates to the increasing resistance of the virus to ARV therapy. The growing availability of ARV drugs in Southern Africa is proving to be a cost-effective intervention that can significantly reduce the burden of HIV-1-related mortality and morbidity. Most studies of drug treatment and drug resistance have been conducted in populations infected with subtype B viruses in the northern hemisphere. The causes and consequences of drug resistance in C-infected populations in Southern Africa have not been thoroughly examined. Drug resistance in the African setting is likely to be complicated by a number of barriers, including intolerance of medication and risk behaviours, as well as programmatic challenges related to sustained treatment support, quality prescribing practices and affordable monitoring.

In the Department of Immunology, the HIV-1 Mucosal Pathogenesis and Treatment Programme was initiated in January 2007 to serve as a platform for highly collaborative, integrated and multidisciplinary research initiatives at the interface of basic science and clinical research. It currently consists of two partially overlapping research projects: a drug resistance study and an HIV-1 enteropathy study that will help answer critical unresolved questions relating to the mucosal pathogenesis and optimisation of ARV therapy in Southern Africa. To date, the department has succeeded in securing R16 million from the European Union (EU) and the NRF in support of these two projects.

To understand the challenges related to drug resistance, researchers are conducting a comprehensive study of subtype C resistance in the context of the public health ARV roll-out in South Africa. The overall objectives of the study are to undertake intensive surveillance of HIV-1 drug resistance, to design and evaluate interventions to manage treatment failure, to obtain an advanced molecular biology and basic science understanding of the mechanisms leading to the development and fixation of drug resistance, and to develop capacity in the field of treatment failure. The basic science component, which is being conducted in the University's immunology laboratories in Pretoria, is focused on developing inexpensive assays to screen patients for drug resistance and on defining the mechanisms underlying the emergence of resistance. A number of specimens have been collected and analysed, with the ultimate goal of developing new strategies for preventing resistance and treatment failure.

The enteropathy study involves a comprehensive analysis of the small and large gastrointestinal tracts prior to and during the first six months of ARV therapy. The study takes advantage of recent methodological advances, including a double balloon endoscopy procedure that enables targeted sampling of multiple biopsies along the full length of the small intestine for purposes of pathogen diagnosis, as well as flow cytometric and molecular analyses. In addition to basic scientists and clinician researchers in the Department of Immunology, the study involves collaborators in Internal Medicine, Gastroenterology, Family Medicine and Pathology

at the University of Pretoria, the CCMT Clinic at the Tshwane District Hospital and the Vita-Salute San Raffaele University in Milan, Italy.

Most of the knowledge of the pathogenesis and therapeutic response of HIV-1 is based on studies conducted on the peripheral blood of patients infected with subtype B viruses. As a result, HIV-1/AIDS has traditionally been divided into three phases: an acute infection phase associated with a massive increase in plasma viral load and a mild transient decrease in blood CD4+ T cells, a chronic asymptomatic phase involving a more gradual but relentless drop in CD4+ T cell numbers (over a period of approximately 10 years) and a symptomatic phase or full-blown AIDS, associated with terminal failure of the immune system and end-stage disease. However, recent studies of the gastrointestinal tract (GIT) have challenged both the timing and the course of the disease process.

These studies have revealed that within 24 hours of infection, there is an intense burst of viral replication and a massive 70 to 90 percent depletion of the body's total population of memory CD4+ T cells in the mucosa, primarily in the GIT. The studies have also suggested that this severe, early damage to the mucosal immune system sets the stage for increased microbial translocation, chronic systemic immune activation and disease progression to AIDS. During the chronic phase of infection, the GIT continues to serve as an important reservoir of treatment-refractory virus and, because of its constant exposure to bacterial, viral and parasitic pathogens, plays a major role in the recruitment, activation and infection of new target cells. Other studies have shown that following the initiation of ARV therapy, CD4+ T cell restoration is delayed and occurs more slowly than in peripheral blood. This suggests that monitoring the GIT may provide a more accurate measure of disease progression and therapeutic response than studies performed on peripheral blood.

The primary objective of the enteropathy study is to advance our understanding of HIV-1 pathogenesis in the context of high levels of pre-existing enteric infection and chronic immune activation: conditions that exist in Southern Africa. In addition to providing subtype- and population-specific information on the extent of CD4+ T cell depletion, HIV-1 replication and disease progression, the research is designed to obtain a wealth of new information related to the viral and microbial factors that drive immune activation and replication in different regions of the intestine, as well as on the compartmentalisation and genetic evolution of HIV-1 in these compartments. Another subset of studies is designed to investigate the role of the GIT in the emergence of drug resistance.

To date, 40 patients have been enrolled in the study, very few of whom have been lost to follow-up. Approximately 75 percent of patients have completed six months of follow-up treatment. New findings relate to clear-cut differences in the rate of CD4+ T cell depletion in different regions of the GIT, the detection of higher levels of HIV-1 replication in the colon relative to the duodenum in association with sustained CD4+ T cell populations and high levels of inflammatory markers, the discordance between blood and gut parameters

of disease progression, and the lack of treatment-induced CD4 reconstitution in the gut relative to blood, despite a substantial clearance of HIV-1 RNA from both the small and large intestine at six months.

According to Prof Sharon Cassol of the Department of Immunology, transitional research involving basic scientists and clinician researchers offers the greatest promise for enhancing the effectiveness of AIDS treatment in Africa. "At the clinical level, essentially all of our patients have shown a marked decrease in HIV-1 viral load in both plasma and the GIT, as well as significant weight gains and the cessation of diarrhoea in response to ARV therapy," she says. In addition, these studies have led to the identification and successful treatment of several subclinical enteric infections.

### Medical virology: a multi-pronged search for answers

The focus of studies that relate to medical virology is on the clinical and practical relevance of the virus in order to identify matters that will help doctors deal with patients with HIV/AIDS. Most of these studies involve patient material, and are aimed at reaching conclusions that will provide health care professionals with guidance in managing patients, particularly in the context of drug resistance.

These studies do not deal with the HIV/AIDS virus in isolation, but study a diversity of clinical issues, such as the incidence of co-infection: cases where AIDS is present in the body of a patient together with another virus or other infection, such as active pulmonary tuberculosis (TB), hepatitis B or adenovirus in HIV-infected children. Examining the activity of more than one drug, as well as more than one virus, in the body of a single individual increases the understanding of the medical profession of the behaviour of the disease.

This research has made a significant contribution to understanding the side-effects of ARV treatment when taken in combination with drugs to treat other diseases. A study of patients at a tertiary South African psychiatric hospital, for example, provides important information on the use of ARV treatment together with the drugs that are needed to treat their mental conditions. The relevance of this study lies in the fact that psychiatric patients have been found to have a higher burden of HIV infection than the general population, and the findings of this research can be applied to clinical challenges in the broader infected population.

Active pulmonary TB is a common co-infection in AIDS patients, and is very often the cause of their mortality. A large, collaborative study to evaluate novel tests for diagnosing active pulmonary TB in HIV-infected individuals in South Africa is therefore a crucial, cutting-edge research project, with enormous public health ramifications. A research study into the respiratory problems associated with HIV, performed in the Department of Medical Microbiology, has similar significance.

Another common co-infection is that of the hepatitis B virus (HBV). Research conducted in the departments of Medical Virology, and Obstetrics and Gynaecology will provide new insights into HBV diagnosis and treatment in AIDS patients,



The Department of Biochemistry conducts cutting-edge research.

which will assist doctors to deal with the effects of two viral infections in the same individual, particularly as the prevalence of HIV can often interfere with the diagnosis of the HBV. Human adenoviruses (HAdVs) cause a wide range of clinical syndromes and have increasingly been recognised as being important pathogens in immunocompromised individuals. A study of the effect of adenovirus infections in HIV-infected children is also providing important information on the activity of two different viruses in the same individual, and what their effect is on each other and on the individual.

## Forensics

In addition to research on individuals with HIV infection, important information is being obtained in research conducted in the Department of Forensic Medicine on the prevalence of HIV in individuals who have died unnatural deaths. Obtaining information on the behaviour of the virus in the body and its activity on surrounding organs has particularly significant occupational health implications for medical examiners and pathologists who run the risk of contracting HIV when working with the corpses of individuals who may not have died from complications arising from the virus, but who were infected with the virus prior to their death due to unnatural causes.

## Dental research

A number of research studies on the effects of the AIDS virus in the School of Dentistry are also providing useful information to dentists in practice. One study, in particular, examines whether oral mucocles and ranulas are HIV-related salivary gland diseases. This emerging phenomenon of a swelling in the salivary glands provides dental surgeons with new information on the role of HIV in dental surgery, which is crucial in their practice.

## Biochemical research

While the research being conducted in immunology and medical virology is focused mainly on the study of tissues, research in biochemistry examines the disease on a cellular level. As many of the attempts to develop a vaccine with which to control the epidemic have proved unsuccessful, it was deemed necessary to go back to the study of the general biology of HIV/AIDS in an attempt to combat the disease.

In the Faculty of Natural and Agricultural Sciences, a dedicated HIV Research Group has been established in the Department of Biochemistry, under the leadership of Prof Debra Meyer, which has established collaborations with the Department of Chemistry for nuclear magnetic resonance (NMR) analysis and the Infectious Disease Unit of the MRC for access to research samples. Other studies in this research group involve characterising the immune response of infected individuals and investigating mass spectrometry-based metabolomics for analysing the downstream effects of HIV infection.

The low success rate of most vaccine strategies can be attributed, among other things, to the inability to address the immune modulation ability of some viruses. Many viruses have, as part of their arsenal, the ability to modulate the apoptotic pathways of the host. It is counter-intuitive that such simple organisms would be efficient at regulating this, the most crucial pathway in the host, given the relative complexity of the host cells. Yet, viruses have the potential to initiate or stay the onset of programmed cell death through the manipulation of a variety of key apoptotic proteins. It was not until recently that the depth at which viruses exploit the apoptotic pathways of their host has been seen. This understanding may provide a great opportunity for future therapeutic ventures.

The focus of the Department of Biochemistry is on fundamental molecular research to find alternatives to vaccines for the prevention and treatment of AIDS, and the development of immune therapies. A number of projects that are currently being undertaken involve the development of novel HIV drugs to prevent or decrease viral replication. New ways of applying chemical methodologies to measure disease progression that may assist in identifying new prognostic markers are also in progress.

Because existing drugs to treat HIV/AIDS are toxic, research is being conducted into metal-based drugs and natural products derived from plant materials to find a non-toxic way of treating the disease. Although some success has been achieved in the development of highly active ARV therapy to combat drug resistance and increase the effectiveness of drugs with a dramatic decline in morbidity and mortality, these therapies still have their shortcomings. There is, therefore, a need to develop more effective medication with fewer side effects.

The inhibition of reverse transcriptase (RT) – the key enzyme in the conversion of viral RNA to DNA – is crucial in arresting the replication of HIV. The search for alternative RT inhibitors was prompted by the fact that one of the first potent anti-RT drugs to be developed has become ineffective due to the development of HIV strains that are resistant to this and other drugs.

The most successful results in developing alternative treatment for AIDS have been obtained with the use of gold complexes as anti-HIV agents. Research and laboratory tests have led to the successful synthesis of a gold(III) compound that inhibits both HIV-1 RT and HIV protease. Although more research is necessary, the results are promising and may lead to an anti-HIV agent with dual functionality against two viral enzymes, reducing the number of different ARV drugs that need to be taken and simplifying treatment and the production of medication.

The findings of research conducted in collaboration with researchers at the Nelson Mandela Metropolitan University into the *in vitro* anti-HIV activity of five selected South African medicinal plant extracts have been consolidated into an article that has been accepted for publication in the *Journal of Ethnopharmacology*. This research emanated from a quest to find a non-toxic drug that is composed of natural products derived from plant material to treat the disease.

Another new field of research is that of developing new prognostic methodologies such as NMR and mass spectrometry analysis to measure disease progression. Metabolic studies involve the analyses of biofluids using NMR spectroscopy and mass spectrometry (MS), followed by the interpretation of the complex data sets using statistics or chemometrics. While current markers for monitoring the progression of AIDS are not infallible, metabonomics is used to identify novel reliable prognostic markers, such as those implicated in HIV-induced oxidative stress. Preliminary results suggested that the lipoprotein profile of patients infected with HIV-1, measured by NMR, is a promising methodology to monitor disease progression in association with oxidative stress.

## The role of nutrition

Research into the role of nutrition in the treatment of communicable diseases by the University's Centre for Nutrition has observed that HIV is increasingly driven by many of the factors that drive malnutrition. These include factors such as poverty, conflict and inequalities in health services. Although dietary interventions cannot cure AIDS, it can slow down the progression of the disease and improve quality of life. According to Prof André Oelofse, head of this centre in the Faculty of Natural and Agricultural Sciences, good nutrition plays an important role in improving immunity. In treating AIDS patients, it is therefore crucial to deal with malnutrition as a preventative approach. In a recent study, 30 percent of malnourished AIDS patients succumbed to the disease, whereas only 5 percent of AIDS patients who were receiving proper nutrition management died from the disease. Nutritional interventions should therefore be part of a holistic, comprehensive, integrated approach to the pandemic, which includes both public health and therapeutic nutrition strategies and actions.

## Centre for the Study of AIDS

The interdisciplinary Centre for the Study of AIDS (CSA) was established in 1999 to mainstream HIV/AIDS through all aspects of the University's core business activities. Its mission is to

understand the complexities of the HIV/AIDS epidemic in South Africa and to develop effective ways of ensuring that all students and staff are prepared both professionally and personally to deal with the epidemic as it unfolds in South African society.

Since its establishment, the CSA has continued to develop and expand its innovative training, educational, counselling and research programmes, and to provide intellectual leadership and consultancy services to government and the private and non-governmental organisation sectors. Its current programme primarily serves more than 40 000 on-campus students. This includes training, counselling and support, and a range of community-based programmes. In addition, it promotes the development of curricula related to HIV/AIDS, research on HIV/AIDS at faculty level, and a holistic understanding of HIV/AIDS, where it is not seen as a purely medical issue, but as a social, medical, developmental and legal one as well.

HIV/AIDS research is an important and crucial aspect of university life. Through rigorous scholarship, a university has the privilege and the right to demand excellence in research, foster intellectual curiosity in all fields and demonstrate that it is able to take on some of the most intractable scientific and social problems, place them under critical scrutiny, and develop hypotheses and ideas that will spark debate, challenge conventions and break new ground in treatment and care.

To foster this approach to research, the CSA collaborates closely with the AIDS and Human Rights Research Unit in the Faculty of Law's Centre for Human Rights and the Unit for Education Research in AIDS in the Faculty of Education. It also supports research in the various faculties to promote a multidisciplinary approach to the problem.

The AIDS and Human Rights Research Unit promotes and supports research on issues arising from the intersection of HIV/AIDS, on one hand, and human rights on the other. Among the research activities of the unit are a review of legislation affecting children in the SADC region, the updating of a review of human rights frameworks in selected countries in the SADC region for the United Nations Development Programme (UNDP), assisting the Gauteng Provincial Legislature to mainstream HIV/AIDS into its oversight function, implementing research and advocacy projects on rights in four SADC countries and hosting international interns for three-month placements.

The Unit for Education Research in AIDS was established to enhance and coordinate the Faculty of Education's already extensive research focus on HIV/AIDS. The faculty is now better able to coordinate its efforts with other University research units, such as the CSA. The unit incorporates research from both members of staff and postgraduate students.

## Multidisciplinary research

In the late 1980s and early 1990s, the homophobia and racism overtly or covertly articulated in scientific discourse was exposed, moving researchers to recognise that addressing the epidemic required an approach that associated vulnerable groups as

partners in the generation of knowledge and the evaluation of interventions. A great deal of the HIV/AIDS-related research being done in the faculties relates to the human behavioural aspects associated with living in a society infected and affected by HIV/AIDS.

Research in the Faculty of Law is mostly focused on human rights issues. In 2005, a clinical trial in South Africa revealed that male circumcision may prevent the transmission of HIV by 60 percent. However, researchers are of the opinion that women may be at risk of contracting HIV from recently circumcised male partners whose incisions have not yet healed. Research to investigate the knowledge and understanding of men and women regarding male circumcision as a strategy to avert HIV infection is aimed at determining whether young circumcised men are provided with sufficient information regarding circumcision and HIV/AIDS in general, as well as how circumcision affects HIV preventative behaviour and human rights.

Research in the Faculty of Theology examines how AIDS orphans cope and what their needs are, as well as the contribution that could be made by faith-based organisations to address the needs of children orphaned by AIDS. In another study, a pastoral narrative approach is taken to examining the care received by residents at an HIV/AIDS centre. The role of the support group in providing a safe place for people to share and tell their stories has a profound transformative impact on the lives of people, both those telling the stories and those listening to the narratives.

Researchers in the Department of Auditing estimated that almost 30 percent of the South African workforce was HIV-positive in 2005. In response to the possible negative economic impact of HIV/AIDS, a proposed HIV disclosure framework was developed to report on the risks and responses of HIV/AIDS. This will help South African companies to take account of the effects of HIV/AIDS on their business.

In the Department of Psychology, researchers developed a therapeutic model of cognitive behavioural therapy to assist HIV-positive women to deal with negative internalised and enacted stigma and discrimination. This was prompted by the fact that women in South Africa are generally more vulnerable to HIV/AIDS due to predetermined cultural gender roles, and that being diagnosed with HIV impacts negatively on their behaviour.

A study in the Department of Social Work and Criminology examined the transmission of sexually transmitted infections and HIV/AIDS in prison through male-on-male rape and unprotected consensual sexual activities. In this study, the nature and extent of the sexual assault and rape of male sentenced offenders and awaiting-trial detainees were investigated. Prison gangs, overcrowding of correctional centres, the involvement of correctional officials and the sexual orientation of the potential victim were highlighted as risk factors.

Research in the Department of Anthropology and Archaeology on navigating childhood sexuality in the time of AIDS is based on a child-focused ethnographic study of a popular rural-based children's performing arts group in Zimbabwe. It investigates how the local children's songs, speech

and dance form a crucial starting point to understand the discursive construction and contestation of childhood sexual knowledge, experiences and responses, and understanding how children define erotic meanings and spaces as they grow up, in the context of AIDS. Females were found to be portrayed as weak, childlike, chaste virgins and vectors of AIDS, while masculine traits included violence, virility and excessive alcohol consumption.

Researchers in the Department of Sociology recognise that AIDS has become part of the existential reality of most South Africans over the past decade. The epidemic forms part of the cultural, moral and political landscape of everyday life. To speak about HIV/AIDS often means touching on questions of power, inequity, the struggle for resources and the contest to determine who has access to what kinds of material and symbolic capital.

Research in the Faculty of Education explores whether a community-based educational psychology intervention could improve teachers' knowledge and skills in supporting community members to cope with HIV/AIDS. Based on the initial data, it became clear that teachers were willing to help their communities, but lacked self-confidence to successfully get involved. Identifying their perceived lack of self-confidence, the researchers developed an intervention to target these self-perceptions of inadequacy. After completing the intervention, participants reported increased levels of self-confidence in their ability to support the community with its HIV/AIDS problems.

From the diversity of the research that is being undertaken in the University's various faculties, it is clear that no aspect of society remains unaffected by this disease. For practitioners in HIV/AIDS research, involving social scientists and working with community groups go hand-in-hand with treating patients, encouraging prevention efforts, and developing and testing new drugs. This is powerful evidence of the importance of interdisciplinary research to move closer to finding a holistic research solution to this global problem. The success of the research that is being conducted, therefore, depends to a large extent on research collaboration.

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## 4.2 Foods and forests for the future

Alien wood wasps that devastate huge forests, novel tree genes and the secret lives of fungi ... These are just some of the fascinating questions that whet the research appetites of the 150 plus research staff and students at the University of Pretoria's Forestry and Agricultural Biotechnology Institute (FABI). Whether their aim is to protect trees and plants from disease or increase crop productivity, the ultimate goal is to resolve problems for farmers and foresters. It is all about ensuring healthy forests, food security and conserving South Africa's rich diversity of native trees.

### FABI's first decade

FABI celebrated its 10th anniversary in 2008. Since being founded in 1998, the institute has been a magnet for leading researchers, top students, distinguished visiting scientists and collaborators from around the globe. The original team of about 50 FABI pioneers has expanded to nearly 200. Most are postgraduate students and postdoctoral fellows who work closely with core academic and technical staff.

"One of the big successes at FABI is that we have been able to achieve a significant international footprint in a relatively short period of time," says its founder and director, Prof Mike Wingfield. "It has been absolutely remarkable how FABI has drawn people from around the world so that we now have a strong and diverse research group where more than 30 languages are spoken." Believing deeply that diversity sparks innovation, Wingfield is absolutely delighted about FABI's multinational, multicultural make-up.

The staff and students at FABI give much of the credit for FABI's impressive achievements to Wingfield. He was the one who recognised the potential of such an institute more than a decade ago, and who had the drive and determination to turn this vision into a reality. His dynamic leadership ensures ongoing growth, and his passion for excellence keeps FABI's science at the cutting edge.

The state-of-the-art facilities, housed in the FABI main building, FABI Square and other facilities on the campus, were custom-built under Wingfield's watchful eye. "While world-class facilities are fundamental to maintain international competitiveness, I believe that people are the most important key to success," Wingfield adds. "Strong people draw the support for facilities such as those found in FABI and I have been privileged to be able to lead a most remarkable team."

A unique feature of FABI is that the research undertaken in the institute is truly interdisciplinary. The institute connects

staff and students from disciplines such as genetics, biochemistry, microbiology, botany, zoology, entomology and plant pathology. This is unusual in a university environment where different disciplines are often artificially delineated. "When one looks back at publications emerging from FABI research over the last ten years, the impact of the interconnected disciplines is clear," Wingfield explains. "Our work is published in increasingly higher impact journals and the collaborations between scientists have had a remarkably positive impact on the international reputations of team members." Wingfield is determined to "continue lifting the science bar" to add even more impact to the accomplishments of FABI's staff members and students.

Without external funding that kept pace with their expanding research, FABI could not have prospered as it did over the last 10 years. Forestry companies and industries in the agricultural sector have provided a vital funding stream for many years. Support from industry unlocked complementary funding from government's Technology and Human Resources for Industry Programme (THRIP) initiative, administered by the NRF. The high level of research at FABI has allowed its researchers to access money via international collaborative projects. Wingfield agrees that success breeds success. "The quality, impact and practical value of our research outputs attract funding partners," he says. "Their generous support is not only a powerful motivating factor. It is also what makes ongoing research possible."

## FABI science today

FABI scientists help to improve crops by developing novel techniques that are used to screen for tolerance against diseases, pests and drought. They are also working on new ways to accurately identify agents associated with plant health. Their research helps to combat pests, for example, some insects, by refining highly effective biological control systems. They study fungal and bacterial pathogens, but also the insects that have a very close association with these pathogens, to better understand the interactions between pathogens, insects and the host plants. Climatic factors that influence plant health are also under the spotlight. The pulping industry benefits from their work to develop timber with designer genes that produce superior fibres ideally suited to pulp production. In addition, work on bananas, citrus fruit, grains, fungi and more, represent core areas of interest. As a result, FABI attracts significant agricultural and forestry industry funding and their diagnostic tools are in demand around the world. Wingfield says: "While we do everything in our power to produce really superb research products, it is important to acknowledge the financial support that we receive from the South African forestry and agricultural industries."

"When FABI was first established, the research team was mainly a group of tree health specialists. We have rapidly expanded our focus to include much more than forestry, so that our current projects have a broad reach across the agricultural and forestry areas," Wingfield elaborates. "I have been amazed at how much synergy has emerged from work on what would typically have been considered very different disciplines," he adds.

To mark its 10<sup>th</sup> anniversary, the FABI team described a new species of fungi, *Julell fabianae* MJ Wingfield and Crous, in the name of FABI, and another, *Lentomitella unipretoriae* MJ Wingfield, Marincowitz and Crous, for the University of Pretoria, which was coincidentally celebrating its centenary in the same year (2008). Wingfield maintains that FABI "could not let the University have a rose cultivar to celebrate its anniversary and not have an equally beautiful fungus."

FABI is home to some very long-running programmes, as well as several highly significant new initiatives. For example, the internationally known Tree Protection Cooperative Programme (TPCP) has been in operation for nearly 20 years. This programme was undoubtedly the catalyst that led to the Department of Science and Technology placing one of its first six centres of excellence at FABI. The institute now also houses the international Eucalyptus Genome Network, while

the in-house Disease and Pest Diagnostic Clinic receives more than a thousand disease and insect samples each year. Many of these diseases cannot be diagnosed accurately elsewhere in the world and services are commonly provided for colleagues and companies internationally.

## Research collections at FABI

The unique research collections at FABI, with their associated databases, are crucial resources for ongoing and future research. The literature collection has about 16 000 articles on pests and diseases of trees, connected to a searchable computer database. Specialised facilities house more than 25 000 microbiological cultures associated with tree diseases from all over the world. With about 3 000 new additions annually, it is the largest collection of its kind in Africa and one of the largest in the world. The sequencing database archives data from DNA sequencing as a reference collection for further research and as backup for data that is pertinent to genomic projects.

The FABI culture collection is another example of a priceless and irreplaceable resource for current and future research. Wingfield is concerned about poor support for these collections and feels that they are seriously threatened. "We are fighting as hard as we can to gain dedicated funding to maintain the FABI culture collection far beyond the term of the researchers that have been responsible for building it," he says.

## FABI achievements

FABI's impressive research outputs prove the dedication and productivity of its research team. Jointly, during the course of the last decade, they have produced more than 530 publications in peer-reviewed journals, and have three books and 46 chapters in books to their credit. They contribute, on average, 30 international and 40 to 50 local conference presentations every year. In the ten years of FABI's existence, team members have



described three new species of insects, three new species of bacteria, as well as two new families, 15 new genera and more than 225 new species of fungus.

In addition to new knowledge, highly skilled young scientists with an internationally competitive advantage are a key deliverable and “all-important to FABI’s core business”, according to Wingfield. In just ten years, FABI has delivered more than 100 MSc and more than 60 PhD graduates, with more than 100 senior research students currently working towards these qualifications. A postgraduate degree from FABI ensures an exceptional depth of knowledge and expert skills in using biotechnology for improving plant health, allowing graduates to take on senior positions in relevant industries and at science-based institutions. “Our most important asset in ensuring the future of agriculture, forests and forestry is a base of human capital with an interest and experience to study and deal with these problems,” says Wingfield. He adds that the industries and programmes that support FABI’s research see a contribution to education as an important part of their contribution to social upliftment in South Africa.

Because of its high profile and excellent reputation, FABI competes successfully for local and international research grants and has hosted numerous research conferences and symposia. In addition to widespread recognition for the institute as a whole, individual ‘Fabians’ have won numerous awards and accolades. Wingfield is confident that the first ten years is only the beginning. He is expecting more and even more impressive achievements from the FABI team in years to come.

FABI is now the strongest single programme that deals with the health of trees in native forests and forest plantations anywhere in the world. It is flourishing as a flagship research institute for the University of Pretoria and is a leading force in plant biotechnology, unrivalled in South Africa and widely acclaimed internationally.

### Chancellor’s medals

During FABI’s 10<sup>th</sup> anniversary celebrations, that were held on 14 May 2008, two of the University of Pretoria’s prestigious Chancellor’s Award medals were presented to Mr Rodney Hearne and Mr Mike Edwards.

Mr Hearne is the co-chairman of the Banana Growers Association of South Africa (BGASA). He played an integral role in negotiations to establish banana research at the University

of Pretoria in 1988. This led to the establishment of the Banana Research Programme at the University, which is still functioning very strongly ten years down the line. It has gained substantial international recognition as it has become strongly linked to various international players. Funding has expanded to include support from various groups other than BGASA.

Mr Edwards heads the South African Forestry Industry Association that binds all players involved in commercial forestry in the country. He has had a very close association with the University of Pretoria through the crucial role that he has played in guiding and promoting the Tree Protection Cooperative Programme (TPCP).

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#### Some ongoing projects and services:

- Sequencing the Eucalyptus genome
- Compiling a DNA data archive of major tree pathogens and pests
- Interrogating diseases in elephant-damaged trees in the Kruger National Park
- Studying death in baobab trees
- Producing somatic embryos of various pine species for forestry companies
- Studying pathogens and storage fungi (and the toxins they produce) of indigenous crops
- Investigating diseases of trees that rural communities use for medicinal purposes or wood carving
- Looking at fungi associated with proteas to help protect these plants that are very important for ecotourism and flower exports
- Exploring the taxonomy, spread and origin of fungi in food crops that produce mycotoxins that can cause serious diseases, including cancer, in people and animals
- Keeping track of the global movement of insect pests and tree pathogens
- Helping to develop regulations for the management of alien invasive pests and pathogens
- Training foresters and agriculturalists throughout South Africa
- Responding to new disease outbreaks reported by farmers and foresters

## 5. Feature articles





## 5.1 Forecasting with dynamic stochastic general equilibrium models: the case of South Africa

Dynamic stochastic general equilibrium (DSGE) models are a general equilibrium framework that can be used to make forecasts for specific sectors of the economy, in addition to being used to study the behaviour of the different sectors following policy changes. The models allow for a wide range of interaction in the economy by deriving the equations of the economy, based on the optimisation behaviour of different agents in the economy.

For example, consumers maximise utility and firms maximise profit. From these two optimisation problems, one can obtain the demand side and supply side of the economy, which results in the general equilibrium. However, as the environment is uncertain due to the different kinds of shocks hitting the economy, a stochastic environment exists. In this regard, expectation is a key element in DSGE models.

Generally, economy-wide forecasting models are in the form of structural models with large numbers of equations that have to be estimated simultaneously. However, two problems are encountered with such models. For the proper identification of individual equations in the system, a number of variables are often excluded without adequate theoretical justification. Identification boils down to ensuring that at least one exogenous variable that appears in one equation does not appear in the other equation, otherwise one would have perfect collinearity, and estimation would not be feasible. Moreover, given that projected future values are required for the exogenous variables in the system, structural models are poorly suited to forecasting.

The Vector Autoregressive (VAR) model, although 'atheoretical', is particularly useful for forecasting purposes. However, VARs do not perform very well when there are structural changes, both in and out of sample. While they may be useful for forecasting future states of the economy, conditional on a given government policy rule, they can seriously mislead policy-makers with regard to the effectiveness and desirability of their policy rule choices. Estimated functional forms obtained from the VAR model do not correctly take into account the dependence of private agent behaviour on perceived or anticipated government policy rules for generating current and future values for government policy variables.

In other words, VARs suffer from the Lucas critique in that they are not 'deep'. Nobel laureate Robert E Lucas junior suggested that if one wanted to predict the effect of a policy change, one should model the 'deep parameters' (relating to preferences, technology and resource constraints) that govern individual behaviour via microfounded general

equilibrium models. One can then predict what individuals will do as a result of the change in policy, and then aggregate the individual decisions to calculate the macroeconomic effects of the policy change. The Lucas critique was influential, not only because it cast doubt on many existing models, but also because it encouraged macroeconomists to build micro-foundations for their models. Micro-foundations had always been thought to be desirable and Lucas convinced economists that they were essential.

Against this backdrop, Prof Rangan Gupta, lecturer in Economics at the University of Pretoria, has looked at alternative forms of DSGE models for forecasting the South African economy. This research has been done for the last three years and is still ongoing. He looked at three types of DSGE models to forecast the South African economy. These were the Real Business Cycle (RBC) model, the closed-economy New Keynesian DSGE (NKDSGE) model, and a small open-economy NKDSGE model.

Based on the results obtained, the New Keynesian framework seems to be best suited for the economy, simply because it allows for rigidities not present in the flexible environment of RBC models. Moreover, in the NKDSGE models, it is the small open economy NKDSGE model that tends to stand out, because this also allows for external shocks to affect the domestic economy.

Prof Gupta's findings prove that, relative to the atheoretical econometric models, such as the classical and Bayesian variants of the VAR and Vector Error Correction (VEC) models, the DSGE models are better suited to forecasting because they incorporate economic theory to obtain the equations of the model. It must be pointed out that although

VEC models can incorporate a bit of theory via short and long-run restrictions because they are not based on dynamic optimisation, they still suffer from the Lucas critique.

Prof Gupta says the research has helped him better understand the reasons behind the economic fluctuations of the economy and, in turn, model them appropriately. The search for a wider array of alternative statistical models has led him to collaborate with other leading economists and statisticians in the country to develop large-scale Bayesian VARs and Dynamic Factor Models (DFMs), which, in turn, allow one to handle large panels of economic variables. More importantly, as far as DSGE models are concerned, Prof Gupta has now been able to find a framework, namely the NKDSGE model, that is most likely best suited for forecasting the South African economy. Naturally, further improvements are required, and he is working on that. He is now trying to estimate the DSGE models using what is known as a particle filter, which allows one to do so without linearising them.

The research has assisted him to delve into a whole new research area. He has attended national and international seminars and conferences to present his findings. The research also assisted in initiating collaboration with some of the best national and international researchers in the field. Given their expertise, this is clearly of tremendous benefit in understanding how the economic system of South Africa performs.

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Prof Gupta's research illustrates the benefit of understanding the performance of the South African economic system.



## 5.2 Democracy as experienced by

# nine-year-olds

In a unique case study undertaken in 2004, Dr Ina Joubert of the University's Faculty of Education explored nine-year-old children's perceptions of citizenship in the context of democratic South Africa. Many people maintain that children of that age cannot grasp abstract concepts, but Dr Joubert's research discovered the opposite.

The youth of South Africa is one of the largest population groups in the country, but appears to be marginalised. This is an international trend. Dr Joubert's research showed that although the age group of nine to twelve years is important in the marketplace the world over, the political opinions of these children are disregarded. The study aimed to investigate and document young children's life experiences as citizens in democratic South Africa, and to gain an understanding of how their experiences shaped their understanding of citizenship and their democratic identity.

Preparing children for citizenship is a core task of state education systems. Citizenship education includes participation by and the empowerment of the young child, features of the national curriculum, as well as the role of the teacher and the social institutions that assume responsibility for the civic education of children (schools, families, communities, civil society). Citizenship education plays an important role in helping to secure peace and human rights in the modern world. Children have to be educated in citizenship from a very young age in order to fulfil their roles as active and responsible citizens. In South Africa, citizenship education is aimed at nation-building in an attempt to sustain the new democracy.

The case study was conducted with the Grade 3 children of an inner-city school in Sunnyside, Pretoria. This school is situated in a neighbourhood that is known for its crime. The dwellings are mostly apartments. Many children are homeless and live on the streets. This particular school was chosen, as it represents the diverse population of any mid-city area in South Africa. Dr Joubert focused on Grade 3 children because they are the most senior children in the Foundation Phase. These children had all been born in the first decade of democracy in South Africa, and were taught citizenship through the new national curriculum for the preceding two years.

The group consisted of 142 children and four teachers. Several participatory activities were used to gather data, such as drawings by the children to depict their images and experiences of life in South Africa, and letters to Mr Nelson Mandela, former president of South Africa, describing their experiences of living in South Africa.

The findings of the study indicated that children in this age group have a very good understanding of politics and citizenship. This suggests that nine-year-old children may

be capable of engaging at much deeper levels of meaning than hitherto claimed by developmental and learning theories. Many developmental theorists claim that children develop in a universal and linear way. This means that all children follow a linear sequence toward achieving maturity and that appropriate intellectual and social behaviours are standardised. According to Dr Joubert, these ideas do not make provision for the ability of nine-year-old children to reason about concepts related to citizenship and democracy.

The children who participated in the study were very patriotic and identified with the South African democracy, the flag and its symbolism. They demonstrated a fairly high social awareness, as well as an understanding of what democracy means, of their rights and responsibilities as citizens, and of the diversity of cultures in South Africa. The study further showed that the participants had internalised democratic values such as social justice, equality, *ubuntu* and respect.

The nine-year-old children were conscious of their identity and status as citizens in the democratic dispensation of South Africa. Their expressions of their democratic identity were evaluated on three levels: cultural or local, national and global. The participants clearly expressed their democratic identity on a national level, as is evident from statements such as "I am proudly South African" and "South Africa is my best world". However, only a few of the children articulated ideas about the global world. This may be because the activities were not designed to focus on this specific aspect. While the children expressed a positive identification with their families, only a few participants seemed to identify with their local community in a geographical sense. They reported overwhelmingly on negative experiences related to crime, violence and an apparent lack of services, especially those needed for securing their safety. Their feelings of vulnerability may signify a sense of defencelessness, causing their seeming lack of local identification. This is a cause for concern, since people who do not receive services on the basis of equality may feel excluded from democratic processes. Furthermore, the sense of belonging and national identity, which is a prerequisite for participative citizenship, may be missing.

The nine-year-old participants revealed understandings of their citizenship and the values related to citizenship. They expressed a strong awareness of morality and moral responsibility, which they related to values such as respect, social justice, equality and the rule of law concerning themselves and other people. The children showed an overwhelming social awareness through expressions of compassion for all people, especially vulnerable people in their local community. They were concerned about diverse groups of people, like street children and homeless people, and individuals such as family members and friends. The children wanted to engage in dialogue about the situation of vulnerable people and expressed a desire to help them. They also wanted to become engaged in their own safety by offering advice to the police and people of authority. This indicates that they had internalised the democratic values of compassion, commitment and public participation, and that they thus had the potential to become a caring, just and participative citizenry.

However, there were no opportunities available for the children to participate in the democratic dispensation. In their discussions about people living in their area, the participants often brought up issues of safety, which might have been a contributory factor in the lack of opportunities for community involvement. The unsafe area may negatively influence the children's future commitment to community involvement. Furthermore, participants expressed insight about various components of knowledge related to citizenship, such as the unique balance of rights and responsibilities in a democracy. Many articulated a right with a corresponding responsibility. They claimed their right to citizenship, but also acknowledged their responsibility to care for South Africa.



What I like and don't like: One of the children's drawings that depicts what he/she likes and dislikes about South Africa.

Throughout the study, participants expressed modest skills of inquiry and higher-level thinking. To facilitate critical involvement in young children, current conceptions of citizenship education have to be broadened by researchers, policy-makers and educators. Dr Joubert intends extending citizenship education in the Foundation Phase. She has received a grant from the University's Research Development Programme (RDP) to use the findings of the case study and establish an inclusive citizenship school environment where the young children in the Foundation Phase will not only be able to learn about democracy, but will also participate in democratic school processes. For active participation in democratic processes, young children need to be patriotic, but they also need inquiring minds and higher-level thinking skills. Both these capacities were demonstrated by the young participants in the case study. This will enable young children to understand the concept of democracy, and may lead to their becoming involved in securing their own and other people's futures as adult citizens in a democratic South Africa.

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## 5.3 Novel braze repair of turbine components

Metallurgy has been of major concern to humanity for many thousands of years. For example, the Bronze Age (up to 5000 to 1200 BC) – so named because bronze was then the chief material used for tools and weapons – prevailed between the Stone Age and the Iron Age. This very same bronze is an alloy obtained from copper and tin. Processes used to make alloys are today known as metallurgy.

Modern metallurgy is that branch of engineering concerned with the production of metals from their ores, the purification of metals, the manufacture of alloys and the use and performance of metals in engineering. An alloy is defined as metal blended with another metal or a non-metallic substance to give it special qualities, such as resistance to corrosion, greater hardness or tensile strength.

### Inside the turbine engine

Turbines are the modern choice in most cases to convert the energy contained in compressed gas, typically steam, into mechanical energy. The impulse turbine has a stationary nozzle from where high-speed gas molecules transfer some of their kinetic energy to the blades of the rotor. In the reaction turbine, nozzles are attached to the rotor, of which the rotation is driven by the reaction force of the gas on the nozzles.

Blades and nozzles in land-based gas turbine engines are not only exposed to service temperatures as high as 1 000 to 1 200°C, but they also experience severe stress, oxidation

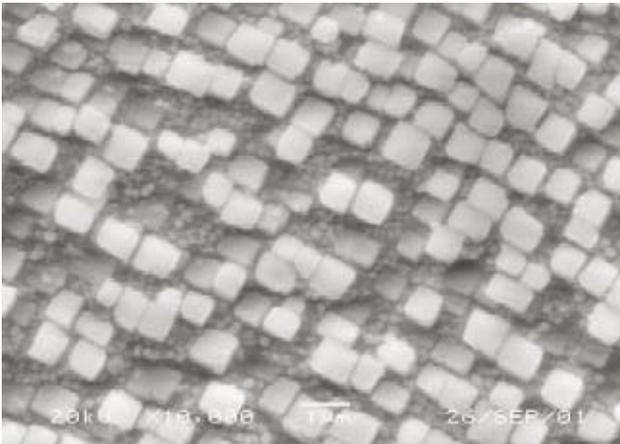
and corrosive attack during service. The blades and nozzles are typically in the size range of half a metre. Because of the high temperatures, the turbine components are usually manufactured from materials referred to as superalloys. By definition, a superalloy is a material that can operate at a temperature of at least 75 percent of its melting point, while still maintaining adequate mechanical strength. Cobalt and nickel often constitute the bulk of a superalloy. Depending on the requirements of the alloy, a variety of additional elements are added, with most superalloys containing up to 20 different alloying elements.

Why is a superalloy so strong? The principle that small stones scattered through a wet cement-sand mixture give rise to strong bulk concrete may well explain why small precipitated particles scattered homogeneously through the superalloy bulk result in a substance stronger than any of its component parts.

Superalloy turbine components operating in gas turbine engines often develop wide cracks, of 0.5 mm or more, during

Photograph: Prof Madeleine du Toit, Head of the Department of Materials Science and Metallurgical Engineering, is involved in the testing of novel braze repair in power generation turbine engines.

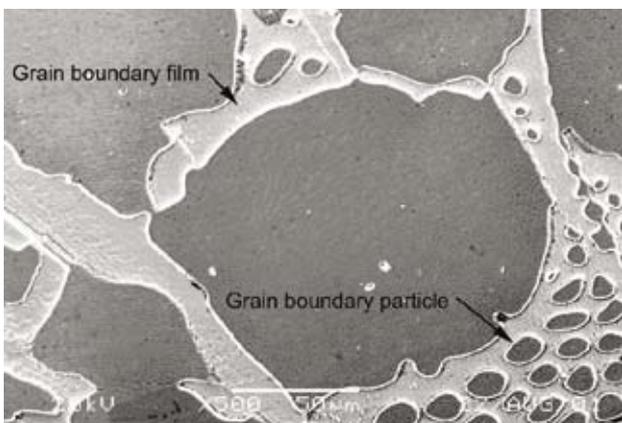
service. When the engine is overhauled, or when cracks propagate to unacceptable lengths during service, it must be decided whether replacement parts should be purchased or whether the damaged components should be repaired. For economic reasons, the majority of users opt for repair.



Cuboidal  $\gamma'$  (Ni<sub>3</sub>Al and Ni<sub>3</sub>Ti) precipitates in a Ni-base superalloy structure (magnification: 10000X).

## Brazing the cracks

Brazing is a method of joining two metallic surfaces by melting an alloy (or metal) at high temperature into the joint without melting the base metal. However, it is difficult, if not impossible, to successfully repair wide cracks by way of conventional brazing techniques, since the brazing of wide cracks results in the formation of hard, brittle joints. The brazing temperature required is typically as high as 1 230°C. The research group has thus examined the feasibility of an innovative repair technique, known as liquid phase diffusion bonding. A major objective was to achieve a lower melting point of the braze alloys. For this purpose, two novel braze alloys, containing hafnium and zirconium, were introduced. It was a welcome spin-off to find a stronger joint than those routinely produced using commercially available braze alloys with boron as melt point depressant.



Scanning electron micrograph of the Ni-Hf braze alloy, showing the phases identified as Ni-rich  $\gamma$  (labelled 'grain boundary particle') and intermetallic Ni<sub>7</sub>Hf<sub>2</sub> (labelled 'grain boundary film').

An optimised braze cycle was developed and the joints evaluated using various metallographic techniques and mechanical tests. These included elevated-temperature tensile tests, creep rupture tests, and low-cycle fatigue tests. (A material's 'tensile strength' is the stress required to break it, 'metal fatigue' is a cumulative effect causing a metal to fail after repeated stress episodes of which none exceeds the tensile strength).

## The braze joints

Microstructural examination revealed the presence of hafnium- or zirconium-rich intermetallic phases in the braze joints. These intermetallic compounds were, although still hard, observed to be significantly softer than the boride phases routinely found in commercially available braze alloys with boron as melting point depressant. Because no boride was present, the novel wide-gap brazed joints displayed excellent mechanical properties, which ranged from 80 percent to 100 percent of the base metal's properties. The low cycle fatigue properties of the novel wide-gap braze joints were found to be superior to those of the nickel-chromium-boron braze filler metals currently used in the repair industry. A wide gap braze repair of FSX-414 cobalt base superalloy (comprising the turbine components) using the novel cobalt-hafnium braze alloy displayed creep rupture and low-cycle fatigue properties superior to those of the base metal. In fact, this was the first time ever that a wide-gap superalloy braze joint proved to be better than the turbine base metal.

## Stakeholders

The liquid phase diffusion bonding technique and the novel braze alloys are currently undergoing extensive testing in power generation turbine engines and the results reported by end-users suggest that the repairs outperform any repairs made using conventional techniques and commercially available consumables. In fact, the technique has already become fully operational in several quarters. The group has not worked on turbines used in the aerospace industry.

This research was done in the Department of Materials Science and Metallurgical Engineering in the School of Engineering, headed by Prof Madeleine du Toit. The United States company GE Energy Services sponsored the research, which was done predominantly by a PhD student of the University of Pretoria, Warren Miglietti. Results from the project have been presented at two conferences in the USA and another three papers on the subject have been accepted for publication in recognised American journals.

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## 5.4 The protective incubator experienced by South African multinational enterprises

South African multinational enterprises (MNEs) have surpassed expectations by successfully competing against developed country firms in developed markets. Emerging markets, particularly in Africa, often lag as a result of low skills, unstable currencies, social instability, poor government and many other locational disadvantages that derive from factors such as colonial legacy, corruption, excessive foreign borrowings and limited economies of scale.

In contrast, Asian MNEs have been able to exploit the advantages of an abundance of low-cost skilled labour, while Africa has had no similar opportunities. African firms have also had to face situations where their advantages in natural resources were rapidly eroded by the knowledge economy and limited investment of infrastructure.

In the 1970s and 1980s, South Africa enjoyed little foreign direct investment into its protected markets due to both lack of infrastructural development and external economic sanctions. There was very little new domestic investment in production capacity and about a third of South Africa's manufactured exports went to other African countries.

While limiting growth, the sanctions provided certain benefits. While South African firms were protected, they could only take advantage of home markets, but global firms with first mover advantage were effectively locked out of the South African market. This is termed a 'protective incubator'.

There is a traditional belief that when firms are protected, they fail to develop a high degree of competitiveness. Until 1983, the South African economy was largely dominated by four diversified conglomerates. This is a consequence of a closed economy with few alternatives to invest. South Africa ranked at the bottom of the world in terms of competitiveness, even when competing with other emerging markets. As a result, many firms in South Africa failed to develop their competitive capabilities under a protectionist umbrella.

However, the past decade has produced a new breed of MNEs that originated in uncompetitive countries that are able to compete successfully in the global markets. A study by Dr Albert Wöcke of the Gordon Institute of Business Science (GIBS), the University's business school in Sandton, in conjunction with Prof Saul Klein of the University of Victoria, British Columbia, Canada, shows a tremendous achievement of companies from South Africa that have used the disadvantages to develop their ability to compete

globally. The study shows how a protective environment may help develop firm-specific advantages in countries with deficiencies in human capital, and market and technological resources. This begs the question: Why are some firms able to exploit the potential offered by protection, while others fail to do so? The research does not answer the question, but shows how firms that overcame these challenges became respected global firms.

While there are many great South African MNEs like Barloworld and SAPPI, these companies were characterised by protectionism and market inefficiencies. However, these firms had a different view of what was traditionally regarded as unattractive markets and also appear to behave differently from their Asian counterparts with respect to foreign direct investment (FDI) decisions. Traditionally, Asian firms concentrated on exporting finished goods, an advantage developed from highly skilled, flexible and low-cost workers manufacturing at home. The study focused on four MNEs: MTN, SABMiller, Nando's and Sasol.

MTN provides cellular network access and associated services based on the GSM telecommunications platform through subsidiaries and joint ventures in 21 countries in Africa and the Middle East. MTN has expanded aggressively in emerging markets and is the market leader in most of the countries in which it operates. The international operations drive growth, as the South African market is largely saturated with limited scope for incremental market share increase.

SABMiller is a global brewing company with South African roots. It is currently the second-largest brewing company in the world. It has operations in Eastern Europe, Africa, Central America, Asia, North and South America. It began its expansion plan after the lifting of sanctions and acquired smaller operations in mostly developing countries, which established international players had ignored.

Nando's is an international food franchiser selling spicy flamed chicken. Founded in 1987, it established its international division in 1995. Expansion is by means of

agreements with sales operators in target countries. The choice of partner is key to brand success and Nando's tried to identify partners whose approach is congruent with the business.

Sasol focuses on the application and commercialisation of unique energy technologies with a global value chain encompassing upstream operations from coal and gas through to synthetics, chemicals and waxes downstream. By 2003, Sasol had subsidiaries in 23 countries. It was exporting to more than 100 countries and was one of the top-five publicly listed companies in South Africa.

These firms overcame both localisation disadvantages and negative government interference to develop their dominant positions at home. A key contributor to their success was the opportunity to develop in the protective incubator provided by a lack of competition. Lack of competition by itself is not sufficient for global competitive success, but it created the conditions for these firms to develop the scale, competencies and skills necessary for global competition in a safe, relatively competition-free environment.

These conditions encouraged the development of alternative technologies as substitutes to imports or to access export incentives. Through such efforts, firms were allowed to extract high premiums from their home market while engaging in FDI and thereby lowering risk and reducing costs. The firms learnt to operate across borders in efficient ways due to foreign exchange controls that made heavy capital investment impossible during early stages of expansion. An additional advantage that these firms enjoy is the ability to operate in a complex market with a myriad of ethnic groups and cultures. These are advantages that are sustainable and difficult to replicate.

Further research will delve into the operating models of emerging market MNEs and the development and replication of the competencies that led to their success in the first place. The results of this study will be published in the *Thunderbird International Business Review*, the second-most read business journal.



The study focused on four multinational enterprises: MTN, SAB-Miller, Nando's and Sasol.

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## 5.5 Violence and reconciliation:

# MK and the legacy of the ANC's armed struggle

Over the past two decades, the Department of Historical and Heritage Studies has built up a strong research profile. It focuses on historical, cultural-historical and heritage themes in Southern Africa. Members of the department are also involved in various projects with historians at universities abroad. These include projects, such as War, Economy and Society in Southern Africa, 1867 – 1902, Chinese in Africa, Religion, Gender and Space in Africa, and Hegemony and Power: South Africa and the Southern African Subcontinent, 1965 – 2005.

Since 2003, the department has actively recruited postdoctoral fellows from abroad. They pursue their research under the supervision of members of the department. The work of these postdoctoral fellows has also contributed steadily to the department's research output. In 2003 and 2004, Dr Nhamo Samasumo completed a research study on economic integration and the development of the beef industry in Southern Africa from 1902 to 1956 under the supervision of Prof Johan Bergh. In 2005 and 2006, Dr Miles Larmer completed a study on unity and dissent in post-colonial Zambia between 1964 and 1991 under the supervision of Prof Alois Mlambo. Dr Thula Simpson is currently investigating the issue of violence and reconciliation: MK and the legacy of the ANC's armed struggle, under the supervision of Prof Mlambo. In 2009, Dr Andrew Cohen will be studying multinational business

in sub-Saharan Africa from 1948 to 1994, also under the supervision of Prof Mlambo.

The research of Dr Simpson, currently in the final year of his fellowship, is primarily concerned with the armed struggle of the African National Congress (ANC). In 2007, he completed a PhD dissertation in History at Birkbeck College, University of London. His dissertation, *The People's War of Umkhonto we Sizwe, 1961 – 1990*, focused specifically on the period from the formation of MK in 1961 to the movement's decision to order a ceasefire in 1990.

South Africa's political transition has required historians to rethink the role played by the ANC in shaping the nation's past. As the ANC's attempts at nation-building in the post-apartheid

era have unfolded, the symbolism and imagery of the liberation struggle have played an important role in underpinning the movement's efforts at political mobilisation. The armed struggle waged by Umkhonto we Sizwe (MK), the ANC's military wing, has been among the most potent of these symbols.

Prior to the 1990s, research on the ANC and the liberation struggle had been limited by a lack of access to relevant sources and the existence of political censorship in South Africa. However, an effusion of primary sources has emerged since the political changes that have taken place in the country. The most notable of these have been the opening of new archives and the publication of autobiographies from leading protagonists in the struggle. These have provided fresh material through which the history of the ANC's contribution to the country's transformation can be reappraised.

Dr Simpson assessed the revolutionary strategies adopted by the ANC during the struggle and challenged a prominent view in the existing literature that the armed struggle had 'failed' to achieve its objectives. He argued for a clearer understanding of these objectives and showed – through an empirical study of every phase of the armed struggle – that the movement's goals and visions had always been influenced by the strand in the movement's history and traditions that stood for racial harmony and reconciliation.

For Dr Simpson, the ANC's development of its strategies for the armed struggle involved negotiating the inherent tensions between its 'non-racial' perspective, and its simultaneous desire to forcibly overthrow the apartheid system, which was essentially a racialised power structure dominated by the white minority. Overthrowing a racial order, while avoiding a racial war, was a dilemma that remained with the ANC throughout its armed struggle. Dr Simpson argued that the limited nature of the ANC's armed campaign should be viewed as much as a result of the military restraint the movement imposed on itself as it grappled with this dilemma, as a military 'failure'.

According to Dr Simpson, the empirical evidence does not support the notion that the armed struggle was ever solely a means of seizing power by force. Instead, it suggests

that MK's armed campaign was also viewed as a way of applying pressure on government to enter into dialogue for a negotiated settlement. This was in accordance with a strategy based on avoiding civil war.

In the transitional period, the ANC was keen to emphasise the fact that it had persisted with its non-racial tradition throughout the struggle. The fact that this emphasis may have been influenced by a desire to take credit for the negotiated transfer in the country does not invalidate the essential truth underlying the claim. In its first official submission to the Truth and Reconciliation Committee (TRC) in 1996, for example, the ANC argued that during the conflict there had always been tension between the imperative of intensifying the struggle and the need to avoid a racial war. The ANC added that this dilemma was ultimately resolved by a decision to reject the idea of a revolutionary armed struggle in favour of a policy of limited military action designed to avoid civil war.

The objective of Dr Simpson's current research is to expand on his doctoral research by exploring themes in greater depth and utilising additional sources. Among the themes he has explored so far are the interrelationship between the ANC's armed struggle and internal mass protest during the 1980s, the ANC's turn to direct negotiations with the South African government, the ANC debates over politico-military strategy in the mid-1970s, and the history of the ANC's eastern front in Mozambique and Swaziland.

Since commencing his postdoctoral fellowship in 2008, he has undertaken extensive research at the South African Historical Archives at the University of the Witwatersrand, the Brenthurst Library in Johannesburg, the National Archives in Pretoria, the Jack and Ray Simons Archive at the University of Cape Town and the National Archives of Swaziland.

His research has already yielded articles on the ANC's relationship to the township uprising in the mid-1980s, the ANC's role in popular protest between 1984 and 1989, and the final year of the armed struggle. These articles will appear in the *South African Historical Journal*, as a chapter in a book on South African popular political and resistance movements (to be edited by Prof William Beinart of the University of Oxford), and in the *Journal of Southern African Studies*. An article on the history of the ANC in Swaziland has been accepted for publication in *African Historical Review*, and another on the ANC's strategic and tactical debates in the mid-1970s has been submitted to *Social Dynamics*.

Dr Simpson's future research on the subject will include the history of the ANC's political and military underground in South Africa in the early 1960s, the history of the ANC in other African states during the years of the liberation struggle, and the history of the ANC prior to the armed struggle. The final product of his research will be a book covering the history of the armed struggle that will serve as an authoritative source for future generations on South African history in the 20<sup>th</sup> century.



Leaders in the fight for democracy on display at Freedom Park.

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## 5.6 Coherent labour and insolvency principles

# in SADC

As an important role-player in the subregion and one of the member states of the Southern African Development Community (SADC), South Africa is committed to promoting sustainable and equitable economic growth and socio-economic development in SADC through deeper cooperation and integration. The Faculty of Law at the University of Pretoria is one of the leading legal faculties on the continent, and plays a prominent role in responding to the needs of the region. It places a high premium on interdisciplinary research and promotes regional and international collaboration.

One of the issues that affects economic development in the subregion relates to foreign investment. On a practical level, this could, inter alia, find application in the buying of an undertaking as a going concern in another country. In this era of globalisation, policy issues that relate to the protection of workers' rights have become central to the development of a future world society. Foreign investors who are in business to optimise profits and increase dividends for their shareholders are no longer restricted by national boundaries.

With the drafting of a new Constitution in South Africa in 1996, a new framework was established to protect workers in this country against unfair labour practices. In the case of workers who become unemployed due to an undertaking being declared insolvent, the principles of insolvency law are influenced by labour law principles enshrined in the Constitution. An important issue to consider is the extent

to which a coherent approach to labour and insolvency law exists in other countries in SADC, and the alignment of these legal issues in the various member states.

Labour and insolvency laws in neighbouring countries that are not in harmony with each other have been found to create dissimilar markets. Progressive labour laws generally guarantee minimum wages and make provision for compulsory contributions to social security funds. This has a definite impact on production costs. Although countries with highly regulated labour relations regimes protect their workers from exploitation, they are at a disadvantage when compared to countries with more flexible and permissive labour laws.

In August 2003, SADC members' heads of state and government signed the Charter of Fundamental Social Rights. One of the objectives of this charter is to harmonise

policies relating to aspects such as social security schemes, freedom of association and collective bargaining, and the promotion of workplace democracy.

One way of creating a relatively level playing field in terms of labour and insolvency law issues is to introduce similar common standards for all members of SADC. When a prospective investor therefore buys an undertaking as a going concern in one of the countries in the region, he will know what rights workers (and creditors) have when a particular business becomes insolvent.

Research conducted by Prof André Boraine of the Department of Procedural Law and Prof Stefan van Eck of the Department of Mercantile Law at the University of Pretoria investigated the feasibility of aligning labour and insolvency law principles in SADC member countries. This research has been included in an international peer-reviewed book, *International Insolvency Law* (under the editorship of Paul Omar of the University of Sussex), as an innovation in insolvency. The research is focused on establishing a vibrant economic hub in Southern Africa that will enhance job creation and work towards the eradication of poverty.

This research is particularly relevant in view of the trying economic times that are being encountered at present. It aims to illustrate the necessity of establishing standards whereby the principles related to the transfer of an undertaking as a going concern, as well as the associated insolvency matters, can be harmonised. A carefully balanced framework will ensure that the region as a whole cannot be classified as either being over-regulated or exploiting workers solely for the benefit of the foreign investor.

One of the determining factors to consider when buying an undertaking in another country is the scope and content of

the different labour laws that apply in the different countries and that regulate the transfer of an undertaking as a going concern, as well as the position of the workers of insolvent businesses.

The benchmarks that have been set at a supranational level are those of the International Labour Organisation (ILO) and the European Union. The ILO Insolvency Convention provides protection to employees for claims against their bankrupt employers by means of a privilege. The European Union has introduced directives regarding the transfer of businesses as going concerns, which bind member states.

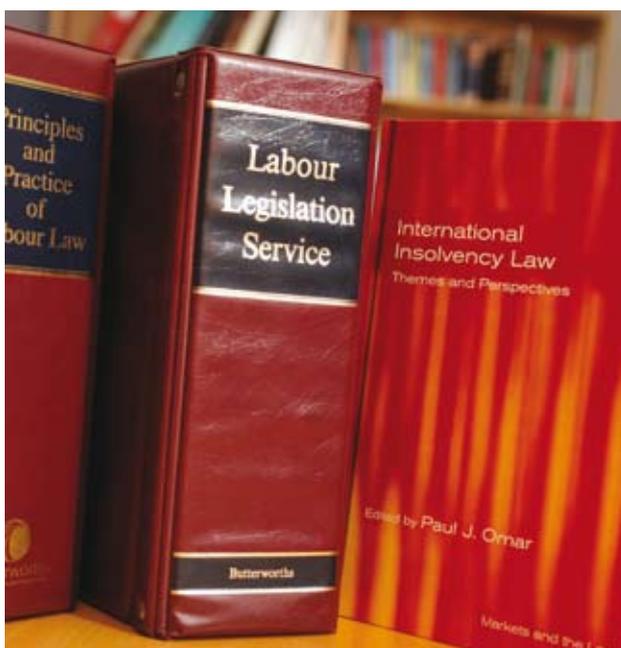
The research conducted by Boraine and Van Eck involved comparing the labour and insolvency law principles of three countries in SADC: South Africa, Namibia and Botswana. These countries are all members of the ILO. From their research, it became apparent that certain countries have been strongly influenced by either the ILO Insolvency Convention or the directives of the European Union. The focus of the study, therefore, was to determine how far apart these three African countries are when it comes to the degree of protection that is provided to workers of undertakings that have become insolvent after being transferred as a going concern. The ultimate objective would be to establish certain minimum standards that could be included in directives – similar to those of the European Union – that would bind member states.

Although the three jurisdictions share the same legal roots to some extent, there are evidently significant dissimilarities, which could either encourage or dissuade potential investors from setting up business in one of these countries. In South Africa, there would be an obligation on an employer to take over all contracts of employment under solvent and insolvent circumstances. In Namibia, there is no such obligation, but there is the possibility that employees may be protected in so far as the relevant authorities may not sanction the dismissal of redundant employees in the shadow of a transfer. In Botswana, employees are only protected during a transfer in so far as years of service are transferred if the employer decides to take over these employees.

According to the researchers, the disparities that exist in other countries in the SADC region might be even greater. Against the background of these differences, the harmonisation of labour and insolvency principles might prove to be beneficial to SADC as a whole, since it will enhance uniformity and mobility in the region, and promote socio-economic development. Any reform attempt in this regard will, however, have to take both economic realities and international norms relating to fair labour practices into account.

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The outcomes of the research have been published in a book on international insolvency law.



## 5.7 Centre minimises the disastrous effects

# of natural hazards

Natural hazards have been afflicting life on earth for the past 3.5 billion years. They originate from the catastrophic release of vast quantities of energy from certain natural phenomena on our planet. These include the seismic events related to earthquakes and volcanic eruptions, which may lead to tsunamis when they occur on the sea bed.

Atmospherically generated hazards include floods and droughts, gale-force winds (especially tropical cyclones and tornadoes), hailstorms, lightning-generated veld fires and avalanches. Biological hazards such as epidemics and botanical pests are equally real. The most annihilating natural catastrophe – of astronomic origin, although the risk of such an event is small on the human time scale – would be the impact of a large meteorite or comet on earth.

It is currently speculated whether certain natural hazards are becoming more severe or more common. For example, are frequencies really increasing or are there simply more informed observers living over larger areas? On the other hand, are higher maximum temperatures and more violent storms in certain places a real trend, and are they linked to global warming?

### A local natural hazard centre

The Aon Benfield Natural Hazard Centre, Africa, was established as recently as July 2008. It is proof of the close and valuable collaboration between Aon Benfield, the world's leading reinsurance and risk intermediary, with its head office in

Chicago, USA, and the University of Pretoria, where the centre is located. The active involvement of Aon Benfield is greatly appreciated and professionally recognised by the centre.

A main reason for creating the centre is to promote research into natural hazards in Africa. Natural hazards, particularly risk information of relevance to the South African insurance community, is a critical function and will be made more widely available. To ensure effective dissemination of this information, the centre gives presentations and publishes articles on recent developments and research in this field.

Prof Andrzej Kijko, an internationally acclaimed seismology researcher, is the director of the centre. He has been active in engineering geophysics and seismology for over 35 years, and has authored books and published more than 100 journal papers. The centre's network of associates has extensive skills in earthquake hazard modelling, mining catastrophe, flood and meteorological risk, and can offer independent advice, opinions and analyses on all aspects of African natural perils. The centre states pragmatically, "we cannot prevent a natural disaster, but we can take steps to minimise the negative effects".

## The African connection

The full name of the centre implies that it is designed to be of benefit to all countries and communities on the continent. However, it should be realised that, in contrast to some other continents, Africa's data sets mostly lack a long-time base, are rarely spatially representative, are often incomplete and therefore not large. The conventional acquisition of good scientific results from such data is very limited. Africa needs African methodologies and Africa-specific techniques to process and interpret its unique data sets of natural hazards. The Aon Benfield Natural Hazard Centre, Africa, is geared to address these needs and is ready to tackle the challenges arising from them. Prof Kijko's conviction that Africa is entering an era of 'new beginning' creates excitement in the centre about the African connection and the expected growing scientific collaboration. The world insurance industry is also looking to Africa for growth and expansion, while Africa is looking to the world markets to provide risk management.

## Focus on South Africa

Why has South Africa been chosen as the African centre? This country has a spectrum of experts in the field of natural hazards, and is furthermore exposed to several types of natural hazards. Groundshaking earthquakes, occasional devastating winds, fierce hailstorms, (flash) floods and emaciating droughts are particularly prevalent. They are capable of causing considerable financial losses, which can be quantified by the use of catastrophe models.



Floods in De Doorns caused damage to homes and property.

In 2008, an interactive seismic hazard map for South Africa was produced. It shows the countrywide likelihood of vibrations strong enough for the destruction of infrastructure. Of particular concern are seismic shock-resistant high-rise buildings, bridges, dams and power plants (nuclear and coal-fired). For this reason, the engineering industry is a major stakeholder of the centre.

In line with the above, the Aon Benfield Natural Hazard Centre, Africa, will provide expertise and research on natural hazards, particularly seismic (earthquake-related) hazards that affect Southern Africa. It will assist in developing Aon Benfield's proprietary (impact forecasting) earthquake model for South Africa to benefit customers and the insurance market in South Africa.

Through its close association with Aon Benfield's University College London Hazard Research Centre in the United Kingdom (the leading hazard centre in Europe), the local centre provides extensive skills in the hazard modelling of earthquakes, mining catastrophies, flood risk and meteorological risk. In worst-case scenarios, the centre has the capacity to provide disaster management skills. The centre also offers professional advice, opinions and results of analysis free of charge to bona fide researchers.

## Techniques and academic collaboration

Mathematical tools play a central part in this work. In conjunction with overseas universities, the centre has developed tools that accommodate the so-called 'mathematics of incompleteness and uncertainty'. These techniques have drawn on the finest minds in Japan, Italy, Norway and the USA, resulting in a true 'mathematics for Africa'. With this mathematical strategy, the best possible synthesis is drawn from available, yet often inadequate African data.

Several departments of the University are involved with the centre by freely delivering very specific inputs. These are the departments of Mathematics and Applied Mathematics, Statistics, Geology, Geography, Geoinformatics and Meteorology, and Insurance and Actuarial Science.

International scientific links were recently strengthened by Prof Kijko through co-authorship of the paper *A probabilistic tsunami hazard assessment for the Makran subduction zone at the northwestern Indian Ocean*. He also co-authored a paper in 2009 with colleagues from the Council for Geoscience and the University of the Witwatersrand, entitled *Seismotectonic models for South Africa: synthesis of geoscientific information, problems and the way forward*.

## A last word

The world's largest independent reinsurance brokerage has decided to open a centre in Africa, because Africa now deserves this attention. Assets are being created everywhere on the continent. It is significant that it chose South Africa, particularly the University of Pretoria, as the base for its African centre. Aon Benfield is acutely aware of the current major economic downturn globally, which directly impacts on risk assessment in the financial orbit. The recent establishment of the Aon Benfield International Credit and Financial Risks Centre in London underlines the seriousness that the Aon Benfield group attaches to this reality.

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## 5.8 Interpreting the Bible

# in (South) Africa

The Bible is the book of and for the church. For many centuries, only priests, as representatives of the church, had the right to interpret Scripture, especially in a predominantly illiterate world. Bibles were practically unavailable until the mid-15<sup>th</sup> century. At that stage, Johann Gutenberg invented the mechanical printing press in Germany, utilising metal movable types. This ushered in the era of mass production of any document.

Indeed, in just the following century, Martin Luther translated the Bible into German with the explicit aim of making it available to whoever wished to read it. Forthwith, a printed version of Scripture became available to any literate German reader and speaker. Translations in other European languages followed, which altogether paved the way for Bible-reading Christians to interpret the sacred contents for themselves. The first Bible in a South African black language (Setswana) was printed in Kuruman in 1833 by the same remarkable man who had translated it, the pioneer Scottish missionary Robert Moffat. Today, all South Africans may read the Bible in their mother tongue.

### Modern trends

It was corroborated that the Bible, the primary authoritative religious document, existentially influences the lives of millions of people, also in South Africa. However, the Bible is approached, read, and used in a variety of ways in Africa. The research team, under guidance of Prof Jan van der Watt of the University's Faculty of Theology, has explored these ways

in depth. A key challenge was to find out how the message of the Bible is actually perceived by black African Christians. This required intensive qualitative research on their holistic view of the world, characterised by a strong interaction between the physical reality on earth and the spiritual world of God and of the forefathers. The aim was to describe the current religious thought patterns of black South African Christians as accurately as possible.

Ostensibly, about 70 to 80 percent of South Africans identify themselves as Christians. Undoubtedly, the Bible commands a central place in their lives and they regard it as authoritative for faith and life. However, the answer to the question of how the Bible functions within their lives had to be explored. For instance, some communities regard the Bible as a magical instrument of power: they believe this power is transmitted to them by sleeping on the Bible. Others claim that reciting texts from the Bible will result in protection against evil. Still others read the Bible for the sake of the salvific message it conveys.

Photograph: Research in the Faculty of Theology focuses on the accessibility of the Scripture in African languages.

The key concept, as well as the common denominator, in dealing with the Bible in Africa is contextualisation or inculturation. The emphasis falls more on the needs of the readers of the text without neglecting or denigrating the original intention of the author. There is a strong interest in the use of the African world view in their mode of reading and interpreting the Bible. The Bible must speak to and through their context, since Christians would like to hear what the Bible has to say about the pains and pleasures of their everyday lives.

### To read or not to read

Although the Bible is so important in the lives of Africans, nearly 12 million people in South Africa are functionally illiterate. They either cannot read or they do not want to read. Even among the tens of millions of literate persons, there often is an aversion to reading. This impacts on the effectiveness of the Bible. A further factor that should be considered is that many of those African readers that do read, feel themselves in many ways alienated from the predominantly Western way of reading and interpreting the Bible, which borders on rejection. A major movement is underway among African theologians to find an authentic 'African reading' of the Bible that touches and enlightens their everyday reality (inculturation).

### Hermeneutics of relevance

Research was done within the above context, seeking ways in which the reading of the Bible could be an enriching contextual experience for the reader without rejecting the rich theological tradition of Bible reading in the West. A 'hermeneutics of relevance' is developed in which the ancient text is decoded and re-appropriated. A hermeneutical bridge must be constructed between the biblical text and the present-day reader so that the two 'worlds' may meet in interactive dialogue. Both the context in which the text was produced, as well as the context in which the text is consumed, should be taken seriously and should be integrated as part of the process of interpretation on the basis of mutual relevance. Readers should be willing and able to approach the text with their own questions and interests (from their contexts), but at the same time recognise the role the Bible plays as authentic and authoritative partner in this process of interaction. A key to the hermeneutics of 'contextual relevance' is therefore that the reading process should start at areas where the two 'worlds' overlap, be it on a linguistic level (words that are similar, like 'God' or 'mediation'), a thematic level (kinship, patriarchal families), everyday life (sheep farming, sowing) or a mythological level (the same type of stories used to explain transcendental phenomena). This 'overlapping' presents a familiar entrance into the text and presents the opportunity for a relevant discussion. The reader comes with foreknowledge (and therefore has something to contribute) to meet what seems familiar in the text and, therefore, not as a passive partner in dialogue. Within this context, a dynamic dialogue develops that integrates the worlds of the text and the reader.

### The final product

The research resulted in the publication of a book (in print), *Reading the Bible in (South) Africa – hermeneutics of relevance*, by Prof Van der Watt and three PhD alumni of the University

of Pretoria. The book is aimed at theologians and Christian leaders. In the decades to come, theological development in black African churches keeps pace with the well-founded international academic tradition regarding the understanding of the Bible, and the contents of the Bible are constantly taken more seriously, resulting in meaningful and delightful access to its message of good news for all.

### Enhancing indigenous knowledge systems

Similar African-focused research is conducted in some other projects in the Faculty of Theology. Comparisons between traditional African (oral and written) religious material and Scriptures of other world religions have provided precious insights. To compare the religious experiences of specific African traditions with existing canonical Scriptures not only enhances the contribution of African religiosity in the African context(s), but the wealth of African indigenous knowledge systems is preserved. The heritage and value of indigenous communities' oral and written traditions are protected by this research.

### Lozi prayers for protection

The Lozi is a Zambian/Namibian African indigenous community. A comparative analysis of African traditional religion and the Old Testament detects proximity and distance amid the two traditions. Microcosmic similarities in prayer for protection between biblical psalms and Lozi prayer traditions confirm closeness in religious experience during times of danger between ancient Israelite society and contemporary African tribal societies. Furthermore, these similarities provide concrete points for dialogue between African traditional religion and biblical studies. Inversely, differences underscore the uniqueness of prayer for protection in each of the biblical and African traditions.

### Pedi psalm-like songs

The Pedi is an indigenous community in Limpopo, South Africa. Various mutual genres for religious experience were identified in the community and the Old Testament Psalm, inter alia, praise, thanksgiving, lament, royal celebration, urge for liberation, promoting wise behaviour, expression of trust and wrath, festive celebrations and structuring relationship with the divine. Pedi texts were found equivalent to biblical Psalm texts in focus, quality, structure and content. These texts contribute to the religious experience and worship of the African people in the same way as biblical Psalms. This awareness of the functioning of Pedi psalm-like texts in African culture is created. The research serves as a contribution to the development of African cultural and religious heritage.



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## 5.9 Pioneering race horse study

# conducted in South Africa

In a groundbreaking veterinary field trial, scientists from the University of Pretoria, working with researchers from Australia and the USA, took research about exercise-induced pulmonary haemorrhage in race horses out of the laboratory and onto the race track in a huge field trial involving 180 horses in 24 races under actual race conditions. The study showed that pre-race administration of furosemide (known as Lasix® or Salix®), a drug that is widely used in the horse-racing industry in the USA and Canada, dramatically reduces the frequency and severity of the bleeding seen in race horses' lungs after demanding exercise or a hard race.

Bleeding from the lungs during or after physical exertion is a widespread problem that costs the horse-racing industry an estimated US\$ 100 million a year in the USA alone, with a much larger cost impact around the world. Strenuous exercise causes horses' lung capillaries to fracture and blood then enters their air passages. Sometimes a horse visibly bleeds through its nostrils. The affliction affects the horse's performance, decreases lung capacity over time and may even be fatal. In some countries, race horses are banned for a period of time following such a bleeding attack.

Lasix is controversial for a number of reasons and banned in many countries. Horses treated with Lasix lose about 2 percent of their body weight within the next hour. This causes them to 'run lighter' and use less energy. An earlier study involving more than 22 000 thoroughbreds proved that horses treated with this drug are more likely to win a race. As

a result, there is public concern for the health and wellbeing of the affected horses and many suspect that the drug is really used to enhance performance. Lasix is also expensive, with millions of US dollars spent every year on day-of-racing administration in the USA alone. Despite the hot debate about its use, there has never been scientific proof of its efficacy to counteract bleeding under racing conditions.

Prof Alan Guthrie of the Equine Research Centre at the University of Pretoria's Faculty of Veterinary Science at Onderstepoort coordinated the field trial. He admits that doing a 'massive field study' with 180 horses taking part in 24 races over two weeks proved to be a logistical nightmare at times. "We believe that we have totally changed the way of doing this kind of research and raised the crossbar considerably. If anyone wants to tackle a similar research challenge in future, this is the standard they will have to aim for," he explains. The

Photograph: The research team, comprising (left to right) Prof Paul Morley of the Colorado State University, Prof Ken Hinchcliff of the University of Melbourne and Prof Alan Guthrie of the Equine Research Centre at the University of Pretoria, at the Vaal Race Course.

field trial was done at the Vaal Race Course near Vereeniging, with the full support of Phumelela Gaming and Leisure (Pty) Ltd, a JSE-listed horse-racing company.

Because the use of Lasix is prohibited in South Africa, local horses had not been exposed to it before, making them ideal subjects for this study. "South Africa is probably the only place in the world where this study could have been done and all the participants should feel proud of what was achieved," says Prof Ken Hinchcliff of the University of Melbourne, one of the international research collaborators. Prof Paul Morley of Colorado State University was the other key partner.

In a carefully controlled trial, each horse was treated with Lasix for one week and a placebo for the other week. An encoded medication system ensured that no-one working with the horses could tell the drug from the placebo. The scientists collected blood samples of horses running with and without the medication to confirm correct treatment and investigate the variation in drug concentrations between horses. They used an endoscope to film inside each horse's lung, looking for the presence of blood and grading the amount of bleeding when present.

"We used an authoritative grading system to assess this and made sure that the study included enough horses to validate our findings – positive or negative," Prof Guthrie explained.

The findings of Prof Guthrie and his collaborators have recently been published in the *Journal of the American Veterinary Association*. "The results of this study now provide sound scientific data on the efficacy of furosemide and will be critical in informing the debate on the use of furosemide in racing," Prof Guthrie explains. Many countries don't allow its use, while others do, thus provoking substantial debate between the different jurisdictions. "We have given the relevant policy-



Endoscopic examination of the airways of a horse during the Lasix trial.

makers and race horse owners unequivocal scientific data from which they can make informed decisions about the use of a very expensive drug," he explains. "We also hope to make a difference to the wellbeing of race horses around the world."

Funding for the study came from The Grayson Jockey Club Research Foundation, a leading American foundation that supports equine research around the world, and the Racing Medication and Testing Consortium, a consortium of racing industry stakeholders, also based in the USA. The study was also generously funded and supported by the South African racing industry.

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Horses competing in one of the Lasix races.



## 5.10 Researchers contribute to an international study

# on childhood asthma

Asthma has been described as the most common chronic infection in children under 15 years of age worldwide. Yet, until recently, very few studies had been done to map the disease trend. In 1991, the International Study on Asthma and Allergies in Childhood (ISAAC) was launched to encourage research on asthma, allergic rhinitis and eczema in children. Originating from two multinational collaborative projects on childhood asthma based in Auckland, New Zealand, and Bochum, Germany, ISAAC is a unique project that has attracted worldwide interest and unprecedented large-scale participation, currently involving nearly 100 countries.

In 2005, the School of Health Systems and Public Health (SHSPH) joined this global research initiative by registering Polokwane and environs as a study site for Phase III of the ISAAC project. The aim was to address the lack of statistics on asthma prevalence in South African children from a rural area, and so to contribute to data gathered by 22 centres in 16 African countries for the third phase of ISAAC. As Polokwane is situated in a dry, high-pollen and fungal spore environment, coupled with its high altitude, low humidity and large industry setting, the city was ideal to assess the risk factors associated with the prevalence of asthma, rhinitis and eczema, compared to Cape Town, the second South African site, which has a 'wet' environment.

"A large smelter company wishing to expand in Polokwane required respiratory baseline data of the area as one of the conditions for expansion in the impact assessment. Their need and location were ideal for the researchers to undertake this work on asthma and allergies for Phase III. Since people in the

area perceive that industries contribute to health problems, the next survey in Phase V (2010 - 2012) will give an indication of whether asthma and allergy rates have increased or not," explained Prof Kuku Vuyi, head of the School of Health Systems and Public Health, who led the research. She is also a member of the African Advisory Committee on Health Research and Development for the World Health Organisation (WHO) African region, which guides the agenda on research for health on the continent.

With the support of the Department of Education, schools in the Polokwane area and within a 60 km radius of the city were randomly selected and a total sample of 3 480 children aged between six and seven and 4 660 children aged between 13 and 14 were included. The survey took place during February and October to coincide with seasonal changes and to avoid disrupting children during exams. Data was collected by a team of five nurses fluent in Northern Sotho from the Department

of Public Health of the University of Limpopo. The study was contracted by SE Solutions, a Pretoria-based consulting and research company that specialises in sustainable development services. The results were pooled and analysed in Auckland.

Alarmingly, Polokwane had the highest incidence of reported severe asthma in Africa (6.6 percent), compared to Kinshasha (0.9 percent), although the data will need to be clinically verified in the follow-up phase. Severe asthma typically presents with wheezing and acute shortness of breath, and can be life-threatening. Polokwane's overall asthma prevalence rate of 18 percent was slightly lower than that of Cape Town (20.3 percent), but still high and comparable with that of Western Europe.

## Contributing factors

There is much around asthma that remains a mystery. Commenting on the results of the Phase III data, Prof Voyi highlighted that the data showed considerable variations between and even within countries. "It is difficult to detect a pattern for this 'silent disease', and genetic factors cannot be ruled out. Compounding our work on asthma even further is the fact that no prevalence figures for underlying genetic factors exist either," she said.

Internationally, environmental factors such as dust mites in homes have been studied, but the information in South Africa is lacking, possibly because there are other more pressing issues facing our children. "But asthma is a life-threatening disease and severe symptoms of 6.6 percent in Polokwane are very disturbing," said Prof Voyi.

"What we do know is that children appear to outgrow asthma, and it declines with age in rural areas, possibly because children are moved to towns where they can get help. We were able to modify the international questionnaire somewhat, and included a question on distance to a health facility, to determine the availability of health care centres and medication. This may help inform policy for standardising distance of health facilities from settlements according to WHO guidelines," she said.

The immediate outcome of the Polokwane work was improved awareness of parents and children of their health status. So far, five research papers have been written and a PhD student finalised her degree on a predictor model that could lead to a better understanding of the interaction of risk factors such as indoor air and climate variation in asthma and allergies in childhood. She is now in Denmark conducting a postdoctoral degree. As a further spin-off, the Department of Environmental Affairs and Tourism has granted funding to the SHSPH for a three-year collaborative project to research air pollutants, among other things, that cause respiratory diseases.

## Shortcomings for developing country settings

"Although the ISAAC project is a good international study, we found several shortcomings arising from a developed world protocol applied to a developing world context. For

instance, unlike developed countries, we couldn't use videos to demonstrate children running and wheezing because of infrastructure constraints in some of the rural schools. We had to act this out ourselves. Whoever designed this study in the 1990s probably never imagined it might be conducted in places without electricity," said Prof Voyi, explaining that video had to be excluded totally from the study in order to prevent data from being skewed.

Secondly, although the original English questionnaire had been translated into Afrikaans, there were challenges with the interpretation and translation of questionnaires into Northern Sotho, particularly for terms such as 'rhinitis' and 'eczema'. Some questions had to be excluded from the international analysis as a result. "Adult literacy was also an issue for the parents and guardians of the six- and seven-year-olds who completed their questionnaires. However, this had an unexpected benefit of helping parents and guardians to be more observant of their children's health," said Prof Voyi.

## Informing policy in South Africa

The SHSPH will pursue its research during Phase V in 2010 to 2012 to apply lessons learnt and determine whether asthma rates in Polokwane have increased. The questionnaire will be refined to include the clinical evaluation of severe asthma symptoms and focus on possible causes of the differences between study sites and countries. "Other countries have been involved in ISAAC for about 15 years. Our entry into the study has provided essential data for us to build on in the next phase, and so provide evidence-based research to inform policy in South Africa. The ISAAC study has been very positive for the SHSPH in terms of international networking, particularly in Africa where health research is sometimes regarded as a luxury," said Prof Voyi.

"Participating in this massive ISAAC study and interacting with developed and developing world colleagues helped to shed more light on cultural considerations that impact on research. The Auckland coordinators are keen to collaborate further with us in terms of expanding the availability of African-language questionnaires," she said.

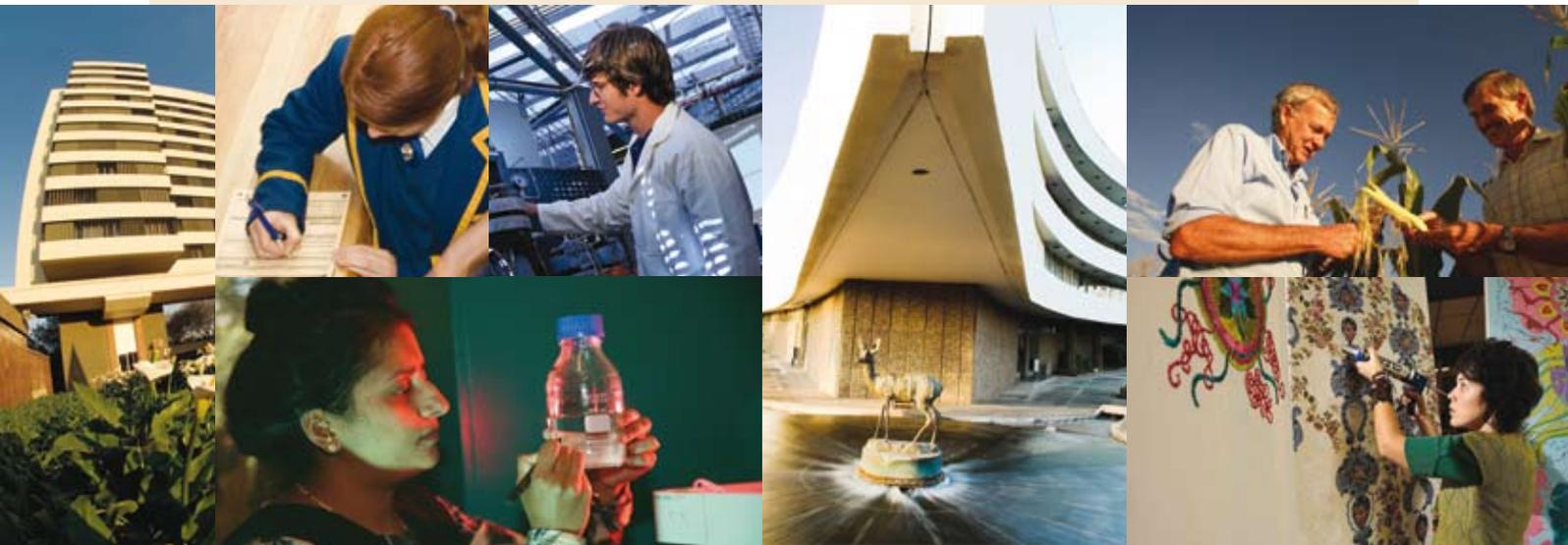
With much around asthma still a mystery, the SHSPH hopes to expand relationships with ISAAC collaborators in other African countries and elsewhere to discover more about this chronic, often debilitating, disease and alleviate unnecessary death and suffering.

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## 6. Research highlights



## 6.1 Faculty of Economic and Management Sciences

The Faculty of Economic and Management Sciences strives to be an internationally recognised and locally relevant centre of excellence in education and research in the economic, management and financial sciences, with a special focus on the needs of Africa.

### Message from the Dean

Although the research outputs of the faculty mainly reflect theoretical research, the application of this research is also noticeable in the number of contract research reports completed to address critical research needs, both in the public and private sectors in South Africa and Southern Africa.

The faculty has set as a key priority the continuous improvement of research quality and outputs by developing the supervision and research capacity of members of the academic staff, improving the quality of writing skills of staff and students, creating sufficient and effective administrative support to academic staff, increasing the number and quality of postgraduate students in the faculty, and increasing the number of NRF-rated scientists.



Economic and Management Sciences Building

International networking with peers at renowned research institutions is of paramount importance in achieving the faculty's goals, and a concerted effort is being made to establish and strengthen relationships. During 2008, the faculty produced 96 master's and 24 doctoral graduates. Three staff members of the faculty obtained their master's or doctoral degrees and numerous staff members are in the process of completing their master's or doctoral degrees. A further seven staff members are studying at international research universities to complete their doctorates.



Prof Carolina Koornhof, Dean

The Faculty Research Award for the department with the highest number of accredited research units in the preceding year was awarded to the Department of Economics. Faculty research awards were also made to individual researchers. Dr Edwin Ijeoma (School of Public Management and Administration) received the award for the lecturer with the best research output, while Prof Rangan Gupta (Department of Economics) received the award for the best performance at the professional research level. Several researchers in the faculty also received national and international acknowledgement for excellence in research.

In 2008, a hands-on, three-day supervision workshop was conducted with support from an external consultant to improve on the quality of supervision at the graduate level and to improve on the quality and quantity of research articles. The workshop ended with the annual Faculty Research Day. Supervision problems, solutions and best practices were discussed by a number of invited guests. Departments are encouraged to have regular 'brown bag sessions' and seminars to discuss the research projects and progress of staff members.

I would like to thank members of the academic and administrative staff, postgraduate students and, in particular, members of the faculty's Research Committee, Postgraduate Committee and Research Ethics Committee for their contributions in making 2008 a successful research year.

The aim of the faculty in 2009 is to continue to build research capacity, to nurture a research culture, and to improve the research output and research impact of its staff and graduates, both in terms of quality and quantity.

Prof Carolina Koornhof  
Dean

## Research highlights

### Accounting

#### Research output scores by accounting departments in South Africa

As a result of undue pressure, the research outputs of departments of accounting, whose academic programmes are accredited by the South African Institute of Chartered Accountants (SAICA), have declined drastically over the years. Research found that one of the main reasons for this decline is the fact that chartered accountants are trained as technocrats, which is contrary to a long-standing tradition of exposing students to the pursuit of science as an endeavour. The researcher recommended that only those departments of accounting that develop the subject as a social science in scholarly activity deserve international recognition. To ensure that UP meets this criteria, the Department of Accounting developed an internationally recognised master's degree in accounting sciences. The aim of the degree is to expose students to international academic excellence and the latest developments in accounting. Several leading international accounting academics provided significant input to the development of the programme. In addition, several of these academics will visit the University in 2009 to facilitate workshops for master's students.

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### Auditing

#### The status of and demand for internal auditing in South African companies

In a research project, sponsored by KPMG and the Institute of Internal Auditors, South Africa (IIA SA), to determine the current status of and demand for internal auditing in South Africa, it was found that research done on the practice of internal auditing in South Africa is limited in its extent. The lack of research is partly due to the fact that, as an academic discipline, internal auditing is still in its infancy and is therefore still a relatively unexplored research area. The main reason for undertaking this study was to address the research vacuum. This study builds on the global survey that was conducted by the Institute of Internal Auditors Research Foundation (IIARF) in 2006 to establish the common body of knowledge (CBOK) of the internal auditing profession. The current project extends the CBOK study to the extent that it elicits the views and perceptions of both the chief audit executives (CAEs) and the users of internal audit services. The users include the chairpersons of audit committees (CACs) and chief executive officers (CEOs), chief financial officers (CFOs) or chief operating officers (COOs) of listed companies in South Africa that have the largest market capitalisation. The researchers obtained data on the profiles of the CAEs of the internal audit activities (IAAs) and analysed the perceptions of the stakeholders of the functions and activities of the IIA SA, the views of the stakeholders on the composition of the IAAs' staff complement and their perceptions of the demand for the services of the IAAs. Furthermore, they analysed the perceptions

of the stakeholders of the IAAs' structure, status and activities, the perceptions of the stakeholders of the IAAs' role with regard to corporate governance and fraud, and the perceptions of the stakeholders of the IAAs' role in respect of risk assessment and risk management. The views and perceptions of the stakeholders were obtained by means of three structured questionnaires. One questionnaire was developed for completion by the CAE, a second for completion by the CAC and a third for completion by the CEO, CFO or COO. These questionnaires were developed and finalised after extensive literature reviews had been undertaken, discussions with stakeholders had been held and pilot testing had been done in South Africa. The study found that the IAAs have a relatively high status. The high status applied especially to in-house IAAs. It was also found that there was a demand for highly skilled internal auditors, especially female internal auditors from previously disadvantaged groups.

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### Economics

#### Property taxation in Africa

The aim of this research project was to gather primary data in-country and to compile a property tax profile for all 53 countries in Africa. The study was led by Prof Riël Franzsen, director of the African Tax Institute, in collaboration with the Valuation and Taxation Department of the Lincoln Institute of Land Policy, USA. Prof Franzsen prepared and proposed a comprehensive continent-wide research project in respect of property-related taxation in Africa. The researchers focused on identifying which suitably qualified individuals from various regions in Africa annually apply for research fellowships with the primary goal to gather data on property-related taxes in African countries and to prepare individual country reports. During 2008, the first three research fellows – from the Democratic Republic of the Congo (DRC), Mozambique and Sierra Leone – tabled individual country reports on property-related taxation in 15 African countries. Six additional fellows – two from Cameroon, one from Chad, two from Ethiopia and one from Niger – were selected for 2008 and commenced their research on a further 16 countries. In December 2008, a further three fellows – from Egypt, Kenya and Zambia – were selected. Six of the 12 fellows were postdoctoral researchers. At least 25 country reports are expected to be



Informal traders in Kinshasa.



published on the African Tax Institute and Lincoln Institute websites by April 2009. It is envisaged that a comprehensive review of the status of property taxation in Africa will be published electronically and in book form by 2010/11. It will consist of an overall overview report and commentaries on regional trends, sourced from individual country reports for all 53 African countries. Preliminary findings from the country reports received to date indicated that at least six different tax bases are used for property tax purposes in Africa, with some countries allowing more than one option in legislation. Despite an undeveloped property market and weak valuation profession in many countries, ad valorem property tax systems are prevalent and indeed on the increase. In addition, the researchers found that although comprehensive legislation was exhibited in most countries reviewed to date, tax base coverage is generally poor and tax administration weak.



Land value systems may still provide a credible tax base in less developed countries.

### Land value taxation

A concise overview of research on land value taxation undertaken by Prof Franzsen and Dr William McCluskey (University of Ulster, Northern Ireland) over the past seven years was published as a chapter in a book entitled *Making the Property Tax work: experiences in developing and transition countries* (2008). The title of the chapter is 'Feasibility of site value taxation'. In addition, Prof Franzsen undertook further research on land value taxation for the book *Land value taxation – theory, evidence and practice*, commissioned by the Lincoln Institute of Land Policy, USA. He found that the number of countries utilising a land value-only property tax system is on the decline. Although the quantity of data required to manage a land value tax system is less demanding, in highly developed urban jurisdictions there are often too few sales of undeveloped land to provide credible evidence to sustain a tax based on unimproved land values only. The lower nominal tax rates associated with capital-improved value systems make these systems politically more acceptable than land value systems. In less developed countries with limited resources and a paucity of valuation skills, land value systems may still provide a credible tax base that can generate adequate levels of revenue.

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### On the real exchange rate effects of higher electricity prices in South Africa

Using a static computable general equilibrium (CGE) model of South Africa and simulating various shocks to the price of electricity, the researchers attempted to measure the impact of this on the real appreciation of the exchange rate or international trade competitiveness. A number of conclusions were reached from the modelling exercises. Electricity price increases have mostly negative effects on the economy. All industry production decreases in the short run, as does gross domestic product (GDP), while many industries are also worse off in the long run. Poorer groups are more badly affected than other groups, therefore price increases should be considered carefully. The most efficient policy is not necessarily the most equitable one. While some industries enjoy the benefits of exemptions, it follows that the consumers and industries that are not exempt have to



bear these costs. The industries and final consumers that face higher increases are obviously worse off than the ones that receive lower increases. The former industries experience a greater negative effect than in the case where all industries are subjected to the same price increase. When foreign consumers pay less for electricity than domestic ones, domestic consumers end up cross-subsidising them. In general, exports and foreign markets determine what the industry results will be when electricity prices increase. The effect on the terms of trade and balance of payments is important. Export-driven sectors are particularly vulnerable to an electricity price hike. Some sectors, like the iron and steel industry, are particularly sensitive to a change in electricity prices. As electricity constitutes a large proportion of their

input cost, any increase in their price influences their cost significantly. Moreover, these industries are export-driven, thus higher costs adversely affect their competitiveness in the world market. In the model, the effect on the consumer price index, and therefore on the real exchange rate, is generally very small. Although the South African Reserve Bank warned against inflationary effects of higher electricity prices, significant effects were not experienced in this regard.

#### The effect of an electricity generation tax on the economy of South Africa

In a joint study with the Monash University's Centre of Policy Studies (CoPS) (Melbourne, Australia) and the South African National Treasury, the Department of Economics conducted a study on the impact of an electricity generation tax on South Africa's competitiveness and trade composition under different scenarios. The study was conducted in two phases. During the first phase, the computable general equilibrium model of the Department of Economics (UPGEM) was used to assess the impact of such a tax. All the countries were grouped together as 'the rest of the world'. During the second phase, the global trade (GTAP) model of the CoPS was used to estimate the impact of the outcome of the first phase (the impact of the generation tax on the domestic economy of South Africa) on world trade and South Africa's competitiveness. Phase 1 findings indicated that the key variables, such as employment and GDP, respond better under a general increase in government expenditure than an increase in investment. Inflation, however, reacts more negatively and the reduction in emissions is slightly less when the revenue is recycled through an increase in government expenditure than through an increase in investment. When considering recycling the revenue through increased government expenditure, it is possible to get a triple dividend: a decline in emissions, an increase in GDP and employment and, as an added bonus, an increase in household consumption. These benefits, however, come at a cost of a net increase in inflation, an increase in imports and a reduction in exports. The findings of Phase 2 indicated that if South Africa were to unilaterally decide to increase its electricity tariff by 10 percent, the country's neighbours and trading partners' GDP would improve marginally. The increase in GDP varies between close to zero and 0.0171 percent. It has to be kept this low because it will turn trade away from South Africa to other countries. Should the other countries



The price of coal influences the electricity price.

decide to introduce a 10 percent electricity generation tax, while South Africa doesn't, it will cause them to contract, which will have a detrimental effect on the South African economy. Should South Africa also introduce such a tax, the effect will be worse than when the other countries do so on their own. This is to be expected, since, in the GTAP model, it is not possible to recycle tax revenue to the various sectors, so the tax is revenue lost out of the system. In effect, the scenarios and results presented reflect the worst-case scenarios. The positive outcome of these taxes is that CO<sub>2</sub> emissions will decline. It should be noted, however, that the general impact on the economy is very small.

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### Evaluating the impact of land redistribution in Zimbabwe

In this study, a counterfactual picture is sketched of what could have happened, had land reform in Zimbabwe been handled in a different way. The researchers used a CGE model coupled with a microsimulation model to quantify the impact of land redistribution in terms of poverty, inequality and production. The results for the land reform simulations showed that the reform could have had the potential of generating substantial reductions in poverty and inequality in the rural areas. The wealthier households, however, would have seen a slight reduction in their welfare. What underpin these positive outcomes are the complementary adjustments in the fiscal deficit and external balance, elements that were generally lacking from the way Zimbabwe's land reform was actually executed. These results tend to suggest that well-planned and executed land reform can still play an important role in reducing poverty and inequality.

### Agricultural trade reform in South Africa

The researchers made use of the Agricultural Trade Policy Simulation Model (ATPSM) of the United Nations Conference on Trade and Development (UNCTAD) to investigate the impact of agricultural trade reform in South Africa. They started off by capturing the magnitude of the economic impact of global agricultural trade reform in South Africa and then proceeded to link the economic impact of the reform in South Africa to agricultural reforms in the European Union (EU). Trade reform focuses on substantial tariff reduction, although in the case of the EU scenarios, it also includes a reduction in domestic support and export subsidies. The results show that unilateral tariff reduction in the selected number of agricultural products amounts to welfare gains of US\$21 million. These gains are three times higher when accompanied by extensive reforms in the EU.

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### Financial Management

#### The appropriateness of discount rates

The Department of Financial Management, in collaboration with two external economists, Mr Christo Luus and Dr Dawie Mullins, conducted a study to evaluate the appropriateness of discount rates used by the Development Bank of Southern Africa (DBSA) for the purpose of a cost-benefit analysis when evaluating projects. The aim of a cost-benefit analysis is to determine whether a project is desirable from a social welfare perspective by means of the use of the time-discounted economic costs and benefits of a project. A critical assumption of cost-benefit analysts is the discount rate – usually referred to as the social discount



Agricultural trade reform focuses on substantial tariff reduction.

rate – because economic benefits and costs derived from a project are seen to have a more direct bearing on society and consumers, compared to owners of capital who normally use a financial discount rate (hurdle rate). The findings showed that estimates for the social discount rate in South Africa, based on theoretical formulations and international empirical review, vary between 8.4 percent and 9.6 percent. The current rate of 8 percent that is used by the DBSA should therefore be adjusted upwards, indicating that the current present value of discounted future values is too low. It is therefore implied that the discounted monetary value of benefits should actually be inflated, which will affect increased levels of approval for investment lending.

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## Marketing and Communication Management

### Afrikaans marketing campaigns

The aim of this study was to determine Afrikaans-speaking consumers' attitudes and perceptions regarding Afrikaans advertising campaigns. The researcher found that urban Afrikaans-speaking consumers have a positive attitude towards Afrikaans marketing campaigns and prefer them to English campaigns. However, they are unlikely to be assertive regarding Afrikaans marketing campaigns. The results also showed that female respondents were more positive regarding the use of Afrikaans, have a greater preference and are more likely to be assertive with regard to the use of Afrikaans in marketing campaigns, than male respondents. In addition, the results showed that where services and contract staff are concerned, urban Afrikaans-speaking consumers prefer Afrikaans marketing campaigns by far. The study concluded that companies that want to build a relationship with urban Afrikaans-speaking consumers must communicate with this target group in their preferred language.

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## Marketing Management

### A higher education marketing perspective

The South African higher education sector is currently facing many challenges. Factors such as a decrease in government funding, increased competition, broadening access, mergers and student unrest compel higher education institutions to apply effective strategies for the recruitment of quality students. In order to be locally relevant and globally competitive, higher education institutions need to become more marketing-oriented. In a restricted financial environment, higher education institutions will have to assess and reassess marketing strategies aimed at attracting quality first-year students. A proper assessment of the importance of the choice

factors students consider when selecting a higher education institution, as well as the usefulness of the information sources they consider, will enable institutions to allocate funds, time and resources more efficiently and effectively. The findings of the research indicated that some choice factors were more important to students than others. Students from different gender groups, ethnic groups, language groups and institutions also differed in the importance they attached to the choice factors. The top ten choice factors respondents regarded as important in the selection of a higher education institution were quality of teaching, employment prospects (possible job opportunities), campus safety and security, academic facilities (libraries and laboratories), international links (study and job opportunities), language policy, image of the higher education institution, flexible study mode (evening classes and use of computers), academic reputation (prestige) and a wide choice of subjects/courses. The findings also revealed that information obtained directly from a higher education institution, such as at open days and campus visits, and from university publications and websites, are the most useful to students, while information obtained from the mass media, such as radio, television, magazines and newspaper advertisements, are not regarded as useful.

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Information obtained directly at open days is most useful to students.

## Taxation

### The progress of SARS on its service quality journey

The South African Revenue Service (SARS) introduced its Service Charter in 2005, to be fully effective from the beginning of the 2008 tax year. The intention of this charter is to set specific service delivery targets, which SARS aims to achieve. To get an indication of the progress made by SARS on its service quality journey, a questionnaire was sent out to tax practitioners (professional accountants and bookkeepers) registered with the South African Institute of Chartered Accountants (SAICA), the South African Institute of Professional Accountants (SAIPA) or the South African Institute of Certified Bookkeepers (SAICB), with the aim of establishing their perceptions about the service quality of certain services mentioned in the Service Charter. An electronic Internet-based questionnaire was selected as the research instrument for conducting the research. The questionnaire was developed by a team consisting of the World Bank survey experts and a South African consultant (a senior lecturer in the Department of Taxation at the University of Pretoria). The results of these perceptions were made available to SARS. SARS introduced reforms to address most of the areas in the Service Charter (and the acts) that proved to be problematic from the survey results. Only in respect of the following areas were reforms not specifically introduced: receipt of an income and employee's tax registration number, attendance to taxpayer by SARS if no appointment was made and the number of calls before a query was sufficiently addressed. Where reforms were introduced, the following areas are those where the reform initiatives only partly solved the shortcoming of SARS as found in the survey: processing a tax return during off-peak periods, responding to written correspondence and answering telephone calls by SARS. Both these areas, that is, those where no reforms were introduced and those where reforms were introduced but which only partially solved the problem, should provide SARS with good justification for motivating the areas on which it will be focusing its attention in respect of future reform initiatives.

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## School of Public Management and Administration

### Social science contribution to appreciative inquiry: the case for public administration

This study investigated the merits of multi-site qualitative research methodologies in public administration, based on condensed field research or action research work as a method of conducting applied research. The study further examined 'new' qualitative research avenues in public administration needed for critical thinking with respect to conceptually sound and triangulated methodological paradigms in conducting



Prof Jerry Kuye, Director of the School of Public Management and Administration, examined the contribution of social science in public administration.

research. It circumvents to explore the viability and possibility of the application of a variety of non-traditional approaches, which could directly impact on the role of subjectivity and consensus in qualitative research methodologies. Furthermore, it addresses the issues of ethics, including the collaboration between internal and external researchers, validity, generalisability and reliability, and the utilisation of such research findings. Finally, the study showed that, from a synoptic research overview with respect to one's perceived construction of qualitative reality, such an approach could be dependent on the methods of a paradigmatic engagement, which may be employed for such research purposes. Qualitative research methodologies, in particular, can give insight into what is happening on an equal playing field, and it is expected to reveal unintended consequences of an innovation or programme. A multi-site case study research design is appropriate whenever policy-makers need an up-to-date understanding of a situation for the determination of the most expedient policy implementation strategy. Qualitative research in respect of policy-oriented studies has, above all, a concern with process, as well as outcome. It has the capacity to reflect the subjective reality of the people being studied and to provide descriptive detail, which makes situations comprehensible. The researcher found that one arena, which is always identified as a potential source of innovation, is the field of public administration and management. In the face of apparently intractable social, political and economic problems, there have been repeated calls for academics and practitioners in the discipline to become more relevant and address the immediate issues of public concern and interest. The researcher suggested that the discipline of public administration and management, in

promoting scholarship, should not ignore the fiscal structure in which public services are delivered. The discipline of public administration, in its search for research excellence, must address the issues of performance and service delivery. In the quest to redefine public management theory, one must move from a generalised study approach of the norms and values in public sector organisations to one that addresses the issues of the delivery of public goods and services in an articulated manner enhanced by adequate research and intellectual substance. The researcher recommended that different groups of researchers must have the methodological freedom to utilise different theoretical approaches in the applied conduct of research and that each should have its peculiarity in an attempt to forge new paradigmatic enquiries in the quest for new discoveries. The study also emphasises that no approach can hope to monopolise the pursuit of intellectual truth and alacrity.

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### Expanding integrated service delivery

The researchers explored the impact of leadership to overcome organisational cultural differences and examined the critical success factors (governance and accountability) crucial to bridge the challenges posed to integrated service delivery. They found that global deconcentration of economic activities has extended local governments' available resources. However, it also resulted in increased pressure on government to perform more effectively and efficiently. In addition, the strengthening of government's reach from central to local spheres of government has become a critical element in achieving success, not only in finding ways that support national unification and democratisation, but also to realise greater efficiency and equity in the use of public resources with the purpose of introducing participative governance. Decentralisation forms an overarching framework to execute government's ideologies. The impact of ideologies on the architecture of governance and state interventions therefore translates directly into different forms of cooperation and collective decision-making. Providing public services through a single window (one-stop delivery, access, clustering and multiple service channels) becomes the main objective and demands a framework that is able to cross traditional boundaries of jurisdiction towards integrated service delivery outcomes. Organisational culture differences are a principal challenge in bridging opportunities for integrated service delivery, mainly because departments prefer to work in silos instead of partnering with each other, which often complicates partnerships due to the absence of a common vision. The researchers concluded that in the attainment of a seamless approach, a new collective vision, underscored by decentralised approaches, must be aligned with governance and accountability structures in order to increase access, choice and citizen engagement.

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## Tourism Management

### The use of mobile technology in the airline industry

The aim of this project was to investigate whether or not consumers were 'ready' to interface with airlines via their mobile devices. Previous studies focused mainly on the development and applications of mobile technology in various environments. Less attention was paid to studies on how customers perceive their value and significance. In this project, the researcher focused on the needs of consumers. The concept of consumer- readiness was conceptualised and the phases of the travel activity chain, as it relates to an airline's communication with air travellers, was identified. A multidimensional measure was developed, based on those factors influencing consumer adoption and the use of mobile devices with customers' benefit and sacrifice-related beliefs forming the foundation of value maximisation. The findings indicated that consumers' mobile readiness is directly related to their perception of the value of receiving information or making bookings on their mobile devices, and that certain predictors, such as the purpose and frequency of travel, are significant. Demographic characteristics, such as level of qualification and age, were found to be predictors of mobile readiness, with some results being contrary to expectation. This research showed that mobile readiness cannot be generalised to air travellers as a whole or even to all customers of one particular airline. Three broad issues must be considered: the characteristics of the market, demographics and travel patterns, the stages in the travel activity chain and the value perception of travellers.

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### A model for travel policy compliance in South Africa

This study shed new light on corporate travel management. The researcher constructed a model for corporate travel policy compliance in South Africa, proving that non-compliance can be significantly linked to certain factors, termed corporate and personal. Using a multinomial logistic regression modelling technique, the predictive value of the model was established. The model showed that travel policy non-compliance in organisations needs to be viewed at a much deeper level than previously considered with corporate factors, such as an ineffective travel policy, lack of control measures and perceived organisational injustice, having a significant influence on policy compliance. Personal factors, such as self-interest, also impact significantly on policy compliance. With this study, the researcher proved that compliance with the corporate travel policy could be improved through the implementation of the tested model. The model made a significant contribution to the subject field, as it is the first of its kind to measure the impact of factors not previously identified.

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## 6.2 Faculty of Education

The Faculty of Education is fully committed to growing the exceptional talent of young people and students in education. It is embracing the many challenges of delivering educators, researchers and critical thinkers who can make real contributions in the education sector: nationally, as well as in the global context.

### Message from the Dean

Education has a high priority in South Africa at the moment. We are at a juncture, like nowhere before, where it is crucial for researchers, policy-makers, educationists and practitioners to work together to strengthen the capacities that are available in the education system, but also to address the numerous challenges that we face in education.

The challenges are considerable. These include the demands on educators, learners' alarming literacy and numeracy skills, the qualifications of educators, and HIV and AIDS. However, while it is important to acknowledge these challenges, we also need to recognise the debilitating effect of continued negative discourses around education. Educational realities are constructed and contested through the narratives we create and the stories we choose to place on the foreground.

In this regard, it is noteworthy that some of the best educational researchers on the continent of Africa make the University of Pretoria's Faculty of Education their home. Consequently, this is where one will find the leading studies on education law and policy, foundation phase education, literacy, numeracy, mathematics and science education, multilingualism, social justice, narrative career counselling, positive psychology, and the training of teachers in music and art. A significant number of the faculty's staff members have been rated by the NRF, and the faculty is well known for the many national and international accolades that are awarded to its academics on a regular basis.

During 2008, the faculty was restructured in order to respond to the growing needs of quality teacher education in South Africa and to expand the knowledge creation that is pursued via research. At the end of the year, the new applications for first-time students in the faculty had more than tripled. The faculty continued to seek out the robust connections between research, teaching and learning, as well as community engagement. Research is viewed as integrally linked to practice, and social responsibility is ingrained in all the work that is done. The faculty values deep-seated relationships in the educational, psychological and policy environments in which research is conducted.

Researchers in the faculty published more than ten books during 2008. These ranged from first-rate scholarly books to accessible texts that ease the work of educators and community leaders. The themes ranged from classroom literacy to designing one's first research proposal. Orders for these books on diversity, educational change, people leadership, outcomes-based assessment, technology in the foundation phase,

English language teaching and literacy in the foundation phase were placed even before they went into print.

The faculty's cadre of researchers is leading some of the largest funded research projects in Southern Africa. These individuals are also aligning their research goals with intensified capacity development by investing in young and upcoming researchers. The Centre for Evaluation and Assessment (CEA) is conducting more than 25 research projects. These projects enjoy international acclaim. The newly established Unit for Educational Research in AIDS (ERA) is creating partnerships in HIV research across South Africa.

Continuing an established tradition of delivering high-quality postgraduate students annually, numerous master's and PhD students completed their studies in the faculty during 2008. These studies are often quoted internationally and students are invited to present their findings to national and international forums on a regular basis. The faculty maintains a growing stream of exceptional international postgraduate students from Kenya, Nigeria, Namibia, Mozambique, the USA and Europe.

The University's Faculty of Education is fully committed to growing the exceptional talent of young people and students in education. It is embracing the many challenges of delivering educators, researchers and critical thinkers who can make real contributions in the education sector: nationally, as well as in the global context.

Prof Irma Eloff  
Dean



Prof Irma Eloff, Dean



Groenkloof Campus, the home of the Faculty of Education

## Research highlights

### Centre for Augmentative and Alternative Communication

#### Development agencies and disabilities

In spite of areas of disagreement and, in particular, the challenge of the low priority assigned to disability by many development agencies, there would appear to be a basis for closer cooperation between the development and disability sectors, although this would require a more systematic approach to mainstreaming disability in development. The aim of this research project was to assess the extent to which disability has been included in development in South Africa and to explore the opportunities, constraints and potential strategies for mainstreaming disability in development. Towards this end, interviews were conducted with the representatives of 32 disability and development agencies currently operating in South Africa. The survey showed that while there was some understanding by development agencies of the relevance of disability to development, it was clear on a number of levels that the majority of development agencies operating in South Africa did not place a high priority on disability. Development agencies repeatedly rated disability as a lower priority than the disabled peoples' organisations (DPOs) rated development. However, there were also a number of positive signs in relation to the integration of disability in development. Half of the development agencies and 80 percent of the DPOs in this study were engaged in projects that included elements of both disability and development. In addition, 66 percent of the development agencies interviewed had formal policies or position papers relating to disability and development.

The study also indicated fairly extensive contact between the development and disability sectors. On the other hand, there were clear indications that in many cases, policies and guidelines developed at the central level by international organisations had not filtered down to staff working at the country or regional level. Furthermore, the majority of projects in the development sector specifically targeted people with disabilities, rather than making provision for people with disabilities in more general development projects. Inclusive approaches to development were more apparent in the disability sector, where a number of projects included both disabled and non-disabled people or aimed to encourage partnerships between the two. In terms of orientation to disability and development, there were both indications of common ground and differences between the two sectors. For example, disability was most commonly characterised by both sectors as a human rights issue, with 75 percent of DPOs and 50 percent of development agencies seeing disability as a human rights issue. This overlap in the emphasis on human rights could play an important role in facilitating understanding between the two sectors, particularly as right-based approaches to development have gained considerable ground in recent years. These and other findings of the survey were assessed against the background of evidence that poverty and disability are strongly related to one another in South Africa, as in other parts of the world, and that the combination of disability with other social inequalities, such as gender and race, can create extreme vulnerability and exclusion.

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Prof Erna Alant (far right) of the Centre for Augmentative and Alternative Communication conducts research to help communication-impaired individuals to adapt to society.



## Curriculum studies

### Changing education in South Africa

In the process of changing education in South Africa, no significant attempts have been made to explore the beliefs and role perceptions that student teachers hold of a professional educator. In an effort to broaden the views of teacher educators on the existing deep-seated personal beliefs and images that pre-service teachers brought into an experience-rich one-year Postgraduate Certificate in Education (PGCE) programme, the researchers isolated the perceptions that pre-service teachers held of teacher roles as an indicator of professional development. Research on professional growth that was conducted in the early 1990s showed that the personal beliefs and images that pre-service candidates bring to programmes of teacher education usually remain inflexible. Candidates tend to use the information provided in coursework to confirm rather than to confront and correct their pre-existing beliefs. A candidate's personal beliefs and images therefore determine how much knowledge the candidate acquires from a pre-service programme and how it is interpreted. In the current study, data regarding the student teachers' perceptions of their roles were obtained using visual image collages that each student teacher had to construct individually. Each student teacher had to explain his/her collage to the interviewer in an open-ended style. The purpose of the collage was to elicit deep reflection, inner exploration, anticipation and visioning by the student teacher to ensure that rich and thick explanations emerged as data. The researcher found that 96 percent of the prospective teachers explicitly imported the concept of multiple roles, which they see themselves performing in the complex classrooms of the knowledge era. Approximately 70 percent of the students conveyed ideas of nurturing and caring by means of the metaphor of being a 'mother' to learners. They typically said: "A school is a safe haven and only place of security for many children from broken families." The presence of inclusion and the teaching of children with HIV and AIDS were strongly presented as reasons for the role of caring. The fact that many children would be orphans, due to parents dying from HIV/AIDS, was another reason for referring to the mother metaphor. The third most popular role manifestation (68 percent) was that of a knowledge provider enacted as a facilitator of learning. Prospective teachers concluded that their role would be "to teach learners how to access and evaluate the quality of all the available information" and not to only lecture the subject content. Therefore, they said that their role had changed from

that of 'sage on the stage' to 'guide on the side' and that new kinds of (power) relationships have to be forged with their learners.

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### Narrative career counselling

Prof Kobus Maree conducted research on postmodern narrative career counselling in several schools in Gauteng, Mpumalanga, North West and Limpopo. He was also involved in designing a combined qualitative/quantitative narrative to evaluate and assess learners with a view to administering career counselling in collaboration with co-researchers, some of whom are international experts in this field. In administering this postmodern approach to the career counselling process, the researchers viewed learners as active agents in their personal development. The overriding aim of the research was to develop a narrative that can be used to help learners make well-informed career choices. The need for a concise narrative to help disadvantaged school-leaving learners to choose their future careers in a relatively short space of time cannot be overemphasised. Learners who took part in the programme were exceptionally keen to participate. The team made a number of findings. There appears to be a dire need in all schools for career counselling. Even in 2009, very few schools have access to state-of-the-art career counselling services. Disadvantaged schools, in particular, are receiving the short end of the stick and have limited access to these (often overly) expensive services. There appears to be a dire need in all schools for 'other' assessment instruments than the traditional test-and-tell instruments. The career interest and broad personality profiles of disadvantaged learners, in particular, simply cannot be established by using only 'positivist' assessment instruments. A storied approach to career counselling lends itself superbly to determining these learners' profiles. The notion of adaptability needs to be facilitated in every classroom. The logistics involved need a serious rethink. It is imperative to adapt qualitative assessment instruments in (South) African conditions. Furthermore, it is essential to adapt assessment instruments for use in all schools by teachers with all learners (and not only a small percentage of learners from affluent environments). It is imperative to develop career interest and personality assessment instruments that will not take overly long to complete and that can be interpreted by, for example, teachers in Life Orientation. Too many learners exit from Grade 12 with little or no idea as to where they are heading. Some are



not even equipped with the most basic information to help them make informed choices. This contributes significantly to the high drop-out rate at tertiary institutions.

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## Education Management and Policy Studies

### In search of best practice

This research project explored issues of best practice in some South African desegregated schools. The research found that despite a number of ongoing challenges to innovation, a growing number of school managers, teachers and parents are grappling with issues of diversity and inequality in ways that provide the possibility for changing institutional cultures. A number of other findings were also made. In six of the nine schools, the learner population had become quite diverse, with fairly high numbers of learners from previously disadvantaged schools. In contrast, the profile of the teaching staff was virtually unaltered, with high percentages of white teachers. Approximately 78 percent of the respondents indicated that their schools did not discriminate and were sensitive to learners' racial and cultural backgrounds. Approximately 60 percent of the teachers indicated that they used materials that were inclusive. Approximately 80 percent of the teachers suggested that training about teaching in diverse classrooms makes a considerable difference in desegregated schools.

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## Educational Psychology

### Enhancing teachers' psychosocial capacity

The aim of this research project was to assist teachers in their pastoral role by providing them with psychosocial care and facilitating support skills training. The project ran over a three-year period in schools in Mpumalanga, Gauteng and the Eastern Cape. Psychosocial support addresses the ongoing psychological and social problems of HIV-infected individuals, their children and the community at large. Psychosocial skills

interventions remained community-based to provide teachers with capacity to support children in the school (as a familiar, social, cultural and ethnic environment that reduces distress). Preliminary findings indicate that teachers use the asset-based approach in psychosocial support in the realm of HIV and AIDS as a cost-effective way to identify and mobilise existing strengths and resources, to encourage synergy among similar projects by developing strategies to expand on existing care and support initiatives, and to transfer their skills to other schools through a 'buddy school' intervention to establish care and support initiatives.

### Strengthening career development in a rural school

This action research project annually targets 120 Grade 9 learners and one group of MEd (Educational Psychology) students. The motivation for the partnership is based on sharing capacity. The staff and students of the University of Pretoria strive to provide much-needed educational psychology support to the school and the children. The school provides a forum in which students can become aware of their social responsibility and the broad scope of practice synonymous with educational psychology on the one hand, while putting into practice their theoretical knowledge in a meaningful arena. Preliminary findings indicate that students applied asset-based career facilitation during career guidance by identifying



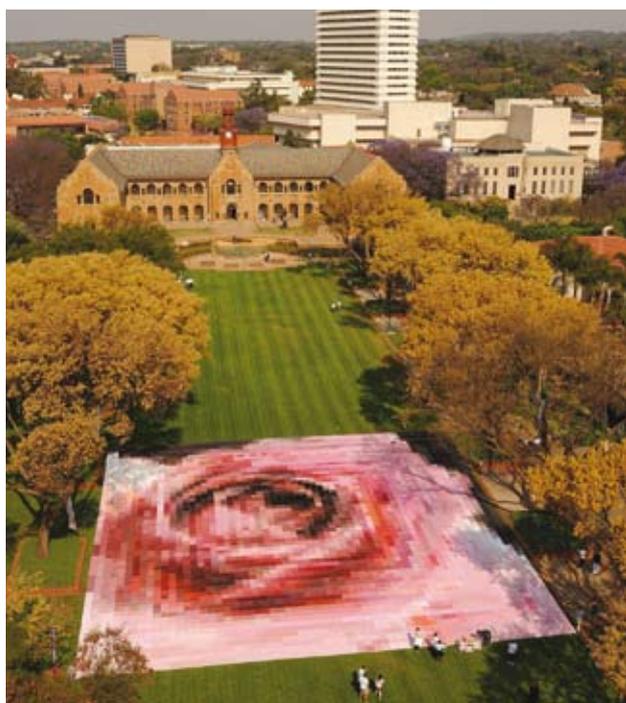
Psychosocial intervention skills provide teachers with the capacity to support children in school.

strengths and barriers in children, utilising identified strengths to address identified barriers by mobilising these identified strengths, identifying established networks for learning support and career planning, and facilitating the acquisition of asset-based competencies (addressing problem-solving difficulties by focusing on internal resources, external capacities and extending their social networks). Findings also indicate that curricular community engagement means that recipient partners benefit (children benefited from current thinking and research on child development, coping styles, academic achievement and career planning). Students in the project benefited because they experienced (and are subsequently better prepared for) the life world characteristic of their future world of work. They had the opportunity to integrate their theoretical knowledge in a meaningful practical environment and reported increased confidence in their ability to contribute meaningfully as educational psychologists in the diverse South African population.

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### Finding roses among thorns

Against a burgeoning worldwide discourse on the psychological and emotional impact of HIV and AIDS on children's development, the researcher conducted an empirical study to explore how a group of orphaned and vulnerable children who were living in a children's home negotiated pathways to wellbeing while affected by HIV and AIDS. The project aimed to explore, understand and describe the phenomenon of wellbeing in the specific context of the child participants' perspectives



The University of Pretoria's centenary rose was used as a theme throughout the year, and found expression in various aspects, including research with vulnerable children.

of their life worlds. The study was informed by a qualitative and intrinsic case study design in an interpretivist paradigm. The researcher utilised task-based participatory activities to guide the informal and conversational interviews with the child participants as the main data generation strategy. By means of the constructivist-grounded theory analysis of the children's expressions, the researcher gained insights that informed his understanding of the children's perceptions and experiences of wellbeing, risks, challenges and stressors in their lives. Findings indicated that the children in the study experienced risks, challenges and stressors arising from personal illness, stigma, discrimination, orphanhood, residential care, death and bereavement. The study also revealed that those children who portrayed characteristics of wellbeing and resilient adaptation utilised psychosocial coping mechanisms. In addition, they were supported by their positive intrapersonal characteristics and affirmative relationships that offered emotional and psychosocial support in their environments. The findings of the study suggested that feelings of wellbeing, hope and optimism might have co-existed with feelings of despair and hopelessness in the daily lives of the children. The researcher recommended that the wellbeing experiences of the children in this study may exist on a continuum and may depend on specific events, occasions or incidents on a day-to-day basis.

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### Experiences of abused women in shelters

This research project focused on nine women at the Sizanani shelter for abused women. The participants were victims of domestic violence. Multiple case studies were conducted on victims of domestic violence and participants shared their experiences during interviews. The research found that the participants were abused by people who were close and known to them. The main causes of violence were the participants' refusal to have sex without using a condom, their refusal to allow the abusers to have extra-marital affairs, their refusal to give the perpetrators money to buy drugs, the perpetrators' demands for sex any time they wanted it because they had paid 'lobola', and the participants' refusal to be isolated from their families and relatives. All the participants experienced verbal, emotional/psychological, physical, sexual, as well as financial abuse. According to the participants, before they came to the shelters, they thought they were worthless. They had developed low self-esteem and most of them had suicidal thoughts. Two of the participants found out that they were HIV-positive. After intensive counselling sessions, they accepted their status and are currently undergoing antiretroviral therapy. According to the participants, they would like to be counsellors and advise other women to identify the signs of abuse, to report abuse immediately before it paralyses them, to break the silence and talk about it, to seek help, to quit the abusive environment immediately, to refuse to be isolated from their support system, and to accept and love themselves the way they are.

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A project to support people living with HIV/AIDS in communities included the initiation of vegetable gardens at schools.

### Coping with HIV/AIDS

This ongoing project explores the sustainability of an activist intervention research project that commenced in 2003 in an informal settlement community in the Eastern Cape. During the initial project, ten teachers became involved in community-based coping with HIV and AIDS by facilitating the processes of initiating a vegetable garden at school, providing information on HIV and AIDS to the community and supporting community members psychosocially. Preliminary findings on the sustainability of these initiatives and the outcome of the teachers taking agency and fulfilling a leading role in the manner in which the community is coping with HIV and AIDS indicate that the outcomes of the initial project have been sustained and built upon in various manners. The three initial projects are still running in the community. In addition, the participating teachers, in collaboration with the school principal, have involved 18 volunteer community members (of which one receives a stipend) to assist in psychosocially supporting community members coping with HIV and AIDS. For this purpose, the school obtained funding to establish counselling facilities at the school and introduced a system whereby the volunteer workers meet once a week prior to providing their service in the community. Furthermore, participating teachers relate the fact that the school's enrolment numbers have been steadily increasing since the start of the initial project to the outcomes of the project, resulting in more parents feeling comfortable about bringing their children to the school and disclosing their HIV status. Based on the enrolment numbers, all staff members could be retained for the past three years. Finally, the

participating teachers have continuously been focusing on the establishment of firm networks in society, resulting in them being able to assist community members with food supplies on a regular basis and providing guidance on aspects such as application procedures for government grants.

### Impact of sudden loss on a family

This research project explored the potential effects of sudden loss of a sibling on the personality structures of bereaved individuals. For this purpose, the Myers Briggs Type Indicator (MBTI®) profiles of five nuclear family members were compared prior to and following the sudden loss of one of the siblings of the family. In addition, the results of 16 Personality Factors (16PF) profiles of the participants' post-sudden loss were incorporated. The findings of the study indicated that certain changes in personality structures occurred in terms of the personality structures of the participants. Pertaining to the four polarities of the MBTI®, the participants displayed a greater preference for the introversion attitude, as well as both the sensing and feeling functions, after experiencing sudden loss. All participants displayed an inclination towards personal growth by moving closer to the judging/perceiving axis post-sudden loss. In addition, two general tendencies could be depicted among the participants: a greater dependence on the inferior functions and the tendency to rely on type exaggeration when dealing with sudden loss.

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## 6.3 Faculty of Engineering, Built Environment and Information Technology

Research forms an integral part of the activities of the Faculty of Engineering, Built Environment and Information Technology. It informs and supports the teaching and community engagement activities over the spectrum of disciplines covered by the faculty.

### Message from the Dean

In an overview like this, it is not possible to sensibly introduce all the excellent research undertaken in 2008. Instead, some highlights of the faculty's research activities will illustrate the breadth of topics and the focus on application that is a hallmark of the faculty's approach.

Student participation and training in research was further developed by the introduction of more credit for research activities, formal training in research methodology, the development of a research management tool to encourage interaction between students and supervisors, and encouragement of the public presentation of research results by way of poster sessions at departmental level.

The intake of graduate students increased again in 2008 and bodes well for the research outputs of the faculty, although the majority of students still study part-time. This is an encouraging indication of the demand for the faculty's students, but places a damper on the rate at which results are produced. The challenge for the faculty is to find levels of support for research activities that will attract full-time students.

Encouraging developments are the Department of Science and Technology chairs in Artificial Intelligence, Carbon Materials, Fluor Materials Science and Process, the Sentech Chair in Broadband Communication, the multi-industry sponsorship of a Chair in Maintenance Engineering, the location of the Hub for Energy Efficiency and Demand Side Management, sponsored by the South African National Energy Research Institute (SANERI), and the Injection-enhanced Silicon in Avalanche (InSiAva) project on light-emitting diodes, where significant venture capital support was obtained for the further development of this promising technology for on-chip communication.

These, as well as existing and pending developments in research initiatives, bode well for the future and have the potential to significantly increase the faculty's research outputs.

Prof Roelf Sandenbergh  
Dean

### Research highlights

#### Institute of Applied Materials

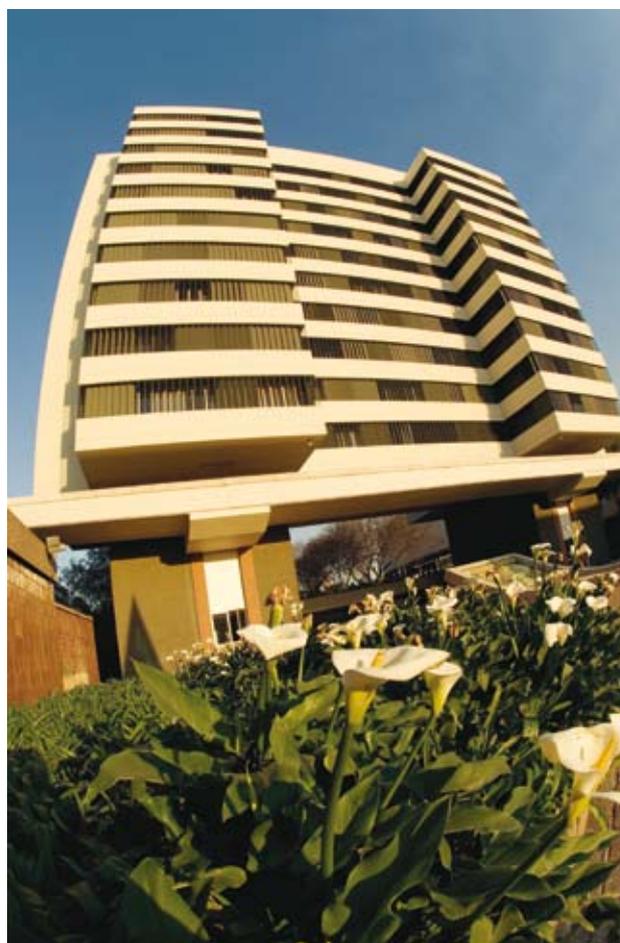
Hydrotalcite:  
surfactant-assisted  
fatty acid inter-  
calation of layered  
double hydroxides

Chamotte Holdings recently started local production of synthetic hydrotalcite for PVC stabiliser applications.

Synthetic hydrotalcites are also known as layered double hydroxides. They are synthetic anionic clays with a composition analogous to that of the mineral hydrotalcite. The key feature of these clays is that they have a unique layered structure that allows the intercalation of guest molecules and guest anions. Such intercalated materials belong to the class of nanostructured materials. Their properties are determined by the nature and activity of the guest molecules. Since the choice of guest/intercalant is virtually limitless, there is immense scope for tailoring these clays for a wide range of applications. The distinctive properties



Prof Roelf Sandenbergh, Dean



Engineering Building

of these modified layered double hydroxides permit a wide range of uses, including polymer additives, precursors for catalysts and magnetic materials. Nanocomposites can be prepared by exfoliation in polymer matrices. Their generally non-toxic nature and membrane-like structure can be harnessed to protect, carry, deliver and controllably release active compounds such as pesticides, pharmaceuticals and even genes. They can be used as absorbents to remove contaminants from water. Hydrotalcite-like anionic clays already have existing applications. In medicine, they are utilised as antacids and anti-peptins. In polymer technology, they function as halogen scavengers, flame retardants and PVC stabilisers. They are employed as catalysts and catalyst supports and their absorbent and ion exchange properties are of interest in wastewater treatment. Surfactant intercalated layered double hydroxides are of interest for a variety of reasons. Hydrophobisation of the layered double hydroxides by ion exchange yields new types of thickening agents. It also facilitates sorption of nonionic organic compounds, for example, trichloroethylene and tetrachloroethylene.

### Polymer additives

A research project was undertaken that focuses on the synthesis and modification of hydrotalcites as functional additives in polymers. In these applications, surfactant intercalated clays assist in the dispersion of nanoparticles in the polymer matrix. Graduate students Edith Landman, Nontete Nhlapo and Lumbe Moyo have been studying the intercalation of anionic surfactants and long-chain fatty acids in these materials. These researchers have developed novel and environmentally friendly processes for intercalating either long-chain fatty acids or anionic surfactants using surfactant or acid-assisted strategies. The stearic acid intercalation reaction is conducted at elevated temperatures with the layered double hydroxide (LDH) powder as a suspension in a stearic acid oil-in-water emulsion. The acidic fatty acid, for example, stearic acid, reacts with the basic carbonate anions.  $\text{CO}_2$  is released and the fatty acid is intercalated as a bilayer. High concentrations of anionic or nonionic surfactants, that is, sodium dodecylsulfate or Tween 60, aid the intercalation process by emulsifying the molten acid and dispersing the hydrotalcite particles. The method is convenient, economical and environmentally friendly. It employs the readily available carbonate form as starting reagent. Water is used as a medium rather than organic solvents. Low reaction temperatures suffice, that is, calcinations of the clay are superfluous and there is no need for working under a  $\text{CO}_2$ -free atmosphere. Similarly, anionic surfactants are intercalated into the layered double hydroxides when used in combination with a short chain carboxylic acid. Best results were obtained using water-soluble organic acids, for example, acetic, butyric or hexanoic acid, to aid decarbonation of  $\text{LDH-CO}_3$ . Intercalation proceeded at ambient temperatures with the precursor powder suspended in an aqueous dispersion of the anionic surfactant. The carboxylic acids are believed to assist intercalation by facilitating the elimination of the carbonate ions present in the anionic clay galleries. These processes are currently employed to synthesise novel nanostructured hydrotalcites for use in pharmaceutical and polymer applications.

### Effect of hydrated fillers and red phosphorus on the limiting oxygen index (LOI) of EVA-PVB and LDPE-EVAL blends

Polymers, or plastics as they are more commonly known, find increasing use as structural and functional materials. Owing to their combustible, organic nature, they pose a fire risk in some applications. Hydrated fillers, for example, aluminium trihydrate and magnesium hydroxide, have utility as flame retardants. They belong to the class of endothermic flame retardants. The candle model for polymer combustion assumes independent pyrolysis and flame zones. Heat transfer from the flame provides coupling between the gas and condensed phases. It drives the thermal degradation reactions that produce volatile fuel fragments that, in turn, feed the flame. This model suggests three possible strategies for flame-proofing combustible polymers: interference with the gas phase combustion and with the substrate pyrolysis reactions or their decoupling via a physical barrier to heat and mass transport. With endothermic flame retardants, this may correspond to the cooling of the substrate and promotion of charring, dilution of the flammable gas with inert gases and, potentially, the formation of an ash-char barrier layer. Endothermic flame retardants contribute significantly to the first two flame retardancy mechanisms mentioned above. The endothermic decomposition reaction releases water vapour. The cooling of the polymer substrate inhibits the solid phase decomposition reactions. Simultaneously, the steam released dilutes the surrounding atmosphere with an inert gas. This reduces the rate of fuel production from the solid substrate and decreases the rate of combustion in the gas phase. The end result is that the flames are snuffed out. The use of these flame retardants is associated with some problems. In particular, on decomposition magnesium hydroxide forms a high surface area, powdery residue that tends to catalyse oxidation of char residues, leading to an afterglow effect. As a result, effective barrier formation is realised only when additional additives are incorporated. Secondly, high loadings are required to achieve adequate flame resistance. This impairs the fluidity of the corresponding melts and the mechanical properties of the solid compounds. The hydrophilic nature of the filler surfaces further compromises mechanical integrity. Surface coating modifications can compatibilise inorganic fillers with hydrophobic polymer matrices. Stearic acid is widely used for basic fillers such as calcium carbonate and magnesium hydroxide.

### Research to improve the performance of hydrated fillers

The Institute of Applied Materials conducted research in collaboration with the Institute of Polymer Research in Dresden, Germany, in an attempt to improve the performance of hydrated fillers in low-density polyethylene (LDPE) and ethylene-vinyl acetate copolymer (EVA). These two polymers are widely used as cable sheathing compounds for cables used in underground mining that must be flame-retarded. In this work, the limiting oxygen index (LOI) was used as a measure of flammability. Cable specification often calls for an LOI value greater than 30. The research strategy had

two aspects. First, the use of red phosphorus as afterglow suppressant and as synergist for the base inorganic flame retardant was considered. Secondly, the utility of blending the polyethylene or the EVA with other polymers carrying hydroxyl functionality was investigated. Hydroxyl groups are known to aid char formation by dehydration reactions with phosphorus compounds. The key findings of this research were that the combination of red phosphorus and hydroxyl-containing polymers had a beneficial effect with respect to LOI values in alumina trihydrate (ATH)-filled blends. An LOI value of 30 was achieved in ethylene-vinyl alcohol copolymers (EVOH) with as little as 32 percent ATH and 3 percent red phosphorus. These loadings are much lower than the >60 percent required when ATH is used on its own. The main advantage is that compounds containing less filler are easier to process and also feature better mechanical properties.

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## Institute for Technological Innovation

### Where are our universities going?

Globally, the classification and ratings of universities are based mainly on an institution's research productivity. Over the last decade in particular, South Africa has experienced an increasing skills shortage, making the need for new and appropriately qualified graduates a priority for the nation. In 1991, Prof Anastassios Pouris examined the trends in



Research proposes that government revise its funding formulae and introduce weightings that give preferential support to scientific disciplines.

the output of science and arts graduates at South African universities between 1984 and 1988. His conclusion was that South Africa had no 'technological' or 'general' universities. In 2008, the study was repeated, following the same methods used in the original study, but covering the period from 2000 to 2006. The conclusions of the repeat study were very similar to those of the 1991 study, even though the South African government had adopted a policy aimed at producing more graduates in the sciences. The researchers examined the policy implications of the current funding formulae for universities and proposed that government revises its funding formulae and introduces weightings that give preferential support to the disciplines to be prioritised. This can be done by adopting a two-pronged approach if government wants to exert a more constructive influence and increase the numbers of students in different scientific disciplines graduating from South African universities. The first prong is to negotiate with selected institutions that are prepared to meet specified graduate targets in the priority disciplines (such as engineering). Additional resources should be provided to these institutions after deciding on mutually agreed upon targets. The second prong is to introduce coefficients that support the priority disciplines in all aspects of the funding formulae (for example, as they affect institutional factors and research outputs). Such a policy will send a clear message to universities that government is interested in encouraging graduates in particular disciplines. It will impact on a larger component of the formulae and will influence all aspects of the university system. For example, differential subsidies for research publications according to topic could facilitate the establishment of research posts in particular disciplines.

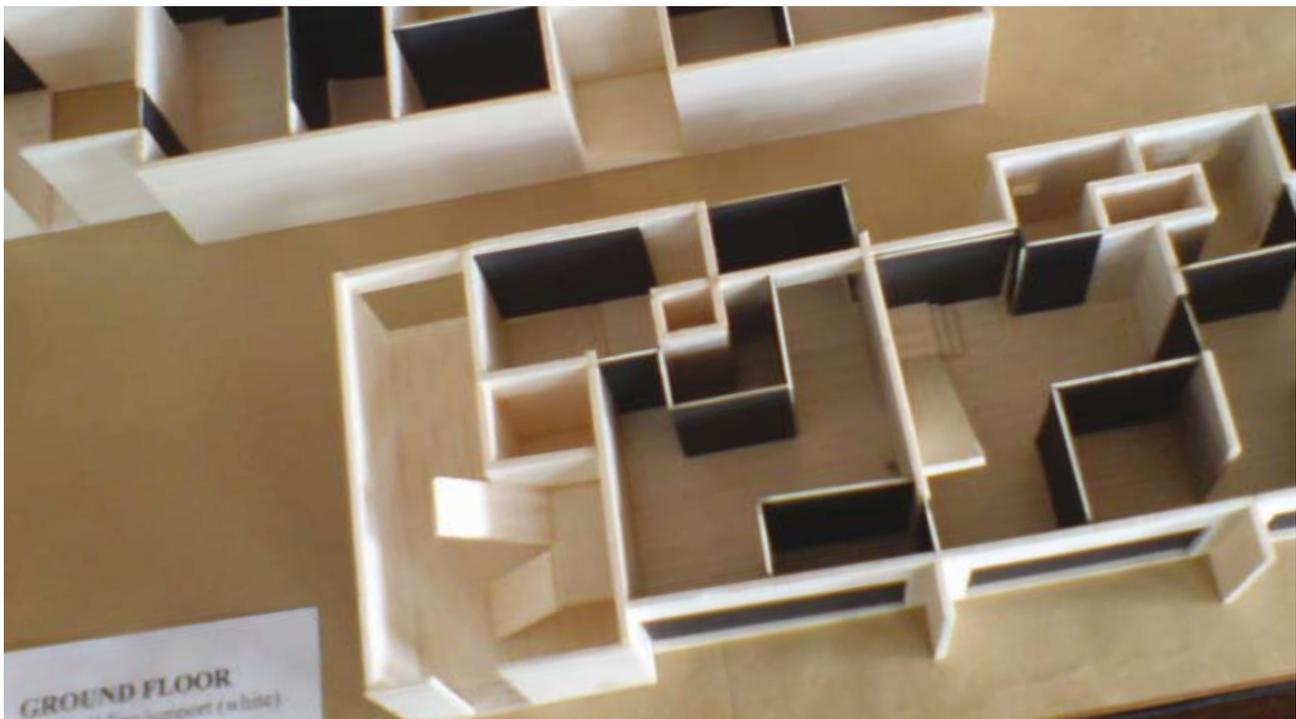
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## Architecture

### Sustainable housing

Terms such as sustainable communities, growth promotion and flexibility are constantly used when referring to sustainable housing. However, there still seems to be a lack of commitment in letting go of traditional methodologies in provision and construction, and practising more appropriate concepts. The appropriateness of the South African systems have been outgrown as populations have increased far beyond the numbers that the earth can accommodate, should we continue to build in the way that we do. Open building construction allows for constant change and the adaptability that modern-day society requires, especially in a country like South Africa, which is undergoing tremendous increases in population densities, economic imbalances, and social and cultural diversity. These transformations, differences and the very fact that the country is gaining momentum as a



Open building construction allows for constant change and the adaptability that modern-day society requires.

developing country not only have to be taken into account in the built environment, but also need to be reflected in the system and the urban fabric chosen. Contrary to traditional social housing planning and construction methods, an open building system leaves room so that no two dwellings in a single development need be the same. Far more freedom of choice is handed over to the user to manipulate his/her units according to his/her own wishes. This is a very empowering position, giving a sense of individuality and ownership to the dweller. The researcher recommended that open building techniques be used to streamline the construction process of mass customised houses. The building should be viewed as a well-organised combination of systems and subsystems, each of which can be carefully coordinated to ensure a better process and product for the homeowner and a parallel positive outcome for the building professionals. By disentangling the systems and subsystems from each other, opportunities are increased for better organisation, increased consistency, quality and more control and flexibility for the homeowner. Developers need to change their marketing strategies relative to the sellers' market they were used to. The South African government needs to readdress its approach to the delivery of low-cost and even the newly introduced high-density social housing developments.

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## Construction Economics

### Impact of HIV/AIDS on workforce in coal mines

The aim of this research project was to investigate the extent to which the high unemployment rate in South Africa has

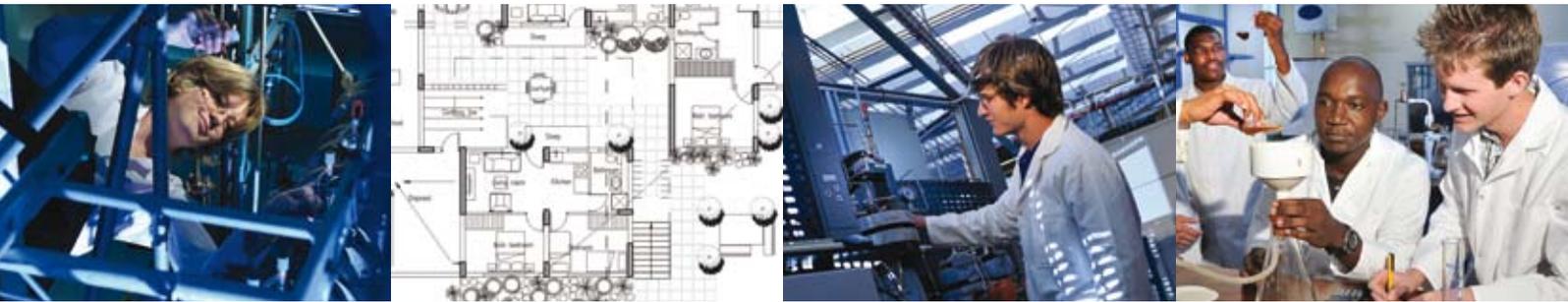
contributed to a reduced impact of HIV and AIDS in South African opencast coal mines. South Africa has more than 20 million economically active people, of which between 35 and 40 percent are unemployed. The age bracket 15 to 34 years accounts for 71 percent of the unemployed workers. This age group also makes up 59 percent of the total HIV/AIDS prevalence in South Africa. According to the Joint United Nations Programme on HIV/AIDS (UNAIDS) in 2006, the AIDS epidemic in South Africa is growing faster than anywhere else in the world. South Africa has 5.3 million HIV-positive people in the economically active age group 15 to 49 years. Preliminary findings indicate that HIV/AIDS had a minimal or no effect on skills availability in opencast coal mines. One of the reasons for this is the high unemployment rate prevalent in the county. This means that there is a ready pool of workers available to fill the gaps left by sick and dying workers.

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## Chemical Engineering

### Dynamic simulation of systems

A dynamic distillation column model has been developed using the Modelica language. Modelica is an object-oriented, declarative, multidomain modelling language for component-oriented modelling of complex systems, for example, systems containing mechanical, electrical, electronic, hydraulic, thermal, control, electric power or process-oriented subcomponents. The model utilises the object-oriented nature of Modelica by using generic models for the different

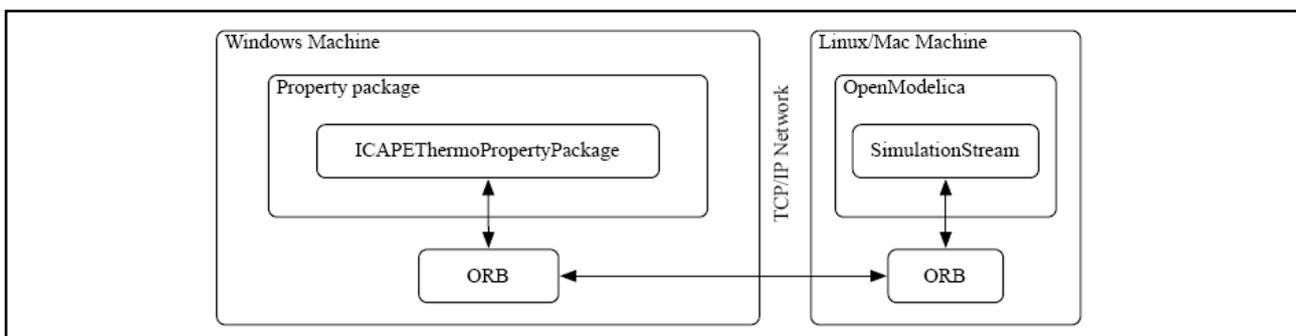


distillation column parts. Together with the column model, a stream class has been developed that can use the external interface of Modelica to access thermodynamic information via Computer-aided Process Engineering, CAPE-OPEN, using Common Object Requesting Broker Architecture (CORBA), a standard defined by the Object Management Group (OMG) that enables software components written in multiple computer languages and running on multiple computers to work together. CAPE-OPEN standards are the uniform standards for interfacing process modelling software components developed specifically for the design and operation of chemical processes. They are based on universally recognised software technologies such as the Component Object Model (COM) and CORBA. Using CORBA enables thermodynamic properties to be calculated by any CAPE-OPEN-compliant property package. In this study, a Modelica library, allowing interface between Modelica and CAPE-OPEN, was developed. Its functionality was demonstrated using a model of a ten-plate distillation column simulated in OpenModelica on a Linux machine, with thermodynamic and property data from Honeywell Unisim on a Windows machine. The data interfacing was done over a network using CORBA. It was found that real-time operation is possible, but that network overhead makes up a

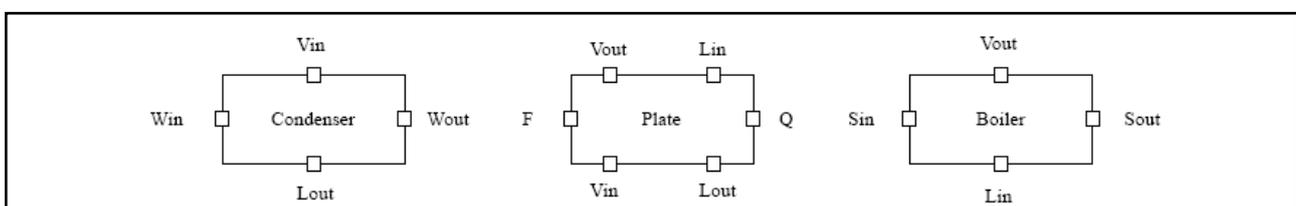
significant fraction of the running time, posing problems for off-line simulation and optimisation.

### Flow sheeting

Flow sheeting has assumed a central position in modern process engineering practice. Diagrams describing the flow of material and energy through a plant are the main mode of communicating process design, and several packages exist that solve the associated equations. Steady state flow sheeting is accepted in industry to such an extent that it is unlikely that a chemical plant of any size is designed without the use of at least one such tool. Acceptance of dynamic simulation is lagging behind the steady state simulations, partly due to the computational requirements associated with such simulation and the increased workload of developing dynamic simulations. There is, however, increased interest in the development of dynamic plant simulations. In addition to dedicated process engineering tools like HYSIS, Aspen, ChemCAD and SimSci, several modelling languages have emerged in the last 15 years that aim to provide an environment for modelling dynamic processes. Ascend and gPROMS are two examples. On another front, modelling systems have been developed for multidiscipline simulation.



Flow sheeting simulation data flow for multiple computers.



Flow sheeting distillation column components.



Modelica was specifically designed as a standard for such simulation, incorporating aspects from other languages. Simulation of a distillation column was done before in Modelica. However, the modelling strategy followed here is more modular, and abstracts the thermodynamics to the streams, allowing easy interfacing with an external thermodynamics package.

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### Fluoro-materials

South Africa has substantial reserves of fluorine-containing minerals. Fluorine also happens to be a very versatile element that, in various compounds, has a variety of applications in such diverse areas as microprocessor technology, special materials, oxygen carriers and the nuclear industry. Research in this field is focused on local beneficiation of these deposits to enhance value addition, and in that way contributes to the development of infrastructure and increasing the value of exports. Despite the fact that the thermal decomposition of polytetrafluoroethylene (PTFE) has been extensively studied over the past six decades, some inconsistencies regarding the kinetic parameters, for example, the order of the reaction, remain. Representative kinetic data is essential for practical purposes, such as reactor design and scaling. In general, the literature data refers to homogeneous bulk heating, whereas the case of the nonhomogeneous heating of a single particle has not received attention. Data (reaction rate and pre-exponential factor) applicable to this latter case was experimentally determined from isothermal thermogravimetric analyses of the depolymerisation reaction of PTFE. The kinetic data obtained on coarse granules (800 to 1 000 micron) were reported. The rate law is consistent with a shrinking particle kinetic model, with chemical kinetics controlling phase boundary movement. The mass loss rate is directly proportional to surface area. A rate law applicable to this case and useable for geometries of arbitrary shape was derived. It has long been known that the thermal decomposition of PTFE predominantly yields tetrafluoroethylene (TFE), hexafluoropropylene (HFP) and octafluorocyclobutane (OFCB).

The product ratios can be tailored by manipulating the working temperature, the pressure, the residence time of the gaseous product stream in the hot zone and the quench rate. PTFE is non-melt-processible, hence one of the recycling methods is via pyrolysis of the solid waste and subsequent recovery of the monomer for re-use. For this process, solid waste is ground down to coarse granules rather than powder for economical and practical reasons. Knowledge of depolymerisation kinetics is essential for reactor design and industrial scaling.

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### Flexible mass transfer model for water minimisation in batch plants

The least constrained mass transfer mathematical formulation for freshwater minimisation in multipurpose batch chemical processes with central reusable water storage is presented in this research. The mathematical formulation is an extension of the model developed by Prof Thokozani Majozi, in which four scenarios were considered with various limitations or constraints. In the scenario presented in this research, only the mass load is fixed, while both the quantity of water used in a particular operation and outlet concentration are allowed to vary. In essence, fixing the mass load is more representative of the practical case. A solution procedure for the resultant nonconvex mixed integer nonlinear programming (MINLP) model is also presented. The solution procedure first involves reformulating the MINLP into a relaxed linear model (MILP). The MILP is first solved, forming a feasible starting solution for the MINLP. The production of high-value, specialty chemicals is generally performed in batch-type processes. Typical industries in this category include pharmaceuticals, food and agrochemicals. Batch processing is suited to the production of such products, since the products are characterised by identical recipes that allow for the sharing of equipment. One of the defining characteristics of batch processing is the discrete nature of the tasks. All operations and material flows are time-dependent, which means that scheduling the operations becomes an important, but complex task. As with continuous processes, batch processes produce effluents. The volume of effluent from a batch process is much less than a similar continuous

process. However, the toxicity of the effluent is much higher. Coupled with this is the mounting environmental pressure on industry to reduce effluent released in the environment. The least constrained mass transfer mathematical model for wastewater minimisation in batch plants has been presented together with an applicable solution procedure. Application of the mathematical model to the first illustrative example involving four water-using operations has shown 32 percent improvement in water use. The solution was obtained in a reasonably short central processing unit (CPU) time, that is, 20.9 CPU seconds, which could be ascribed to the structure of the overall model. The model was applied to a second illustrative example and an 84 percent reduction in the amount of wastewater was achieved. Furthermore, the solution to the exact model in the second illustrative example could only be determined once a linearised model was first solved and then used as an initial solution for the exact model. It is worth mentioning, however, that the overall mathematical model is a non-convex MINLP, which implies that global optimality cannot be guaranteed.

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### Evaluation of electrodialysis for the treatment of a hazardous leachate

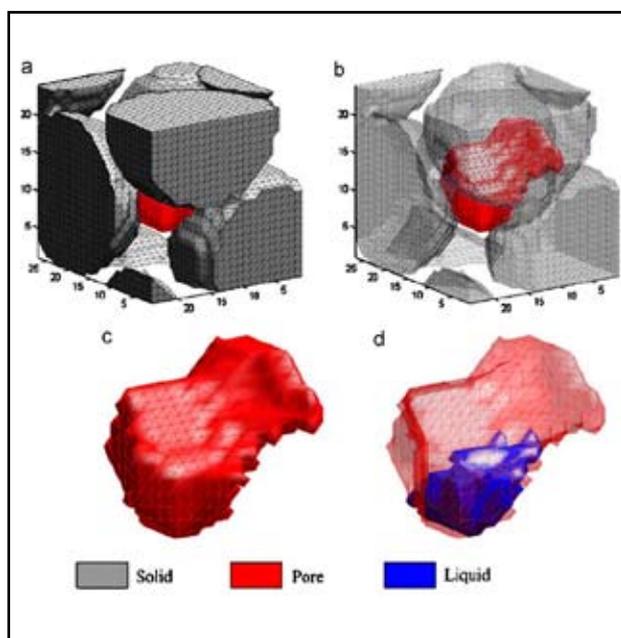
The chloride concentration of a hazardous leachate of approximately 22 000 mg/l is too high for the direct discharge requirement of less than 1 000 mg/l into the municipal sewerage system. Electrodialysis (ED) was selected among various other alternative technologies for the desalination/concentration of the leachate. Lime pretreatment of the leachate was superior to caustic soda treatment for the removal of scale-forming chemicals (Ca, Ba, Sr, Fe, Mn). Membrane fouling took place during ED treatment. However, membrane fouling should be restored with polarity reversal and mechanical cleaning of the membranes. Batch ED tests have shown that ED performance remained more or less constant during eight desalination/concentration runs. The electrical energy consumption for ion transport and brine volume varied between 9.6 and 11.4 kWh/m<sup>3</sup> feed and 17 and 35 percent of the treated feed, respectively. A very good quality water could be produced with ED treatment of the leachate. The electrical conductivity of the leachate could be reduced from 5 490 to 139 mS/m (97.5 percent removal). Chloride was reduced from 21 957 to 345 mg/l (98.4 percent removal). Arsenic was reduced from 8.8 to 1.37 mg/l. The capital cost for a 100 kl/d ED plant is estimated at US\$0.6 million. Operational costs (ion transport) are estimated at US\$0.38/m<sup>3</sup> leachate. The chloride concentration of a hazardous leachate of approximately 22 000 mg/l is too high for direct discharge into the municipal sewerage system. The chloride concentration should be reduced to less than 1 000 mg/l to make it suitable for discharge. ED, reverse osmosis (RO) and evaporation are technologies that can be considered for the desalination of the leachate. However, the osmotic pressure of the leachate should be too high to consider conventional RO for the treatment of

the leachate. Evaporation technologies are very expensive for this type of application. ED, on the other hand, is not dependent on the osmotic pressure of the leachate and can be used to reduce high saline concentrations in effluents to low concentration levels. Membrane fouling, however, may adversely affect the process. Nonetheless, it was decided to evaluate ED for the desalination of the leachate. The objectives of this investigation were therefore to evaluate ED for the desalination/concentration of the leachate and to determine the preliminary economics of the process. Excellent removals of calcium, barium, strontium, iron and manganese were obtained with lime treatment of the leachate. Sludge volume will comprise approximately 10 percent of the treated leachate. More membrane fouling was experienced at higher current densities (100 to 120 mA/cm<sup>2</sup>) than at lower current densities (20 to 80 mA/cm<sup>2</sup>). It appears to be possible to control membrane fouling with polarity reversal and mechanical cleaning of the membranes.

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### Capillary-gate mechanism

In this groundbreaking study, the researchers investigated the use of the capillary-gate mechanism to explain the multiplicity behaviour in trickle-bed reactors. They reviewed



An example of a typical pore identified by tomography: (a) in relation to its neighbourhood, (b) the pore nestled in the void space, (c) the pore on its own and (d) the liquid inside the pore.

the experimental trends in literature on the basis of a limiting cases framework and evaluated the three-dimensional pore-scale liquid distribution using computed tomography (CT) data. This led to the identification of 20 phenomenological trends that characterise hydrodynamic multiplicity, including

hydrodynamic flow hysteresis, as well as the effects of pre-wetting. The CT study yielded additional experimental insight into the role of capillary pressure and ultimately led to the proposal of a capillary-gate mechanism based on contact angle hysteresis as the root cause of multiplicity. The mechanism was incorporated into a simple pore network model and it was shown that the qualitative performance of the model corresponds closely to the majority of phenomenological trends.

### Kinetic model for the dimerisation of 1-hexene over a solid phosphoric acid catalyst

The oligomerisation of olefins allows the petrochemical industry flexibility in the production of gasoline and diesel from shorter chain olefins. This involves the use of a solid acid catalyst. In industry, mainly ZSM-5 and solid phosphoric acid (SPA) are used. Industrially, the oligomerisation of shorter chain olefins is more established in the production of petrol. The oligomerisation of heavier olefins, such as 1-hexene, can, however, also be used for the production of diesel and lubricating oils. In general, acid-catalysed olefin oligomerisation may involve many different reaction steps, among which are isomerisation (for C<sub>4</sub> and longer olefins), hydrogen exchange, dimerisation and trimerisation, and cracking. In previous studies on 1-hexene oligomerisation, the reaction selectivity towards the formation of dimers, trimers, heavier products and cracked products was investigated as a function of solvent type or catalyst type. Batch kinetic experiments at 150°C, 200°C and 250°C showed that the reaction can be modelled with a three-step sequential reaction scheme. Firstly, this involves linear isomerisation of 1-hexene, followed by skeletal isomerisation, and finally dimerisation and cracking. The first and last steps in the sequence are modelled as reversible reactions. When first-order reaction kinetics was assumed for each of the reactions, the model gave a very good representation of the experimental data. In order to test the validity of the series pathway hypothesis, the reaction was repeated with a skeletal hexene isomer – 2,3-dimethyl-2-butene (DMB) – as reactant. Although the rate and equilibrium constants for the third reaction step, as obtained from the 1-hexene conversion data, gave a good prediction of the DMB conversion at 200°C and 250°C, it failed to predict the reaction rate at 150°C. This suggests that a different reaction pathway – where linear hexene isomers are directly converted to dimer products – becomes more significant at lower temperatures. The same equilibrium conversions of both 1-hexene and DMB were observed at all three temperatures investigated, suggesting that the equilibrium conversion is independent of the type of hexene isomer in the reaction mixture.

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### Environmental microbiology

Breakthroughs were achieved in the fields of environmental microbiology and advanced oxidation processes. One such

breakthrough is the recent identification of 25 microbial culture species and serotypes capable of reducing Cr (VI) at a rate 8 to 10 times higher than previously observed in cultures isolated from other parts of the world. The fastest acting of these species in less than 110 hours completely reduced Cr(VI) in solutions with initial Cr(VI) concentrations as high as 300 mg/l. While working with sulphate-reducing bacteria from the South African gold mines, the research group discovered species that are capable of selectively extracting strontium (Sr(II)), one of the fission products in the thermonuclear reaction, from mixed waste. Strontium was utilised in this study to simulate the removal of metallic elements. Sr itself poses a serious environmental hazard. Sr(II) is mistakenly taken up and incorporated into the bone material of animals since living cells cannot distinguish it from the essential mineral calcium (Ca(II)). In this study, Sr removal was determined to be predominantly a surface reaction, which was determined by the fit to the common adsorption isotherms. However, the surface reactions and subsequent uptake into the cell were metabolically linked.

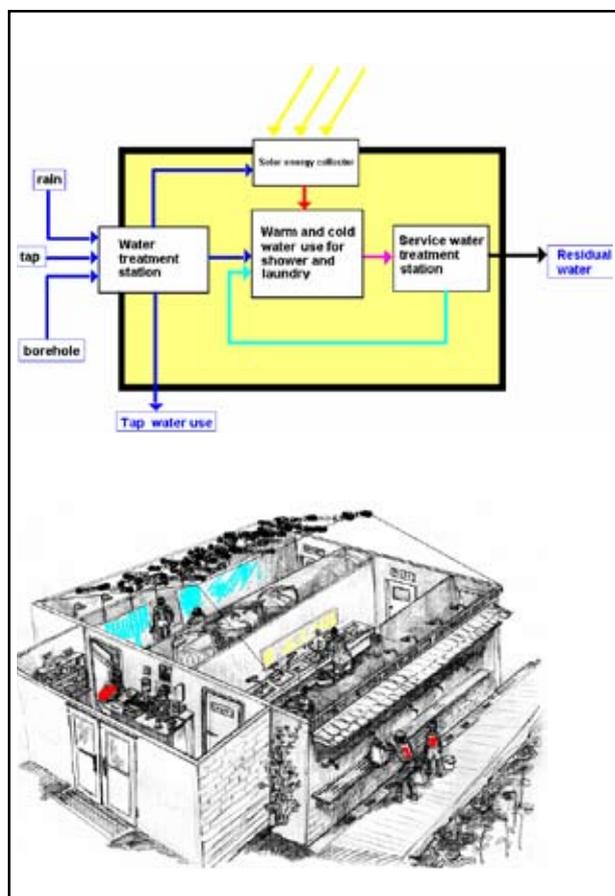
### Photolytic and photocatalytic degradation of harmful organic compounds in water

In a parallel activity supported by the Water Research Commission, the research group investigated the photolytic and photocatalytic degradation of harmful organic compounds in water. Photolytic and photocatalytic processes are emerging as a cleaner solution for treating pollutants, such as refractory organics, pharmaceutical compounds and endocrine-disrupting compounds (EDCs) emanating from industrial, medical and cosmetic applications. Another troublesome class of pollutants is emerging from halogenated forms of algal metabolites in eutrophic water sources. These compounds, when chlorinated, form carcinogenic halogenated products such as trihalomethanes (THMs), haloacetic acid (HAA) and chlorophenols (CPs). Photocatalysis accelerates the photochemical transformation of substrates in the presence of a semiconducting material such as TiO<sub>2</sub>. The catalyst may accelerate the photoreaction by interaction with a substrate in its ground or excited state and/or with a primary photoproduct, depending on the mechanism of photoreaction. An energy source is needed during photocatalysis, usually ultraviolet light, to create reactive sites called electron band pairs in semiconductor particles. The potential difference between an electron band pair (that is, the -ve valence and +ve conduction band) forms a natural band gap for the given material. The band gap refers to energy difference between the valence and conduction bands. The band gap is also seen as a void region that extends from the top of the electron-filled valence band to the vacant conduction band and is dependent on the nature of the semiconductor material. In photocatalysis, adsorption of energy (hν) equal to or more than its band gap produces electron excitation in the catalyst and electrons gain sufficient energy to change levels from the valence to the conduction band. On the other hand, an electron vacancy or hole (h<sup>+</sup>) is created in the valence band. Excited-state conduction-band electrons and valence-band holes can recombine and dissipate the input energy as heat, get trapped in metastable surface states, or react with electron donors and electron acceptors adsorbed on the semiconductor surface or in the surrounding electrical double layer of the charged particles.

The research succeeded in reducing the residence time required for the complete degradation of single ring aromatic compounds to less than two minutes under aerated conditions in a photocatalytic reactor. These results indicate a high potential for substituting slower-acting biological processes with photocatalytic and photolytic systems to degrade refractory and hard-to-degrade organic compounds using a cheap source of energy such as sunlight.

### Communal water house

The German Federal Ministry for Education and Research and the NRF funded a scientific water management project that deals with a technological unit called the communal water house (CWH). The aim was to improve the water situation, especially in rural communities. Kouga Local Municipality was the beneficiary of the project in South Africa. The CWH is a facility that aims to provide water of definite quality and temperature for household use, shower and laundry purposes in rural settlements. It consists of two or more separate rooms inside the building for laundry and shower activities, and tap water outlets outside the building. Water sources are tap water, rainwater or well water. The water for laundry and shower purposes is recycled inside the building and treated by a service water treatment station. This treatment station consists of three technological units that work in a controlled manner: a biological treatment unit, an ultraviolet light disinfection unit



Communal water house

and membrane filtration modules. The quality of the treated water is in accordance with the European Union bathing water regulations. The water is heated by a solar heating system. Water is pumped by solar pumps. The researchers found that CWH improves water use efficiency and that twice as many people can be served by the same amount of water at the same level of services, highest sanitary standards and reduced costs. CWH is therefore very well suited for rural communities that lack water supply and energy to improve the living conditions of their people. It can be used as a full, sustainable water management solution or as an intermediate solution. Moreover, it can be used in tourist facilities, such as camping grounds, sport grounds and other camps. Sanitation for CWH users is provided by urine diversion toilet systems.

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### The effect of fabric on the behaviour of gold tailings

The behaviour of cohesionless soils is known to be influenced by the method of reconstitution. It is generally accepted in the literature that different reconstitution methods produce samples of varying fabric and thus samples of varying behaviour. Very little evidence has been presented to validate this statement. The main aim of this research project was, firstly, to observe the fabric of *in situ* and reconstituted gold tailing samples and, secondly, to investigate the difference in behaviour between these samples at the same state. The study focused on testing *in situ* and reconstituted gold tailing samples obtained from three positions on a tailing dam: pond, middle beach and upper beach. Laboratory reconstitution methods included moist tamping and slurry deposition. Fabric analysis involved the use of scanning electron microscope (SEM) images to classify the observed differences in the fabric of the undisturbed and reconstituted gold tailing samples. A particle interaction model based on the observed fabric was postulated to explain the differences or similarities in behaviour. The scope of behaviour investigated included sedimentation, collapse and swell, consolidation and compressibility, creep, stiffness and shear behaviour. The fabric analysis indicates that differences in the fabric of undisturbed and reconstituted gold tailing samples are visible. Moist tamping produces an aggregated fabric, while slurry deposition yields a homogeneous fabric similar to that of the undisturbed samples. Comparison of behaviour indicates that neither moist tamping nor slurry deposition can fully replicate the behaviour of the undisturbed sample. Consolidation and compression is a function of the fabric, while friction angle is independent of the fabric. Available shear strength and liquefaction potential is also affected by the preparation method and the resulting fabric.

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## Electrical, Electronic and Computer Engineering

### Ephaptic excitation in the electrically stimulated cochlea

The aims of this study were to investigate the occurrence and effect of ephaptic excitation in electrical stimulation of the auditory system, to quantify the influence of ephaptic excitation on nerve stimulation, and to determine whether it is a necessary factor in neuromodelling. It was shown with a simple model that ephaptic excitation could be important at stimulus intensities close to threshold. The results show that the contribution of ephaptic excitation is significant up to at least 6 to 7 dB above threshold. Cochlear implant patients normally have a small dynamic range (average of 7 dB), indicating that the ephaptic effect might be important in models of the implanted cochlea. There is a significant qualitative difference between the results of the coincidental location and the separation of location of the active nerve fibres. When the fibres are bundled together, a constant stimulus current is used, while the current increases with an increase in spread of the active fibres when they are spatially separated. When the fibres are bundled together, there is no spatial constraint to the number of active neurons, which leads to large numbers of active neurons. This is also the reason why excitation by the electrode stimulus is at some stage outweighed by ephaptic excitation in these results, while the electrode stimulus dictates spread of excitation at high stimulus intensities (that is, large numbers of active neurons) when the active neurons are spatially separated. Results obtained for the planar orientation of the fibres could be used to estimate the extent of ephaptic excitation for the peripheral part of the fibres along the basilar membrane. In addition, ephaptic excitations were frequently observed to initiate in the central neural processes because of the larger fibre diameters, resulting in larger membrane currents per node and easier recruitment of thick fibres. This is of interest since cochlear implant users are often assumed to have an essential loss in the peripheral processes of their cochlear neurons as a consequence of long-term deafness. In conclusion, it was shown with a very simple model that ephaptic excitation could be important at stimulus intensities close to threshold. Limitations of this model include an assumed ideal volume conductor, a point source electrode and planar fibre location. Future research work in this field should focus on the development of a model that includes a more realistic description of the volume conductor (that is, the cochlea with the implanted electrodes). The results obtained from such a model should be compared with physiological results measured in animals or psychoacoustic results measured in human subjects, for example, forward masking data that provides an indication of the spread of neural excitation.

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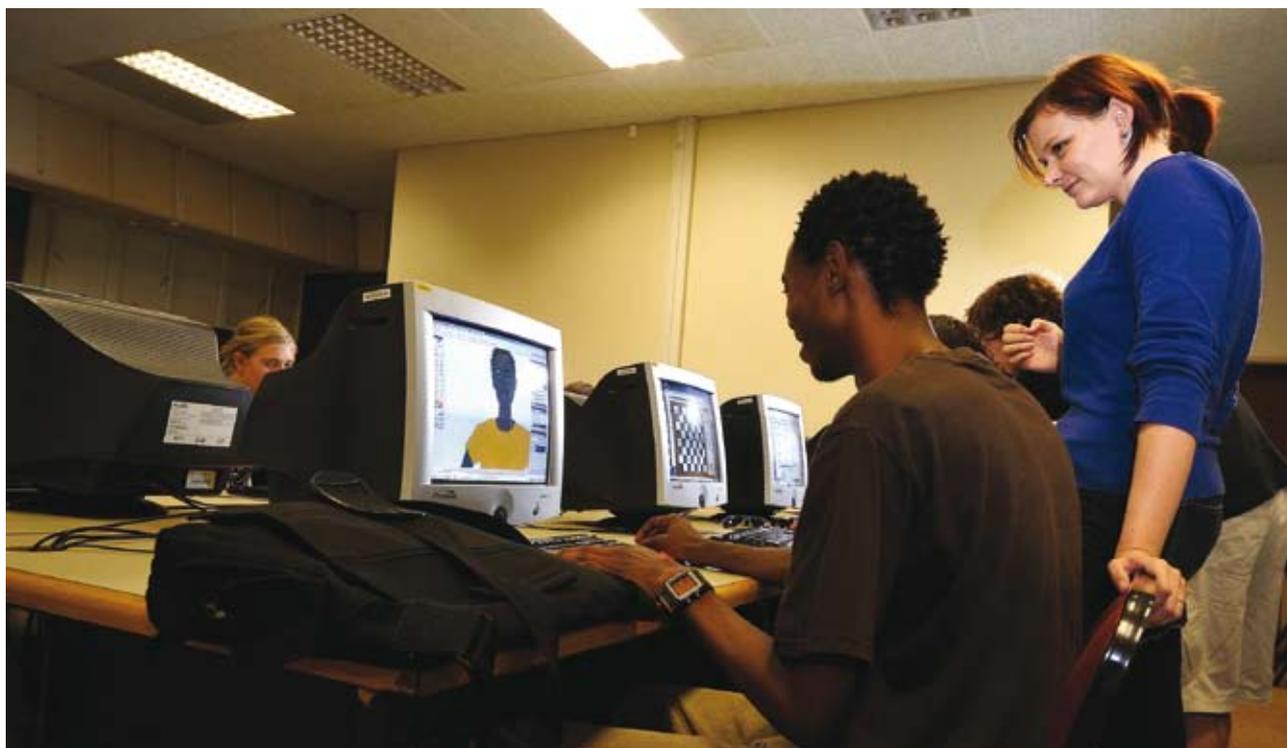


Ephaptic excitation was studied in patients with cochlear implants.

## Materials Science and Metallurgical Engineering

### Recovery processes for electronic waste materials

Material footprints, which can be defined as the quantity (mass) of material used for an application, such as the total mass of concrete and brick in a house, together with the carbon footprint, form components of the ecological footprint. The material footprint emphasises material resources, whereas the carbon footprint focuses on energy consumption. Use of the material footprint helps decision-making when resource conservation is desirable, but should not be viewed in isolation. Material footprint calculations have been carried out for some illustrative examples such as personal computer equipment and home appliances. While the material footprint compares resource usage among various types of equipment as an aid in determining environmental impact, it does not indicate what quantities of material are being used or recycled. It is essentially a per unit approach. In order to obtain a more holistic perspective involving quantities of materials, material flow analysis is generally used. From such an analysis, it is possible to obtain a better understanding of how materials flow and reside in the market. That again makes it possible to determine where there are bottlenecks in the flow, and also whether recycling is financially feasible. Treatment of secondary materials can be complex and is often purpose- designed. However, in general, it seems that physical separation methods should preferably be used to their fullest extent, as their environmental impact is generally lower than chemical separation processes. Clean metallic fractions could be suitable feeds to pyrometallurgical or hydrometallurgical processing. Mixed materials are probably best treated by hydrometallurgical techniques. For local processors, the cost of establishing refineries to treat secondary materials only is probably prohibitive. With an extensive South African industry dealing with primary feed materials, it would seem advantageous to process suitably cleaned secondary materials together with the primary



Material footprint calculations are done for items such as personal computer equipment.

feed materials. For instance, a fairly clean copper fraction could probably be accommodated in the anode casting step at the Palabora Mining Company. Clean zinc metal or oxide could possibly be used by Zincor instead of calcine as neutralising material. Precious metal fractions should be accommodated at the Rand Refinery and Platinum Group Metals (PGM) refineries. Platinum and palladium are used in catalytic converters and such fractions might, with suitable alloy adjustment, be suitable for use in this application without further refining and separation. E-waste has, over the last number of years, received greater attention and several recyclers are dealing with this material mainly by size reduction and metal fraction separation. Volumes are still small and the cleaned metal fractions are generally exported for refining. The associated plastics generally contain brominated flame retardants (BFRs), which makes them unacceptable for normal plastic recycling. As a result, they are exported to China or dumped into a landfill. Local companies have developed uses for these plastics. More attention should be given locally to these secondary feed materials. If present, primary producers could accommodate cleaned metallic fractions. Environmentally certified processors could probably import e-waste to increase volumes. This should be beneficial in terms of capital utilisation, work creation and to the economy, as well as to the environment, if the energy consumption is not weighed too heavily.

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## Computer Science

### SMSSec: an end-to-end protocol for secure SMS

Short message service (SMS) is usually used to transport unclassified information, but with the rise of mobile commerce, it has become an integral tool for conducting business. However, SMS does not guarantee confidentiality and integrity of the message content. This research project was aimed at implementing a protocol called SMSec that can be used to secure SMS communication sent by Java's wireless messaging application programming interface (API). The physical limitations of the intended devices, such as mobile phones, made it necessary to develop a protocol that would make minimal use of computing resources. SMSec has a two-phase protocol with the first handshake using asymmetric cryptography, which occurs only once, and a more efficient symmetric  $n^{\text{th}}$  handshake, which is used more dominantly. What distinguishes this work from conventional protocols is the ability to perform the secure transmission with messages of a limited size. Performance analysis showed that the encryption speed on the mobile device is faster than the duration of the transmission. To achieve security in the mobile enterprise environment, this is deemed a very acceptable overhead. Furthermore, a simple mechanism is proposed that handles fault tolerance without additional overheads.

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## 6.4 Faculty of Health Sciences

The Faculty of Health Sciences makes a contribution to health and science through research into diverse topics ranging from maternal and child health to forensic anthropology.

### Message from the Dean

The Faculty of Health Sciences increased its research output in 2008.

The faculty has two South African Medical Research Council (MRC) research units: one focusing on various aspects of inflammation and the other on maternal and child health care. These two units illustrate the diversity of the faculty, not only in their areas of focus, but also by illustrating that the faculty's research varies from laboratory-based, cutting-edge science to finding marketable solutions for the burden of maternal and childhood-related morbidity and mortality in Africa.

Among the many exciting projects performed by research groups in the School of Medicine are the development of an artificial liver, the development of new cancer drugs, the testing of novel agents for the diagnosis of tuberculosis and investigating the role of the gastrointestinal tract in the pathogenesis of HIV/AIDS. Multidisciplinary research is also conducted to improve diabetes care. Two new research centres were established in the School of Medicine in 2008: the Forensic Anthropology Research Centre and the Centre for Applied Morphology.

The School of Health Systems and Public Health (SHSPH) has a keen interest in endocrine-disrupting chemicals (EDCs) and pesticides used for malaria vector control. The development of a toolbox of biological assays for analyses of estrogenic and anti-androgenic activity in water sources started as a global initiative and was taken to the next level by Prof Tiaan de Jager and his research team, who are applying it to South Africa and are setting guidelines to be used by the Department of Water Affairs and Forestry. This was made possible by the new dedicated EDC and toxicology laboratories at the SHSPH. The research on the organochlorine pesticide, DDT, not only received an award locally, but also received international attention when it was included in an international review on the state of science. This information is used by the World Health Organisation (WHO) to formulate its statements on malaria control and persistent organic pollutants (POPs).

The School of Dentistry focused on tobacco and the impact of tobacco use on health in general and oral health in particular. Prof Lekan Ayo-Yusuf proposed an integrated educational approach to promote oral health and prevent tobacco use in schoolchildren in South Africa. Further research in community dentistry identified determinants for early childhood caries and proposed a placement time frame protocol to optimise the use of fissure sealants to prevent caries in South Africa. Multidisciplinary teams in the school also evaluated various dental materials and the appropriateness of their use in South African conditions.

The Comprehensive Physical Rehabilitation Centre in the School of Health Care Sciences was approved by Senate in 2008. This exciting new venture ensures collaboration between the departments of Physiotherapy, Occupational Therapy, Human Nutrition, Sports Medicine and Clinical Epidemiology.



Prof Thanyani Mariba, Dean

The University is indebted to all the faculty members who, with vision and dedication, pursue solutions that will improve the health of all South Africans by being locally relevant, yet internationally competitive.

Prof Thanyani Mariba  
Dean



Health Sciences Building

## Research highlights

### Community Dentistry

#### Smoking prevention

Research shows that adolescents who did not live with their mothers were less likely to brush their teeth regularly. However, adolescents with a general predisposition to cope adequately with stress and those who do not smoke are more likely to brush their teeth regularly and experience good gingival health, irrespective of their level of oral hygiene. The onset of smoking, on the other hand, is least likely in youths who strongly believe that smoking causes bad breath and that bad breath has negative social consequences, such as peer rejection. These results from the initial phase of the project supported the implementation and evaluation of an intervention integrating oral health promotion with a social skills-based smoking prevention curriculum, Life Skills Training (LST). In addition to teaching stress-coping skills, the curriculum provided information on the short-term health consequences of smoking, focusing on effects such as bad breath and its influence on social interaction, especially as it relates to the adolescents' romantic aspirations. A two-year randomised controlled trial showed that LST was very effective in promoting adolescents' regular tooth-brushing behaviour and good gingival health. However, the intervention did not significantly reduce smoking prevalence, but increased non-smokers' cigarette-offer refusal self-efficacy, which may reduce susceptibility to future smoking.

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### Dental Management Sciences

#### Fissure sealant placement time frame protocol

Research has indicated that fissure sealants should be placed within four years after eruption. Due to considerable variations in the eruption times of molars, this recommendation is of limited value from a public health perspective. This study, therefore, sought to provide empirical support for a public health fissure sealant placement time frame protocol. The researchers analysed the first and second molar eruption patterns of black South African children aged five to seven and 11 to 16 years in relation to caries (tooth decay) experienced using the 1999 to 2002 National Children's Oral Health Survey. The researcher found that by the age of seven, 90 percent of first molars had erupted, with a caries experience of 3 percent. By 14 years of age, the erupted first molar caries experience was 20 percent. The 13- and 14-year-olds presented with 86 percent and 98 percent erupted second molars with a caries experience of 11 percent and 20 percent respectively. The findings suggested that during school-based fissure sealant programmes involving black South African children, first molars should be targeted at the age of seven (grade 1), or as soon as possible thereafter. However, caries protection may still be achieved until 13 years of age (grade 7). Furthermore, second molars should be sealed between the ages of 11 and 13 years (grade 5 to grade 7).



Research in the field of Dental Management Sciences contributes to the dental health of the nation.

#### Early childhood caries prevalence and severity

The aim of this study was to describe the prevalence and severity of early childhood caries (ECC) or tooth decay in South Africa and to examine the link between ECC and socio-demographic factors, area-based measures of sugar consumption and water fluoride levels. ECC is a disease where bacterial processes damage hard tooth structure. This eventually leads to dental cavities. The researcher focused his study on children between the ages of 36 and 71 months. He found that socio-economic factors played a major role in the prevalence of ECC. In addition, he found that coloured children were at a higher risk of developing ECC, while white children were at a lower risk. The study findings support the implementation of an integrated primary oral health care strategy to address the underlying socio-economic determinants of ECC in South Africa.

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## Anatomy

### Asthma model

The murine Balb/c asthma model has been used successfully for a number of *in vivo* immunological applications and for testing novel therapeutics. It is a reliable, clinically relevant facsimile of the human disease. The researchers focused on whether or not this model could be used to study other components of the human body, for instance ultrastructure. They studied the effect of the phytomedicine *Euphorbia hirta* (used to treat asthma) on the ultrastructure of fibrin, as well as platelets and cellular structures that play an important role in the coagulation process. Hydrocortisone is used as a positive control. Ultrastructure of the fibrin networks and platelets of control mice were compared to asthmatic mice that were treated with two concentrations of hydrocortisone and one concentration of the plant material. Results indicated that control mice possessed major, thick fibres and minor thin fibres, as well as tight round platelet aggregates with typical pseudopodia formation. The minor fibres of the asthmatic mice had a netlike appearance covering the major fibres, while the platelets seemed to form loosely connected, granular aggregates. Both concentrations of hydrocortisone made the fibrin more fragile and the platelet morphology changed from a tight platelet aggregate to a more granular aggregate not closely fused to each other. The researchers concluded that *E. hirta* does not impact on the fragility of the fibrin and that it prevents the minor fibres from forming the dense netlike layer over the major fibres, as is seen in untreated asthmatic mice. This ultrastructural morphology might give researchers better insight into asthma and possible new treatment regimes.

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## Centre of Applied Morphology

### Direct and indirect cellular effects of aspartame on the brain

The use of the artificial sweetener, aspartame, has long been contemplated and studied by various researchers and people concerned about its negative effects. Aspartame is composed of phenylalanine (50 percent), aspartic acid (40 percent) and methanol (10 percent). Phenylalanine plays an important role in neurotransmitter regulation, while aspartic acid is also thought to play a role as an excitatory neurotransmitter in the central nervous system. Glutamate, asparagines and glutamine are formed from their precursor, aspartic acid. Methanol, which forms 10 percent of the broken-down product, is converted in the body to formate, which can either be excreted or can give rise to formaldehyde, diketopiperazine (a carcinogen) and a number of other highly toxic derivatives. Previously, it has been reported that the consumption of aspartame could cause neurological and behavioural disturbances in sensitive individuals. Headaches, insomnia and seizures are some of the neurological effects that have been encountered, and this may be accredited to changes in regional brain concentrations

of catecholamines, which include norepinephrine, epinephrin and dopamine. The aim of this study was to identify the direct and indirect cellular effects of aspartame on the brain. The researchers found that excessive aspartame ingestion might be involved in the pathogenesis of certain mental disorders, as well as in compromised learning and emotional functioning.

### Ultrastructural morphology of platelets

Platelets and fibrin play an important role in the coagulation process where they are involved in the maintenance of haemostasis. Fibrin dysfunction is associated with the development of vascular complications, while proneness to the formation of tight and rigid fibrin networks is independently associated with thrombotic disease. Rabbits have long been used successfully as animal models, and are often the species of choice for models of antithrombotic efficacy. It was previously shown that rabbit and human platelet and fibrin morphology are very similar in ultrastructure and fibrin fibre thickness. It was also previously reported that the thin minor fibres form a thick, fine network cover over the major fibres during pregnancy. According to research, white blood cell counts also change during pregnancy and stay changed for up to six weeks post-partum, where the number of neutrophils increased and the number of lymphocytes, basophils and eosinophils decreased. The researchers showed that the same ultrastructure and white blood cell count changes occurred in lactating rabbits (four weeks post-partum). They found that a rabbit morphology model studying platelet and fibrin morphology can be used successfully, either to study the effect of pharmaceutical products to be used during lactation and pregnancy in humans, or in veterinary research. Furthermore, the effects of pharmaceutical products on immunology and white blood cell counts can possibly also be used successfully.

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### Ultrastructure of activated mouse platelets

Platelets form an integral part of the coagulation process and their ultrastructure can provide valuable information regarding diseases associated with haemostasis. During coagulation, platelets aggregate. This aggregation can be achieved *in vitro* by adding thrombin to platelet-rich plasma. Previous research showed that human thrombin could be used successfully to activate mouse platelets. When conservative changes are included, the amino acid similarity between human and mouse thrombin is approximately 75 percent. In this qualitative study, the researchers compared the ultrastructure of mouse platelet aggregates activated by human thrombin, as well as two concentrations of mouse thrombin, using the scanning electron microscope. Results show that both human and mouse thrombin activate platelets to form aggregates with typical pseudopodia formation. Magnification up to 250 000 times showed membrane morphology with the open canalicular system pores visible in both the mouse and human-activated platelets. It is, therefore, concluded that mouse platelets can be successfully aggregated using either mouse or human thrombin.



### Ultrastructural changes in platelet aggregates of HIV patients

Several haematological abnormalities associated with HIV have been documented. However, the mechanisms responsible for the cytopenias in AIDS patients are complex and not always completely understood. Thrombocytopenia, which occurs in about 40 percent of patients with HIV infection, may be caused by increased peripheral platelet destruction, a defect in platelet production due to the impaired formation of platelets by HIV-infected megakaryocytes, or a combination of these. The aim of this study was to compare the morphology of the platelet aggregates in platelet-rich plasma (PRP) clots prepared from HIV patients with those of controls without HIV. These platelet aggregates were studied using the scanning electron microscope to determine the effect of the virus on platelet ultrastructure. The results showed that although the platelets aggregate, the morphology was changed with membrane blebbing, as well as torn cellular membranes. Membrane blebbing is typically associated with apoptosis. It is concluded that the altered morphology of platelet aggregates in HIV patients may be related to thrombocytopenia as a result of peripheral platelet destruction.

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The anterior tibiae of individuals from a 19<sup>th</sup>-century mining community in Kimberley were analysed to confirm illnesses recorded in hospital and government documents.

### Collagen-based tissue engineering scaffold for dermal regeneration

Tissue engineering and its contribution to regenerative medicine has advanced through the years. This fairly young science employs advanced scaffolds, such as Integra<sup>®</sup>, to mimic the extracellular matrix. The aim of this study was to develop a collagen and chondroitin 6-sulphate dermal regeneration scaffold. Frozen slurries (0.5 percent collagen) were dried under vacuum, cross-linked and then thoroughly rinsed. The scaffolds were subjected to a range of quantitative and qualitative tests that included scanning electron microscopy analysis, collagenase enzymatic degradation and cytotoxicity assessment. Results indicated that highly porous (mean pore diameter of 87.34  $\mu\text{m}$ ), bioactive, non-cytotoxic tissue engineering matrices were obtained. Scaffold resistance to enzymatic degradation were manipulated after dehydrothermal treatment by employing combinations of cross-linking agents, such as glutaraldehyde and/or carbodiimide, with or without the presence of L-lysine.

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### Forensic Anthropology Research Centre

#### Accurate diagnosis

Examination of the histological structure of bone not only helps investigators estimate age at death, but can also aid in the diagnosis of palaeopathological lesions. The purpose of this research project was to assess whether histological features, as described in the literature, can confirm the macroscopic diagnoses of ossified subperiosteal haematomas, associated with healed scurvy, and syphilitic bone changes observed on the anterior tibiae of individuals from a 19<sup>th</sup>-century mining community from Kimberley, South Africa. The frequent occurrence of these two diseases among the deceased was well established in related hospital and government documents. A section of bone was removed from lesions on the tibiae of 14 individuals. These bone changes were macroscopically diagnosed as being indicative of treponematosi, ossified subperiosteal haematomas or non-specific periostitis. Cross-sections were prepared for microscopic investigation, using a manual ground section technique. Ossified haematomas were histologically identified in seven individuals. These sections



were characterised by normal cortical bone, an intact original periosteal surface and newly formed, radiating trabecular bone apposing it. Three phases of ossified subperiosteal haematoma formation and remodelling could be distinguished. Infectious bone changes, most likely associated with treponematosi, were observed in one individual. These were characterised by lysis and numerous resorption holes/channels. No clear distinction could be made between the internal spongy, cortical or newly formed bone. Histological features described by some authors as characteristic of this condition could not be identified. In addition, three individuals presented with microscopic features indicative of both the aforementioned bone affections, and three did not show any pathological changes on the microscopic level. It was concluded that, although specific pathological conditions can most likely not be diagnosed purely on the basis of histomorphological observations, broad distinctions could be made between lesions caused by the ossification of subperiosteal haematomas and bone changes due to infectious diseases.

### Trauma and amputations in 19<sup>th</sup>-century miners from Kimberley

Trauma is the result of violent, accidental or therapeutic events that cause physical or psychological injury. The frequencies and types of trauma in a population can give important information regarding their lifestyle, as well as the quantity and quality of medical care available to them. The purpose of this study was to assess the incidence of trauma in the Gladstone sample population with regard to the presence of interpersonal violence, a hazardous working environment, strenuous working requirements and the availability of medical care. The individuals studied were diamond miners from Kimberley, dating to the late 19<sup>th</sup> century. A total of 107 well-preserved skeletons were excavated from unmarked graves after accidental discovery. This sample included 86 males, 15 females and six individuals of unknown sex. The majority of individuals (71 percent) were between 19 and 45 years of age. The remains were most likely those of migrant mine workers of low socioeconomic status who had passed away at local hospitals. All bones were visually assessed for macroscopic indications of traumatic bone alterations and compared to standard palaeopathological texts and photographs. A total of 27 percent (n¼28) of the individuals in the sample presented with well-healed, healing or perimortem fractures. Fractures to the skull encompassed 49 percent (n¼20) of all the fractures that were observed. A total of six (6 percent) amputations

were noted. Spondylolysis was observed in 7 percent (n¼7) of the individuals in the sample and long-standing subluxation was noted in two individuals. The high incidences of cranial fractures in this population suggest high levels of interpersonal violence, while long bone fractures, spondylolysis and evidence of long-standing subluxations are indicative of the strenuous work requirements and the high-risk environment to which these individuals were exposed. When considering the presence of well-reduced fractures and healed amputations, it seems that adequate medical care was available to at least some members of this community.

### Adult scurvy

Throughout history, scurvy has been a well-known disease that develops due to restricted sources of fresh fruit and vegetables. The condition results from an extended limited intake of vitamin C. Although skeletal lesions associated with infantile scurvy have been well described by many authors, very little literature is available on adult scurvy and the resulting skeletal lesions. The purpose of this study was to investigate



Skeletons of diamond miners from a late 19<sup>th</sup>-century Kimberley community were studied for macroscopic indications of traumatic bone alterations.

the skeletal remains of a 19<sup>th</sup>-century mining population from Kimberley, South Africa, for any skeletal lesions that may be indicative of adult scurvy. Scurvy is well documented as being extremely prevalent in this population. The skeletal remains of 107 individuals, presumed to have died around 1898, were studied. The majority of these individuals were males between 19 and 45 years of age. It is likely that most individuals were migrant workers at the diamond mines. All bones were visually assessed for macroscopic indications of pathological bone alterations associated with healed scurvy. Bone samples were also taken from ambiguous lesions in order to perform histological investigations. Lesions indicative of possible healed adult scurvy were observed in 16 individuals. These lesions included bilateral ossified haematomas, osteoperiostitic bone changes and periodontal disease. Histological investigation confirmed the presence of ossified haematomas on the anterior tibiae of some individuals. Hospital records and historical documents describing the incidence of scurvy in the local hospitals and the daily diet of the black mine workers supported these findings.

### Life expectancy of the Venda population

Research on the life expectancy of the Venda population was published in 2008 and provides information on the mortality rates of rural South African groups from this region. The purpose of this study was to apply abridged life tables to estimate life expectancy from both skeletal remains and death registry information of modern South African communities. Comparisons were also made with prehistoric and contemporary groups to better evaluate life expectancy for this time period. The sample consisted of 160 skeletons of known Venda origin and burial registry information for 1 364 black South Africans from the Rebecca Street and Mamelodi cemeteries in Pretoria, South Africa. Standard anthropological techniques were applied to determine sex and estimate age from the skeletal remains. Both stationary and non-stationary life table models were used to analyse the data. A high rate of child mortality, low juvenile and adult mortality, with a steady increase in mortality after the age of 30 years was observed for both the Venda and the cemetery samples. Throughout the 20<sup>th</sup> century, life expectancy was shown to increase for black South Africans.

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Research on the life expectancy of the Venda population showed that life expectancy was increasing for black South Africans throughout the 20<sup>th</sup> century.

## Immunology

### Rapid and inexpensive test for detection of HIV-1 drug-resistance mutations

The researchers evaluated the feasibility of the oligonucleotide ligation assay (OLA), a specific, sensitive and economical ligase-based point mutation assay designed to detect HIV-1 drug-resistance mutations at 12 codons of HIV-1 subtype B pol, for potential use in resource-poor settings. Specimens from HIV-1-infected individuals collected by seven international laboratories, including subtypes A, B, C, D, F, G, J and recombinants AE and AG, were tested by the OLA developed for HIV-1 subtype B. Common polymorphisms that interfered with reactivity of the OLA were identified, and modified probes designed and evaluated. The researchers successfully genotyped 92.5 percent (2 410) of 2 604 codons in specimens from 217 individuals. A high rate (range 8.3 percent to 31.2 percent) of indeterminate results (negative OLA reaction for both mutant and wild type) was observed for five codons. Modified probes at reverse transcriptase codons 151 and 184 and protease codon 90 increased the rate of valid OLA to 96.1 percent. The researchers found that the OLA designed for HIV-1 subtype B genotyped most pol codons in non-B subtypes from Asia and Africa, but was improved by the addition of several modified probes. International laboratories experienced in molecular techniques were able to perform the OLA.

### Characteristics of HIV-1-associated Kaposi's Sarcoma

The aim of this study was to provide a detailed description of the clinical, virological and immunological characteristics of AIDS/Kaposi's Sarcoma (KS), an associated herpes virus in men and women who are not making use of antiretroviral therapy (ART). The study also measured the extent of KS disease directly (level of cutaneous and visceral involvement), rather than relying on the reporting of non-specific symptoms such as fever, diaphoresis and weight loss. The proportion of women with HIV-1-related KS (ratio of 1:1) was substantially higher than that reported for American, European and other African population groups. One of the reasons for this might be the fact that the prevalence and incidence of HIV-1 in KwaZulu-Natal are among the highest in sub-Saharan Africa, with young women bearing the major impact of the burden. The researchers found that AIDS/KS is unequally distributed among different age groups and that the proportion of AIDS/KS cases was highest among women in their mid-20s. Also of considerable interest was the finding that the age-specific distribution pattern for female KS was essentially identical to that previously reported for HIV-1 on its own. In past studies conducted in KwaZulu-Natal, the prevalence (and incidence) of HIV-1 increased in young mothers between the ages of 21 and 25, and then levelled off and declined in women 30 years of age. Taken together, this data suggests that the risk of developing female KS, at least in KwaZulu-Natal, is closely related to the epidemiology (and/or transmission) patterns of HIV-1. The finding that, at diagnosis, women had more extensive KS disease is consistent with studies from Zimbabwe and Italy showing that women with AIDS/KS are more symptomatic, have more advanced disease, and a more aggressive clinical presentation and disease course.

relative to men. The reason for the increased severity of KS in HIV-1-infected women is not known, but does not appear to be related to virological or immunological differences, since the men and women in the study had similar mean viral load and mean CD4p T-cell counts. The lack of a gender-related correlation between disease severity and CD4p T-cell count is in agreement with the Zimbabwean study, but at variance with the data from Italy. Italian investigators found that, relative to men, women with KS were more immune-deficient. Despite the lack of a difference between men and women, the researchers found that in each gender group, there was a statistically significant relationship between lower CD4p T-cell counts and more advanced KS disease, and between lower CD4p T-cell counts and poor disease prognosis, suggesting that immune suppression may play a role in KS progression, but that this role may not necessarily be related to gender. The wide variation in CD4p T-cell counts observed in this study (from 1 to 1 406 cells/mm<sup>3</sup>) and the finding that 21 percent of patients had CD4p T-cell levels .350 cells/mm<sup>3</sup> (38 percent .200 cells/mm<sup>3</sup>) suggest that, in African populations, severe immune suppression is not a prerequisite for the development of KS lesions. Although the reasons are not known, higher than expected CD4p T-cell counts in African patients had been reported previously. In the African setting, great care must be taken to accurately diagnose and differentiate between KS- and tuberculosis-induced pulmonary diseases. Given that tuberculosis may coexist with AIDS/KS in 20 percent of patients, and that the diagnosis of this condition may influence both the timing and choice of ART, it is recommended that all AIDS/KS patients receive a clinical evaluation and sputum examination for the detection of acid-fast bacilli, and that those with symptomatic lung disease be ruled out for tuberculosis.

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### Differentiation of human monocytes

Canova is an immunomodulatory, homeopathic preparation that has been shown to activate macrophages *in vitro* and *in vivo*, with resultant enhanced spreading of the cells and formation of microvillus extensions from the cell body. Since monocytes are the precursor cells of macrophages and dendritic cells, the objective of this study was to investigate the effects of Canova on the differentiation of human blood monocytes *in vitro*. Monocytes were isolated, grown in culture and exposed to 10 and 20 percent Canova without the addition of cytokines. After 48 hours, monocytes were prepared for analysis by scanning electron microscopy, while cells kept in culture for seven days and exposed to Canova on days one, three and four were analysed by flow cytometry for alterations in the levels of expression of CD1a, CD11c, CD14, CD80, CD83, CD86 and HLA-DR. Scanning electron microscopy revealed that monocytes exposed to 10 percent Canova had a morphological appearance similar to that of macrophages. Various cytoplasmic projections were observed with pseudopodia formation. Flow cytometric analysis after exposure of monocytes to 10 and 20 percent Canova indicated high cell viability and upregulation of CD80, compatible with differentiation into either macrophages

or dendritic cells. Exposure to Canova per se causes activation of monocytes with resultant differentiation into large macrophage-like cells of indeterminate phenotype that have increased expression of CD80. Like cytokines, Canova induces differentiation of monocytes, an activity that may underpin the immunomodulatory activity of this product.

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### Medical Virology

#### A virus in surface water in South Africa: what are the risks?

The aim of this study was to assess the potential risk of infection constituted by the Hepatitis A Virus (HAV) to persons using surface dam and river water for domestic and recreational purposes. The researcher estimated the potential risk using a deterministic exponential risk assessment model with mean values and conservative assumptions. HAV was detected in 17.5 percent of river and 14.9 percent of dam water samples that were tested. The number of indicator organisms in these sources exceeded drinking and recreational water quality guidelines set by the United States Environmental Protection Agency (US EPA), indicating possible health risks to recreational water users. Based on the available data and taking all the assumptions into consideration, the probability of infection ( $P_{inf}$ ) to the higher socio-economic population using the river water for recreational purposes was  $1.1 \times 10^{-3}$  per day and  $3.3 \times 10^{-1}$  per annum if 100 ml was ingested per day. For recreation in the dam water, the  $P_{inf}$  value was  $1.2 \times 10^{-4}$  per day and  $4.2 \times 10^{-2}$  per annum. For the lower socio-economic population, risk values for drinking purposes (two litres per day)



Boating at Hartebeespoortdam – what are the risks?

were tenfold greater. These surface waters therefore did not conform to the US EPA guidelines of one infection per 10 000 consumers per year for drinking water or eight gastrointestinal illnesses per 1 000 bathers per day in environmental waters used for recreational purposes. This is the first risk assessment study addressing the risk of infection by HAV in surface water to different socio-economic populations in South Africa.

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## Obstetrics and Gynaecology

### Essential steps for managing obstetric emergencies

The MRC Maternal and Infant Health Care Strategies Research Unit concentrates on researching and developing effective methods for introducing health care programmes into health districts. It has successfully developed the Essential Steps for Managing Obstetric Emergencies and demonstrated that the programme significantly improves the skills of interns when managing obstetric emergencies. This programme will be scaled up throughout South Africa in the next few years. The unit also focuses on ways of integrating maternal, neonatal and child health programmes into the district health system. The main focus for 2008 has been to perform a gaps survey on the prevention of mother-to-child transmission (PMTCT) of HIV. This survey revealed that the main problem in the PMTCT system was disconnectiveness between patient, health care provider and health care manager at all levels. A strategy has been developed to remove these barriers. It will be tested in Mpumalanga in 2009. The unit also produced the sixth Quality of Perinatal Care Survey of South Africa (2006 to 2007) and the fourth Quality of Child Health Care in the Health System Survey of South Africa (2006).

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## Paediatrics

### Metabolite fingerprint

The aim of this study was to identify a metabolite fingerprint in the urine of patients with possible mitochondrial disorders in order to simplify the very tedious and expensive methods currently used. The first phase was to do stability tests to assess the influence of storage conditions and time. For urine metabolite stability analyses, a total of 1 231 metabolites (features) were extracted. Given the different levels of the analysis scenarios (factors), a data matrix of 54 (cases) and 1 231 variables was produced. The researchers also received 24 positive control urine samples from the Netherlands, which proved to be extremely important to this investigation. The metabolite stability study has progressed up to the sixth month and preliminary data presented has shown that creatinine remains stable under the conditions investigated. The metabolomic analysis, however, shows



Students learn from the research conducted in a teaching hospital.

that time of storage and temperature have an effect on the data. The further analysis, interpretation and implementation of this information will be crucial in further urine analyses.

### Neuromuscular disorders

Children with neuromuscular disorders impose a diagnostic challenge to the clinician. Molecular genetics or enzyme deficiencies are the gold standards for the confirmation of myopathies, and immuno-histochemistry is a diagnostic option for specific conditions, but not readily available. The contribution of oxidative phosphorylation (OXPHOS) and Pyruvate dehydrogenase complex (PDHc) analyses to the diagnosis of children with myopathies were assessed. The researchers tested 77 patients with possible neuromuscular disorders between 2004 and 2007. Diagnoses were confirmed in 49 (64 percent) patients. Molecular genetics were done for 30 patients and diagnoses were confirmed in 17 (22 percent). Spinal muscular atrophy was the most common genetically confirmed diagnosis (12/17). Muscle biopsies were performed on 47 patients. Five biopsies were only sent for histology, and dermatomyositis was confirmed in four cases, while 42 biopsies were sent for histology and enzyme analyses, and an additional 28 diagnoses were made on the basis of the OXPHOS and PDHc results. The confirmation of neuromuscular disorders remains a challenge. Thorough clinical assessment remains the cornerstone in the initial assessment and the appropriate investigations must be selected accordingly. The researchers found that although molecular genetics is valuable, it only has a limited number of available investigations. Histology is useful to confirm inflammatory disorders. The availability of PSPHOS and PDHc analyses contributed 37 percent additional diagnoses in a previously undiagnosed population. In addition, the researchers found that OXPHOS and PDHc analyses should be done routinely on muscle biopsies of children with a suspected neuromuscular disorder.

### Respiration analyses

Deficiencies of enzymes in the mitochondrial oxidative phosphorylation (OXPHOS or energy-producing) system are of the most frequently encountered inherited metabolic diseases and are often collectively referred to as mitochondrial disorders. Diagnosis of these disorders is complicated and requires a com-

bination of clinical, histochemical and biochemical assessment of respiratory chain function and molecular genetic studies. The objective of this study was to perform respiration analyses, in addition to single enzyme assays, on freshly prepared mitochondria of patients with possible mitochondrial disorders in order to improve the diagnostic yield of mitochondrial disorders in muscle specimens. The researcher found that of the 18 controls and 26 possible patients, 19 patients (73 percent) were identified with either OXPHOS and/or PDHc complex deficiencies. The respiration analyses supported the diagnoses of a mitochondrial disorder in only four (15 percent) cases. No additional patients were identified through respiration analyses only. The researcher concluded that single enzyme analyses remain the gold standard for the diagnosis of mitochondrial disorders. It was postulated that respiration analyses may contribute to the diagnostic yield, but it only supported the diagnosis in 15 percent of cases. In addition, the researcher found that respiration can still be normal in the presence of enzyme deficiencies and it did not contribute significantly to the diagnoses of patients with mitochondrial disorders.

### Mitochondrial disorders in children

The aim of this study was to find ways to diagnose disorders in the ethnic diverse paediatric population in South Africa caused by deficiencies in the oxidative phosphorylation system (OXPHOS) and Pyruvate dehydrogenase complex (PDHc). The strategy, competencies and logistics to provide the basic diagnostic capability, however, have only been established in recent years. The researchers identified 28 patients with mostly combined deficiencies of the respiratory chain and/or PDHc enzymes. The protocols for biochemical analyses were modified over time to increase sensitivities and allow changes in strategy. The researchers used 600xg supernatants for enzyme analyses that allow the use of frozen biopsies and have thus excluded respiration analysis. The patients had mostly combined enzyme deficiencies, but complex I (CI) deficiency was the most prevalent, followed by the combined deficiency of complex II + III (CII + III). The researchers found that, as has been the norm worldwide, the age of onset and the phenotypes were diverse. The phenotypes differed in the different ethnic groupings. African patients had predominant early onset with mainly myopathic presentation, in contrast to Caucasian patients that had a group with early onset central nervous system (CNS) involvement and a group with later onset in the second or later decade with predominant exercise intolerance as one of the presenting features. The researchers concluded that this investigation provides the first clinical and biochemical data on a cohort of South African paediatric patients suspected to have a mitochondrial disorder. It has also provided a basis for reviewing the strategy of diagnosis and research of mitochondrial disorders in a developing country. Considering the demands on health care facilities in Southern Africa, future diagnosis and research on mitochondrial disorders will require optimisation through a constant review of strategy and ethical considerations.

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## Psychiatry

### Obsessive-compulsive disorder in the schizophrenic Afrikaner population

The aim of this study was to evaluate the lifetime prevalence and clinical characteristics of obsessive-compulsive disorder (OCD)/obsessive-compulsive symptoms (OCS) in Afrikaner schizophrenic and schizoaffective disorder patients. The researchers conducted a genetic study of schizophrenia among the Afrikaner founder population. In this cohort of 400 subjects from the original genetic study, they identified 53 subjects with schizophrenia or schizoaffective disorder and co-morbid OCD/OCS (study group). They were matched for gender and age of onset of illness with 59 subjects who do not have OCD/OCS (control group). The diagnostic instrument used in this cohort is the Diagnostic Interview for Genetic Studies (DIGS) version 2, which has been translated into Afrikaans. In addition to the DIGS, information for the relevant clinical characteristics reported in this study was also drawn from a detailed narrative chronological summary report and clinical files. A checklist was completed. The researchers found that the prevalence of co-morbid OCD/OCS among 400 subjects with schizophrenia or schizoaffective disorder was 13.2 percent, of which 40 were male and 13 female patients. The prevalence of OCD was 10.7 percent and OCS was 2.5 percent. Contamination obsessions were the most common type of obsession reported, followed by religious obsessions. The most prevalent compulsions were repetitive rituals followed by checking behaviour. Onset of psychotic symptoms was found to be insidious in 86.8 percent of the study group, compared to 24.6 percent of the control group. Second-generation antipsychotic use was found to be statistically more prevalent in the study group (77.4 percent), compared to the control group (45.8 percent). In addition, 73 percent of the study group experienced depressive symptoms, compared to 50.8 percent of the control group. Both groups were found to have similar incidences of suicidal thoughts and suicide attempts. Substance abuse among the control group was significantly higher (35.9 percent), compared to the study group (19.2 percent). Cannabis was most commonly abused in both groups, followed by alcohol. The researchers also found that the prevalence rate of 13.2 percent of co-morbid OCD/OCS in Afrikaner schizophrenia and schizoaffective disorder patients differs from findings in other ethnic groups, suggesting the possible role of genetic and cultural factors in the prevalence of co-morbid OCD/OCS. Second-generation antipsychotic use among schizophrenia and schizoaffective disorder patients with co-morbid OCD/OCS was found to be significantly higher than in those without co-morbid OCD/OCS. Clinical characteristics of Afrikaner schizophrenics and schizoaffective disorder patients with and without co-morbid OCD/OCS are the same. Both groups were associated with significant psychopathology and a poor prognosis.

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## Physiology

### Sutherlandia frutescent extracts

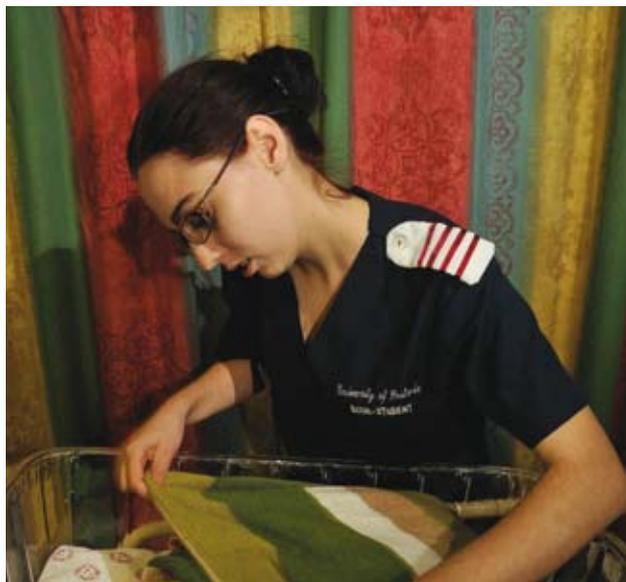
*Sutherlandia frutescens* is a well-known South African herbal remedy traditionally used for stomach problems, internal cancers, diabetes, various inflammatory conditions and recently to improve the overall health in cancer and HIV/AIDS patients. The influence of crude *Sutherlandia frutescens* extracts (prepared with 70 percent ethanol) was investigated on cell numbers, morphology and gene expression profiles in an MCF-7 human breast adenocarcinoma cell line. Time-dependent (24, 34, 48 and 72 hours) and dose-dependent (0.5 to 2.5 mg/ml) studies were conducted utilising spectrophotometrical analysis with crystal violet as DNA stain. The researcher observed a statistically significant decrease to 50 percent of malignant cell numbers after 24 hours of exposure to 1.5 mg/ml *Sutherlandia frutescens* extract when compared to vehicle-treated controls. Morphological characteristics of apoptosis, including cytoplasmic shrinking, membrane blebbing and apoptotic bodies, were observed after 24 hours of exposure. A preliminary global gene expression profile was obtained by means of microarray analysis and revealed valuable information about the molecular mechanisms and signal transduction associated with 70 percent ethanolic *Sutherlandia frutescens* extracts.

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## Nursing Sciences

### Infant developmental needs

While evidence confirms that developmental surveillance should be incorporated into the ongoing health care of the infant, such services are not consistently provided in health care settings and, if provided, its delivery suffers from significant inadequa-



Research in the field of nursing science addresses the needs of infants.

cies. A case study strategy was used to investigate the phenomenon and content analysis utilised to analyse the data. The transactional model of development was selected to interpret the data obtained in the study. Findings of the study showed that infant developmental care was not included to its fullest potential in the health care delivered to infants and their families, thereby indicating that community nurses do not meet the standards of the profession with regard to the management of infant developmental needs. Health service managers need to review their commitment and type of support to community nurses if infant developmental care, as part of community nurses' responsibilities, is to be effective and of high quality. Furthermore, community nurses and other health care professionals must recognise the nature and potential of interprofessional collaboration to ensure positive outcomes for infants with developmental delays and disabilities. The researcher developed a set of guidelines (DEFINE HOPE) aimed at improving the quality of developmental care for infants and their families. As guidelines help to translate scientific information into statements, it could be valuable to community nurses to improve their delivery of developmental care.

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## School of Health Systems and Public Health

### DDT, genetics and male reproductive health

Although DDT has been banned for international use, countries like South Africa have restricted use for malaria vector control. South Africa is a signatory to the Stockholm Convention on the Control of Persistent Organic Pollutants (POPs), including DDT, and now has the obligation to limit and control the release of substances like DDT into the environment. In response to mounting concerns about the influence of environmental chemicals on human health, a cross-sectional epidemiological study was initiated by Prof Tiaan de Jager and his team to specifically investigate the effects of 1,1,1-trichloro-2,2-bis(4-chlorophenyl)ethane (DDT) on male reproductive health. More than 300 men from Venda, Limpopo, where DDT is still sprayed, participated in the project. Semen analyses, toxicological target analyses and hormone profiles were included. Various sperm parameters were affected and very high concentrations of DDT and metabolites were detected in the blood serum. The effects of DDT on seminal parameters were clear, and the project will be extended. DDT was also shown to have an effect on the sperm chromatin and DNA. In addition to the epidemiological approach, reproductive toxicology studies were performed. A general trend in decreased fertility parameters was observed after exposure of rats to a mixture of DDT, deltamethrin, nonylphenol and phytoestrogens. DDT and deltamethrin, at environmentally relevant concentrations, had negative effects on reproductive health, with phytoestrogens in combination with other endocrine-disrupting chemicals (including DDT) showing synergistic effects.

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## 6.5 Faculty of Humanities

The research activities of the Faculty of Humanities are unusually diverse, encompassing, on the one hand, applied research projects and, on the other, practice-based research in both the creative arts and various aspects of sports science.

### Message from the Dean

Despite this diversity, unintended synergies sometimes emerge in the research focuses of different departments, in some cases leading to richly imaginative collaborative projects that not only challenge disciplinary boundaries, but also encourage engagement with the public sphere.

The most obvious beneficiaries of this engagement are marginalised communities that, for a variety of reasons, are willing to form strategic alliances with university-based researchers to achieve social and other goals that play a crucial role in sustaining their wellbeing.

The Humanities also engage the public sphere in other, equally important ways through research aimed at improving performance, both physical and psychological.

In addition to these socially connected, interactive research projects, researchers in the Faculty of Humanities excel in thinking and rethinking questions and issues that are central to our understanding of what it means to be human. As such, they make an important contribution to upholding values and practices without which our society would not be able to function.

Prof Sandra Klopper  
Dean



Prof Sandra Klopper, Dean  
since 1 October 2008



Prof Marie Muller, Dean until  
30 April 2008



The Old Arts Building, which housed the first classes in the Arts, with the Humanities Building towering in the background.



Prof Henk Potgieter, Acting  
Dean,  
1 May to 30 September 2008

## Research highlights

### African Languages

#### Developing natural language processing applications for Northern Sotho

During 2008, the Department of African Languages was involved in a joint research project with the Institute for Computational Linguistics (IMS) at the University of Stuttgart, Germany. The focus of this project was on the development of computational tools for automatic part-of-speech (POS) annotation of a Northern Sotho corpus. Thus far, a tag set has been designed, as well as tools for noun and verb guessing. Research has also been done on the formulation of disambiguation rules in an attempt to disambiguate highly homographous tokens. The value of this project is not limited to benefiting Northern Sotho only, but the tools that are developed can also be utilised for other disjunctively written languages, such as Tswana and Southern Sotho. Having access to a POS-tagged corpus will facilitate machine translation of English texts into Northern Sotho, which is one of the main aims of the project.

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### Afrikaans

#### The use of African languages in education

The pedagogical soundness of the use of mother tongue/home language as language of instruction is beyond question. The superior educational results that this ensures have been recorded time and again. Moreover, in a situation where schooling is near universal, the use of local languages in the school system is crucial for the maintenance of linguistic diversity and promoting linguistic rights. The South African education system is characterised by a complex history that has made the issue of the medium of instruction or language of learning and teaching (LoLT) a burning one for learners who are not native speakers of English – particularly black learners who speak a Southern African Bantu language. According to the regulations in place since 1997, any of the country's 11 official languages may be used as a LoLT up to grade 12 or National Senior Certificate, but the use of African languages as LoLTs is in practice only supported for the first three school grades. In recent years, many schools in townships and rural areas have either drastically limited the use of African languages as LoLTs or have opted for a policy of using English as LoLT. This has contributed to questionable results in terms of literacy acquisition in both the mother tongue and in English, and has possibly also led to a loss of learning ability. Furthermore, this situation may also be threatening the transmission of languages to succeeding generations, as many African families seem to be making English their home languages in a bid to improve their children's chances in school and – they believe – their professional future. In reaction to this state of affairs, the Department of Education has established programmes, such as the Foundation for Learning Campaign, which seek to promote early mother tongue literacy through



The use of local languages in education is crucial.

the provision of readers in all official languages. It is planning an extension of the use of African languages as LoLTs up to grade 6 in pilot schools across the country. Teacher training in the use of African languages as LoLTs and teaching them as subjects of study is being revamped. The research team studied two main issues: the requirements for the successful implementation of a mother tongue policy in education, and the teaching of African languages as subjects for native speakers. In contrast to provinces such as the Western Cape, the Eastern Cape and KwaZulu-Natal, urban Gauteng is exceptionally complex from a political point of view, and implementing a language-in-education model such as mother tongue-based bilingual education, accepted as the desirable approach in multilingual regions, may not be readily possible in the Gauteng education system. It is therefore necessary to collect sociolinguistic information about (urban) Gauteng schools in order to propose a language-in-education approach that will support learners' educational development. Attention will also be given to issues such as the training of teachers to teach content subjects in African languages. The second part of the project is the training of African language teachers and the appropriateness of linguistic behaviour in urban school classrooms.

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### Ancient Languages

#### The editing of the biblical book of Psalms

Research on the biblical book of Psalms has concentrated for a long time on the 150 different psalms as poetic prayers, hymns and laments. During the last two decades, however, researchers have begun to focus on the Psalter as a literary composition in itself. It seems that the individual psalms were arranged in a meaningful way so as to simulate the history of Israel from the time of the monarchy under David through to the periods of exile and restoration. The focus of the book gradually

shifts away from David and his dynasty towards the kingship of YHWH, the God of Israel, and the establishment of his divine rule on earth. Individual psalms would be selected, edited, adapted or even created for a specific position in a cluster of psalms so as to endow the larger composition with a collective message. Among the various ways in which the individual psalms were edited for incorporation into the collection was the practice of supplying them with headings. One of the research projects in the Department of Ancient Languages focused on the contribution that the headings of Psalm 3 and Psalm 34 make to their interpretation. Both headings contain references to particular circumstances during the life of David when he could have written the respective 'prayers': Psalm 3 during the time of his flight from his son Absalom, and Psalm 34 during the time when he had to flee from Saul before he became king himself. Through its heading (the first in the book of Psalms), Psalm 3 becomes the first exemplary prayer of David, which he formulated under difficult circumstances. This heading draws the attention of the observant reader to various intertextual connections the psalm has with 2 Samuel 15-19, the history of Absalom's revolt and eventual death. This heading suggests that individual supplicants can, irrespective of their social status, approach God in times of distress like David did. Another, similar, heading is found at the beginning of Psalm 34. Research into this text has pointed out that both the 'history' of David in 1 Samuel 24-26 and the text of Psalm 34 have been edited to establish several verbatim connections between them. Through the addition of this heading, Psalm 34 presents David as an example to believers and an object of identification in times of distress, but since this is a teaching psalm rather than a prayer, his authority is also used to endorse the exhortations in the psalm to believers to stay true to a certain code of conduct. Conversely, the addition of the heading enhances the image of David, so that he also takes on the roles of wisdom teacher, theologian, suffering servant and inspired author.

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## English

### Why are South Africans afraid of tokoloshes?

The research of Ms Molly Brown into fantasy and its importance for child readers received international recognition when an article was published in *The Lion and the Unicorn*, the prestigious children's literature journal of The Johns Hopkins University Press. In this article – "Why are South Africans afraid of tokoloshes?" – Ms Brown attempts to explain why so little fantasy has been produced for older children by South African authors. She finds that social factors such as religious conservatism and classical capitalist values, both of which were identified by Ursula le Guin as inhibiting responses to fantasy in the USA 40 years ago, may still be operating in South Africa today. She goes on to argue that destructive cultural schisms may have done even more to inhibit the development of South African fantasy since the heightened racial sensibilities characterising South Africa also complicate any attempt by white writers to make creative use of indigenous folklore lest

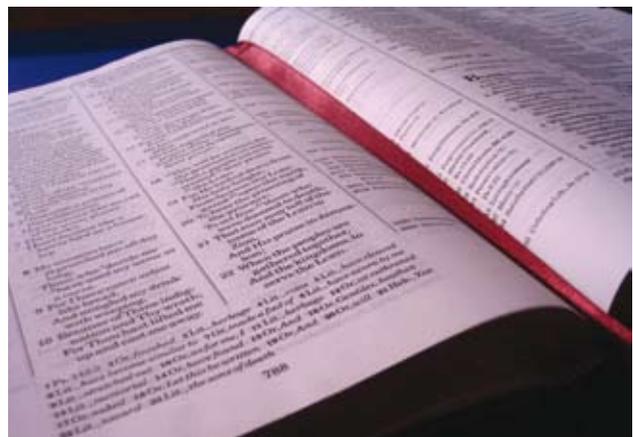
they become vulnerable to charges of literary colonialism, the forcible seizure of tropes and figures belonging by right to others. Ms Brown suggests that reading fantasy should not be viewed simply as an escapist activity, since reading examples of truly indigenous fantasy may contribute to cultural healing by enabling children from post-colonial societies to regain an awareness of and pride in their own stories and in the societies that produced them.

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## Unit for Creative Writing

### The pen and the couch

The aim of this research project, entitled *The pen and the couch: narrative therapy and creative writing within the South African context*, was to examine alternative therapeutic methods, specifically within the South African context. The researchers studied postmodern, discourse-based therapy, which focuses on re-storying life experiences and the therapeutic benefits of creative writing. They linked these qualities to the narrative therapy process, as well as to the use of narrative therapy in the South African context, specifically with regard to HIV/AIDS, as well as the correctional system. The researchers found that although narrative therapy is a relatively new therapeutic method, it provides possible alternatives to the more traditional forms of therapy. The process of re-storying negative experiences into more positive, if not triumphant ones, as well as the concept of separating the problem from the client, serves to aid individuals going through the therapy process. Rather than being inextricably involved in the problem, the person can step away from it in order to negotiate new meanings for him-/herself. Creative writing is essentially a process of structuring ideas into a recognisable narrative format, and has inherent therapeutic benefits of its own. When adopting a narrative therapy or creative writing partnership, new possibilities for therapy arise. People can write down their problems into a recognisable narrative structure, facilitated by the therapist, with the clear aim of re-storying their negative experiences. A record is formed, be it through diary entries, autobiographical essays or poems, which can be referred to for the duration of



The biblical book of Psalms is a literary composition.



the therapy in order to note the emergence of positive stories. In terms of illiteracy in South Africa, the researchers found that narrative theatre, together with a creative writing or narrative therapy partnership, can be of great therapeutic benefit for individuals who cannot read or write. Instead, they would tell their story to a facilitator who would rework it into a performable structure, which the individual could view. HIV/AIDS in South Africa is a crisis, which needs to be addressed as widely and as creatively as possible to provide alternative methods that may assist the medical field. This project underlined the importance of a mind shift to include collaborative therapies. Because of the illiteracy in South Africa, persons with HIV/AIDS were encouraged to look beyond their illness and view their lives more holistically. Furthermore, the value of a narrative creative writing partnership in work with incarcerated people is illustrated. Findings also indicated that the convergence between the two disciplines is a viable collaboration and it is hoped that this type of alternative partnership will spark more varied collaborative projects in South Africa.

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## Anthropology and Archaeology

### Mapungubwe

One of the major highlights of the Department of Anthropology and Archaeology was the linking of research on the world heritage cultural landscape of Mapungubwe with the engagement of communities, mainly Venda, in matters to do with the repatriation of material remains excavated from this and other nearby sites by the University. Narratives about Mapungubwe were collected from communities and staged as a performance in collaboration with the University's departments of Drama and Architecture. The project harvested stories and mythologies that are told about Mapungubwe and presented these as intersecting narratives that floated over the 'hard' archaeological evidence of the site. Live performance, archaeological material, visual (still and video) material and sound recordings were presented simultaneously in order to construct a multisensory, multimedia and multinarrative event. The performance was supported by video recordings of storytellers from the region, as well as by photographs, spoken translations and written texts. The performance included narratives spoken in various Southern African languages. These narratives were based on interviews with self-identified Mapungubwe descendants and were filmed in the Mapungubwe cultural landscape. The performance was staged in the Old Arts Building and entrance



A performance of Mapungubwe's story included narratives based on interviews with descendants from Mapungubwe.



was free. This is an extension of a research project entitled *Urban landscape dynamics* that was conducted in partnership with the Department of African and Comparative Archaeology and Ancient History of the University of Uppsala, Sweden. The aim of this project was to understand the rise of complex societies in the middle of the Limpopo Valley during the early first millennium AD.

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## Historical and Heritage Studies

### Historical dictionary of the Anglo-Boer War

Prof Fransjohan Pretorius, a renowned Anglo-Boer War expert, undertook a research project at the request of the American publisher, Scarecrow Press, on the Anglo-Boer War. His research culminated in the publication of a book entitled *Historical dictionary of the Anglo-Boer War*. The devastating war that raged on the South African veld between 1899 and 1902 – the first of the 20<sup>th</sup>-century wars – was small in comparison with the world wars. Yet, it revealed many military, political and social issues. The conflict between the British Empire and the Boer settlers was in many ways a precursor to what was to come. It saw vast changes in the organisation, tactics and weapons used by the British army. It had far-reaching effects on the white political structure in the country and stimulated Afrikaner nationalism, which, in its aggressive form half a century later, led to the introduction of apartheid. This dictionary presents the history of this war, which is also known as the South African War, the Boer War and the Transvaal War. Topics include the involvement of black people in the war, the concentration camps, rebels, great personalities, volunteers or repatriation and compensation after the war.

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## Philosophy

### Friedrich Nietzsche's ethics of virtue

The aim of this research project, entitled *Overcoming resentment: remarks on the supra-moral ethic of Nietzsche and Hannah Arendt*, was to explore some points of convergence between these two thinkers. The research found that both these philosophers consider a truly ethical or virtuous life to be one that displays strength of character and generosity of spirit (magnanimity). Hence, their basic concern is to devise strategies to overcome resentment. Despite mutual differences regarding such strategies (notably with regard to the importance or unimportance of the political), they both agree that overcoming resentment means first and foremost freeing oneself from the grip of the moralistic and egalitarian view of life. Moral sentiments such as pity and compassion should never be taken as the spring or fountainhead of virtue. When moral attitudes and issues such as social injustice and inequality are allowed to dominate public life, this will inevitably lead to the destruction of the basic conditions for a life of freedom and virtue, that is, a life characterised by excellent, virtuous action.

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### Ethics as the everyday business of business

In recent years, a succession of corporate scandals has rocked the international business community. As a result, many companies have invested considerable time, money and effort in developing ethics management programmes. However, in many cases, such programmes are nothing more than insurance policies against corporate liability, designed merely to limit the fallout of scandals, should they occur. Dr Mollie Painter-Morland conducted a research project entitled *In business ethics as practice*. She redefines the typical seven-step ethics management programmes from within, challenging the reader to reconsider what is possible in each aspect of this process. In doing so, she draws on the insights of Aristotle, Nietzsche, Heidegger, Foucault and numerous contemporary organisational theorists and sociologists to create the space for the emergence of a morally responsive corporate ethos. The main thrust of the argument is that moral decisions do not result from deliberate 'rational' ethical decision-making. Instead, it is the result of tacit knowledge

that emerges over time in interaction with others in a specific organisational context. Since much of what informs ethics in organisations relates to knowledge and beliefs that people may not even know they have, ethics training that seeks to draw on explicitly stated principles and deliberate decision-making strategies has little effect. Instead, one has to engage people's tacit belief systems and involve them as embodied, emotional and relational beings. Most importantly, one has to develop a keen eye for the value orientations that emerge in the everyday practices of organisations. The existence of certain rituals, artifacts, heroes, budgets, performance management systems and perceptions of success play a much more important role in an organisation's ethics than its formal code of conduct.

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## Political Science

### Migration experiences

The aim of this research project was to study the migration experiences of Asia and Southern Africa under the themes of brain-drain migration, illegal migration, xenophobia, and the political and economic impact of such population movements on both sending and receiving states in Asia and Southern Africa. Migration is often viewed as a double-edged sword. On the one hand, migration could be a positive force, as it creates subregional stability, alleviates poverty and contributes to the overall development of the Southern African Development Community (SADC). On the other hand, skilled migration (or the brain drain) could also have negative impacts (to varying degrees) on the development of national economies and the ability of governments to provide essential services to the poor. The importance of the nexus between migration and the economic wellbeing of economies makes SADC extremely vulnerable. The rationale for the capitalist global market is to attract those who possess superior skills and knowledge, whether they are from South Africa or Swaziland. The researchers found that although there is a lack of data on migration in the region, a preliminary cost-benefit analysis revealed that SADC members are losing skilled migrants at a huge cost. It is therefore argued that SADC members have to actively intervene in order to create conditions that would retain potential skilled migrants.

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## Sociology

### Sustainable and credible land restitution

A key challenge facing the post-apartheid South African democratic state in meeting the expectations of rural communities dispossessed in the past as a direct result of apartheid is the question of land restitution. Moreover, in a country where high-quality arable land is scarce,

sustainable land restitution becomes perhaps even more pressing. During the first half of 2008, the Department of Sociology conducted baseline surveys in three communities in Limpopo, KwaZulu-Natal and the Western Cape, which have benefited from the restitution process. The purpose of the baseline surveys was to provide a community profile and to establish people's existing perceptions on credible land restitution and land usage in these beneficiary communities. This data is meant to enable leadership in planning on how the restituted land should be developed. The researchers made a number of findings. All three communities have a youthful population structure, with an indication of a growing number of aged residents, suggesting that sustained expenditure on social services will be required. There is limited commercial farming activity in these communities. Where subsistence farming activity is undertaken, capital and labour are required. This relieves pressure on limited resources by providing produce for consumption. Overall, households are primarily dependent on cash income for subsistence. The level of income is low. Access to social grants is a key source of income for most households in a context where employment opportunities are very limited locally. The majority of the economically active are geared towards seeking employment, but levels of migrant labour remain low and many generate an income through informal economic activity. It is clear that a significant number of households face serious economic hardship that makes surviving in everyday life immensely difficult. Social grants cushion some of the vulnerability imposed by a deteriorating socio-economic context. The pressures of impoverishment and a high level of unemployment influence individuals' expectations around how the land returned to the community should be used. Participation by members of the community in the process of land restitution has been extremely poor so far. Community involvement in this regard is not being helped by divisive tensions that have developed. Expectations for a better life are high and the government retains a degree of goodwill. Failure to address growing needs holds the possibility that frustrations may be vented.

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## Biokinetics, Sport and Leisure Sciences

### Sport psychological skills training and psychological wellbeing

The impact of psychological skills training (PST) package programmes on life, health and wellbeing in general, and the South African youth in particular, has been relatively neglected. For example, prior to this research, the impact of PST on the core health component of psychological wellbeing had not been evaluated, nor had the conceptual and/or empirical relationship between psychological skills and psychological wellbeing been investigated. While PST is often conducted individually due to its personal and specific nature, group training should not be overlooked, especially in South Africa, where community interventions are an important part of health promotion. Psychological wellbeing has undergone extensive

empirical review and evaluation over the last two decades. Theoretically and conceptually grounded on the work of researchers such as Gordon Allport, Charlotte Buhler, Marie Jahoda, Carl Jung, Erick Erikson, Abraham Maslow, Bernice Neugarten and Carl Rogers, as well as additional more meaningful connotations of 'eudomonia', such as realising potential through some form of struggle, and the research of Ryff (1989) have brought about a shift in focus from a subjective to an objective conception of psychological wellbeing. This has resulted in the development of a new objective psychological wellbeing measurement, with the following components: autonomy, personal growth, environmental mastery, purpose of life, positive relations with others and self-acceptance. When unpacked, these components and psychological skills components of arousal, mental imagery attention and concentration, self-confidence, goal-setting and motivation appear to overlap. With these considerations in mind, a triangulated design that involves individual, group and community interventions, as well as elite and expert case studies, was utilised to evaluate the effectiveness of a PST programme and to investigate the relationship between psychological skills and psychological wellbeing. Results based on quantitative and qualitative outcome and process measurements indicated general improvement in psychological skills, psychological wellbeing and sporting performance. Psychological skills and psychological wellbeing were found to be interrelated concepts with overlapping components.

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### Emotional appraisals during demanding times

This research study, entitled *The effect of therapeutic recreation activities on undergraduate students' appraisals of their emotions during academically demanding times*, was a joint project between the Department of Biokinetics, Sport and Leisure Sciences and the Department of Social Work and Criminology. Student Support Services identified stress management as one of the life skills that first-year students lack. Participation in physical activity decreases over the life span. By the age of 21, only 42 percent of males and 30 percent of females report participating in vigorous physical activity on a regular basis. This level of physical activity can be modified by behavioural interventions. Exercise not only improves physical health, but also decreases depression and anxiety and improves mood state, self-esteem and body image. The aim of the study was to determine whether participation in therapeutic recreation activities will have a positive effect on the stress management of university students during academically stressful times. The research design was quasi-experimental using a one-group pre-test/post-test design. The groups and the recreation sessions were presented. The measuring instruments for the pre-test and the post-test were the Leisure-Time Exercise Questionnaire and the Positive and Negative Affect Scale (PANAS). The results of the measurement indicated that the students showed a significant increase on all levels of activity, be it mild, moderate or strenuous. The therapeutic recreation intervention and the group intervention led to an increase in physical activities and thus improved healthy behaviour. This is



A study determined the incidence of stress fractures during basic training.

important, as the impact of therapeutic recreation and skills on stress and time management can be used to generate active lifestyles in the student community.

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### Stress fractures sustained by soldiers during basic training

Stress fractures represent one of the most common and serious overuse injuries in the military environment. The aim of this research project was to determine the incidence of stress fractures during the 12 weeks of basic training, and to compare the results of the intrinsic risk indicators obtained from the group of participants who suffered stress fractures with the rest of the original group (control group) who did not suffer from any stress fractures. In addition, the researchers assessed changes in physical markers, while following a progressive, scientifically designed physical training (PT) programme during basic training. The cohort (n=183) was measured at the beginning and at the end of the basic training period. The standardised physical fitness test was completed in the fifth week of training. These results were compared with the results obtained by a control group that had undergone basic training

the year prior to this cohort. The size of the cohort, the intrinsic risk factor profile and the control of certain extrinsic risk factors may have contributed to the zero incidences of stress fractures found. Within the intrinsic risk factor profile, sex, age, race, foot morphology, Q-angle, hip external rotation and bone density were normal, while the measured leg discrepancy and limited ankle dorsiflexion did not appear to have a sufficient risk for the development of stress fractures. The small sample of the cohort that reported menstrual irregularities, smoked and had a history of previous fractures did not place this cohort at risk for the development of stress fractures. The cohort had lower isotonic, isokinetic and isometric strengths than the other cohorts who reported a relatively high incidence of stress fractures. The basic training period found statistically significant changes in bone density, flexibility, body composition, muscle strength and endurance. The female participants showed an increase in the T-score and Z-score of the left femur area, a deterioration in left ankle dorsiflexion and hip external rotation, while their plantarflexion increased. Their mesomorph component increased, and decreases in their percentage body fat, as well as in the ectomorph and endomorph component, were also found. The male participants' plantarflexion and hip external rotation decreased, while their dorsiflexion improved. Their lean body mass and mesomorph component increased, while their percentage body fat, as well as their ectomorph and endomorph component, decreased. The new cyclic-progressive PT programme controlled risk of injury by allowing sufficient periods of recovery by gradually increasing the duration, frequency and intensity of training, by reducing repetitive weight-bearing activities and by including a variation of exercises. Running shoes, rather than combat boots, were also worn during PT, while marching on concrete was eliminated. Significant improvements were shown by both the male and female participants in aerobic fitness, and muscular endurance and strength. Future research should include a larger cohort who developed stress fractures utilising basic training groups from different corps and units in the South African military environment. Other potential extrinsic risk factors, such as surface and equipment, should also be investigated.

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## Communication Pathology

### The problem of infant hearing loss in South Africa

Approximately 2 000 babies are born daily with permanent bilateral hearing loss or acquire it in their first few weeks of life. At least 90 percent of these babies reside in developing countries like South Africa. Undetectable by routine clinical

examination, infant hearing loss is only identified after critical developmental periods for language acquisition have passed if screening is not provided. The far-reaching effect of late identification is evident in poor linguistic, cognitive and socioemotional development, which undermines literacy skills, academic achievement and ultimately educational and vocational outcomes. Fortunately, unlike many other congenital or early-onset disabilities, infants with hearing loss have the prospect of excellent outcomes that potentially match those of their hearing peers, provided the loss is identified early and intervention initiated by six to nine months of age. This has led to the widespread implementation of universal screening programmes in countries like the USA and the UK, where more than 95 percent of all newborns are screened for hearing loss to ensure that those with hearing loss are provided the opportunity to develop to their maximum potential alongside their hearing peers. Prof De Wet Swanepoel has been at the forefront of investigating infant hearing loss in South Africa. His research endeavours in this field have included the extent and impact of infant hearing loss and the status of early detection and intervention services in South Africa. A recently published article reported the first national survey of early detection services in the public health care sector of South Africa, which serves 85 percent of the population. Results indicated that less than 10 percent of infants in South Africa have any prospect of having their hearing screened at or shortly after birth. A follow-up study is underway to survey such services in the private health care sector. Pilot studies are also underway to assess contextual infant hearing screening models in the South African health care context, including a clinical trial of a promising screening device and a screening programme implemented at primary health care clinics where the screening is scheduled to coincide with the six-week immunisation visit. These research projects are part of a larger endeavour to provide contextual answers to the problem of infant hearing loss in South Africa so that optimal outcomes may be assured for all.

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## Psychology

### Serithi project

More than 600 pregnant patients with HIV from the Atteridgeville and Mamelodi antenatal clinics took part in the Serithi project. They joined the study shortly after they were diagnosed. Their involvement ended when their children reached the age of two. The aim of the study was to follow the progression of the disease, its influence on nutrition, the psychological impact, the experience of stigma and the impact of a support intervention. Women's experiences of stigma, depression, social support and coping were studied, as well as the levels of disclosure of their HIV status. Additionally, a community survey involving 1 077 participants was done to assess the level of stigma in the communities from which the women originated, and to compare the experiences of different groups. The research made a number of findings, among others that 43 percent of the women experienced high levels of depression after diagnosis.

One third of the women in the cohort had not disclosed their HIV status to their partners three months after diagnosis. Women who felt stigmatised reported a history of violence, used avoidance coping and were less likely to disclose their status. Women with HIV experienced the level of stigma much worse than others in their community. They did not experience high levels of enacted stigma. On the contrary, after disclosing their status, most of the women experienced acceptance from family members, although a few experienced serious adverse consequences, such as being abandoned by their partners (2.3 percent), being physically hurt (1.7 percent) and threatened to be killed (1.2 percent). Over time, women coped better with their diagnosis and experienced less stigma. An interesting finding was that the stigma the community attached to HIV might be decreasing as the epidemic develops over time and people become more knowledgeable about HIV and get to know more people with HIV. The HIV support intervention was found to be effective to enhance women's active coping strategies and level of disclosure, compared to a similar control group that did not participate in the intervention. Support groups can therefore contribute to women's psychological wellbeing. The findings of the study were used to develop an intervention for HIV-positive women. The intervention involved 150 HIV-positive women who each attended ten weekly group sessions as part of an experimental design to evaluate the effectiveness of the intervention. The intervention was found to be effective to enhance women's active coping strategies and level of disclosure, compared to a similar control group that did not participate in the intervention.

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## Social Work and Criminology

### The sexual assault and rape of male offenders

In this study, the nature and extent of sexual assault and the rape of male sentenced offenders and detainees awaiting trial were investigated. Prison gangs, the overcrowding of correctional centres, the involvement of correctional officials and the sexual orientation of potential victims were highlighted as risk factors in the sexual assault and rape of male offenders and detainees awaiting trial. In order to obtain in-depth information on the research participants' experiences of sexual activities and rape in the correctional centre, face-to-face structured interviews were conducted with 100 research participants. After the analysis and interpretation of the data, it became evident that male-on-male sexual activities occurred in the correctional centre. The researcher found that the reasons given for the rape included the fact that an agreement could not be reached between the inmates, as well as corruption by correctional officials, the involvement of prison gangs and deception by the perpetrators. Six research participants revealed that they had been victims of rape. All the victims were raped within days or weeks of their arrival at the correctional centre. Five of the research participants reported that they had sexually assaulted and/or raped other inmates. Four of the perpetrators were awaiting trial for an aggressive offence (armed robbery) and one for a sexual offence (rape). The perpetrators forced their victims

to engage in oral sex, interfemoral sex and anal sex. Based on the feedback of the participants, as well as existing literature on the subject, the researcher developed an Offender Sexual Protocol, which can be used by the Department of Correctional Services to reduce and manage sexual assault and rape in male correctional facilities.

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### Continuous Professional Development Policy for social workers

The aim of the research project was to evaluate the appropriateness and feasibility of the draft Continuous Professional Development (CPD) Policy of 2004. The objective of this draft policy is to enable social workers and social auxiliary workers to participate in continuous professional development that would ensure a skilled, empowered, professional cadre of workers and, accordingly, make amendments in order to pave the way for the compulsory implementation of CPD. The South African Council of the Social Service Profession (SACSSP) decided, in principle, to implement a CPD system for all professionals registered with the council in 2001. The eighth draft CPD policy was implemented as a pilot project in January 2004. A quantitative study was done in the two pilot provinces: Gauteng (urban) and the Northern Cape (rural). Research findings indicated that similar issues prevail in both provinces with regard to CPD challenges; the challenges are just more intensely experienced in rural areas. The most significant purposes of CPD were indicated as education and development, improved and quality service delivery, self-development and building confidence, support and networking. The research findings indicated that the attendance of CPD activities is influenced by external factors such as the role of the employer, an enabling working environment and financial support for CPD activities. The accumulation of CPD should take various factors into account, including the accessibility of CPD activities, a mixture of group and individual activities, the nature of employment, the credits per hour (that is, per hour vs range according to level of participation of the attendee), the number of points carried forward to the following year, and allowance of CPD activities on an annual basis. The need for effective communication media to inform the constituency on the availabilities was emphasised. In summary, the qualitative study confirmed the social work profession's commitment to CPD and that the principle of CPD recognition has been established. Social workers indicated that they were reluctant to attend activities if they were not CPD-linked. CPD enriches the scope of practice and hence enhances the professional status of the profession. CPD provides an opportunity to engage in professional decision-making. The qualitative research findings have been presented in all nine provinces where they were further debated. The research findings informed the final CPD policy, which is currently being disseminated for final consultation.

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## 6.6 Faculty of Law

In addition to its focus on undergraduate teaching, the Faculty of Law places a strong emphasis on research and postgraduate studies. Its research is aimed at enhancing the role and the rule of law in South Africa and on the African continent.

### Message from the Dean

The Faculty of Law sees itself as a research faculty, in line with the broader aspiration of the University of Pretoria to be regarded as a research university.

A number of initiatives were consolidated and introduced during 2008 in pursuit of this objective. A significant change was the reform of the LLM programme. The coursework master's programmes in the faculty now have a 50 percent research component. In addition to this, a structured LLD programme was designed, approved and funded, and the first students will start with their studies in 2009.

Innovation and continuing relevance in the areas of law that it covers and the appointment of experts to ensure renewal remain hallmarks of the faculty. The faculty received a significant sponsorship from the law firm Adams and Adams to establish a Chair and a Centre in Intellectual Property Law, one of the emerging areas of law. Prof Danny Bradlow, Director of the International Programme at the American University in Washington DC, was appointed as South African Research Chair in International Development Law and African Economic Relations. Dr Hespina Rukato, Deputy CEO of the New Partnership for Africa's Development (NEPAD), and Justine Limpitlaw, an expert on Space Law, were appointed in this unit. The faculty took transfer of a five-room house adjacent to the Law Building, which houses Prof Bradlow, together with his staff and students, as the International Development Law Unit.

The faculty secured a generous grant from the World Bank to strengthen two initiatives aimed at promoting the rule of law in Africa. The first is the *Law of Africa* Collection in the Oliver R Tambo Law Library, the most comprehensive collection of primary legal sources (legislation and law reports) of the 53 countries of Africa in the world under one roof today. The other is the Pretoria University Law Press (PULP), the publishing house of the faculty. During 2008, PULP produced 10 new publications, including a Portuguese translation of one of its earlier publications dealing with the African Union, which is available in French and Arabic in addition to the standard English edition.

The faculty continued to host a number of regular legal publications and brought out new editions of its accredited journals *De Jure* (including a third edition) and the *African Human Rights Law Journals*. The *Tydskrif vir Hedendaagse Romeins-Hollandse Reg* is edited from within the faculty. The same applies to the *African Human Rights Law Reports*, of which new editions were published in English and in French. The year also saw the launch of the *Pretoria*

*Student Law Review*, a student-run journal that publishes articles on the law and law reform that are written by students of the University of Pretoria, as well as other law faculties worldwide. A second edition of one of the major publications of the faculty, *Constitutional Law of South Africa*, was published. This encyclopaedic work – the most often cited source on the South African Constitution worldwide – is now also available online. Members of the Centre for Child Law launched a permanent volume called *Commentary on the Children's Act*. The centre also brought a large number of groundbreaking law suits dealing with the rights of children on all levels of the courts, including the Constitutional Court.

The faculty is responsible for the African coverage of the *Oxford International Law in Domestic Courts Reports* and is represented on its international editorial board. This is



Prof Christof Heyns, Dean



Law Building

a massive project that traces and comments on the extent to which international law is cited in any court in Africa.

The faculty entered into a privileged relationship with the Institute for Advanced Constitutional Law (SAIFAC) on Constitution Hill, which will help ensure that students have easy access to the proceedings of the Constitutional Court and to the expertise of the members of SAIFAC.

Prof Johan Scott and Prof André Boraine were nominated as exceptional academic achievers and Dr Stuart Woolman was nominated as an exceptional young researcher. Prof JMT (Lappies) Labuschagne (posthumously) and Prof Christof Heyns were included among the 100 academics who received awards as leading minds of the University of Pretoria during its first century. During 2008, research outputs in a wide range of areas of the law were produced in the form of books and accredited journal articles locally and overseas. Faculty members served on the editorial boards of a range of national and international publications.

The Centre for Human Rights was awarded one of ten research awards granted by the Geneva Academy of International Humanitarian Law and Human Rights to fund research projects commemorating the 60<sup>th</sup> anniversary of the Universal Declaration of Human Rights. The award enabled the centre's Gender Unit to conduct research on the reproductive rights of women living with HIV. The centre further embarked on a multidisciplinary research project on the xenophobic violence that broke out in Pretoria and many other parts of South Africa in 2008. The research team, consisting of a sociologist and legal experts, investigated the extent of the state's obligations against the background of pertinent issues raised during interviews with South African and non-South African nationals.

The AIDS and Human Rights Research Unit (a collaboration between the Centre for Human Rights and the Centre for the Study of AIDS) provided technical assistance to the Southern African Development Community Parliamentary Forum (SADC PF) in the drafting of a model law on HIV in Southern Africa. This model law was adopted on 24 November 2008 at the 24<sup>th</sup> plenary assembly of the SADC PF. Working with the Programme on Information Justice and Intellectual Property and the International Human Rights Clinic of the Washington College of Law (American University in Washington, USA), the unit further drafted and advocated for the adoption of a Resolution on the Right to Health and Access to Medicines by the African Commission on Human and Peoples' Rights. The African Commission adopted this resolution at its 44<sup>th</sup> session in November 2008. The unit also completed a compendium and electronic database of key documents relating to human rights and HIV in eastern and southern Africa.

Prof Christof Heyns  
Dean

## Research highlights

### Centre for Child Law

#### Publication of information arising from a divorce: protecting children's right to privacy

During May 2008, the Constitutional Court was asked to consider whether all information arising from a divorce may be disclosed to the public by the media. The dispute arose from a section in the Divorce Act (Act No 70 of 1979), which stated that the names of the parties to a divorce may be published, but no other facts arising from the divorce. Johncom Media Ltd successfully argued that this prohibition on publication unreasonably and unjustifiably infringed on the right to freedom of expression. At the Constitutional Court stage, the Centre for Child Law represented the Media Monitoring Project as *amicus curiae*. It was accepted that the prohibition on publication in the Divorce Act was too broad and infringed on the right to freedom of expression. Newspapers and other media fulfil an essential function in providing the public with information on how the legal system works, especially on recent developments in the law. It is also in the public interest that the law is seen to be done. The research team's concern was that a complete removal of the offending prohibition on publication would leave children in a vulnerable situation. Divorce papers frequently include in-depth psychological assessments with extremely personal information about the children and details on alleged sexual or physical abuse. If the offending section is removed without replacing it with some other safeguards, information that may be extremely embarrassing for children may come to light and will be in the public domain. The team conducted extensive comparative research to determine how other countries have dealt with this problem. They also studied the international law in this field. Children's right to privacy in the media is recognised internationally in the guidelines on reporting on children of both the International Federation of Journalists and the United Nations Children's Fund (Unicef).



The OR Tambo Law Library is a valuable resource for research.

The guidelines state that children have an absolute right to privacy. Comparative research showed that there is an established practice in various democratic jurisdictions to place a restriction on the publication of any information that may identify a child who may be affected by or is the subject of court proceedings, including New Zealand, Australia, Canada and the United Kingdom. Other information that may come to light during court matters may be published as long as the child concerned cannot be identified by the information. When a child is found to be in need of care and is taken into state care, all proceedings in respect of that child is confidential and the child's privacy is protected by legislation. A child's identity and privacy is also protected at all stages of a criminal trial when the child is the accused. In each instance, the prohibition on publication allows the judge or magistrate to lift or limit the prohibition. Based on their international and comparative research and analysis of current law, the researchers submitted in the Constitutional Court that publication of all information arising from a divorce should be allowed, except the identities of any of the parties involved. In this way, the public remains informed about important legal developments, while the child's right to privacy remains protected.

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### Parental responsibilities and rights

The aim of this research project, *The exclusive jurisdiction of the high court on the guardianship aspect of parental responsibilities and rights: a missed opportunity for effective reform*, was to explore the importance of the aspect of guardianship in relation to children: how the exclusivity of the jurisdiction of the high courts will affect children, the

possible reasons for the exclusive jurisdiction and what remedy would be appropriate to address this matter. Once the whole of the Children's Act (Act No 38 of 2005), comes into operation, the parental responsibilities and rights of care and contact will be able to be awarded and terminated under the jurisdiction of the high court, divorce courts and children's courts. Allowing children's courts to hear care and contact proceedings, previously referred to as custody and access, is an innovation introduced by the Children's Act. However, the Children's Act left the jurisdiction in matters relating to the parental responsibility and right of guardianship exclusively to the high courts, which the researcher views as a missed opportunity to reform. It is not in line with the overall aim of the Children's Act, which is to make courts accessible, since children's courts are located in all magistrate's courts and are therefore easily accessible – geographically and financially – to communities. The researcher recommended that all sections in the Children's Act that provide for the exclusive jurisdiction of the high court with regard to guardianship should be amended. Guardianship must, as will be the case with the parental responsibilities and rights of care and contact, be adjudicated in the children's court. The high court will retain its jurisdiction, but it will not be exclusive.

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### Children's living conditions in South Africa

The South African government's policies and laws were examined in this research project to determine the extent to which children's socioeconomic rights are being met through provisions aimed at improving the living conditions of the poorest children. The developing jurisprudence arising from



South Africa's legislation was examined to determine to what extent provisions aimed at improving the living conditions of the poorest children were effective.

the constitutional guarantees on socio-economic rights for children was examined. The Constitutional Court judgment of *Grootboom*, handed down in 2000, was initially met with disappointment by the children's rights movement. The subsequent 2002 judgment in the *Treatment Action Campaign* case revived hope. A key question arising from these two landmark Constitutional Court judgments is whether children have a direct and immediate claim to have their socio-economic rights met. Is their claim, like the claim of adults, to be subjected to progressive realisation? Dr Ann Skelton explored the jurisprudence that was developed regarding the socio-economic rights of children living with their parents and those who are separated from their parents, as well as how far the courts will go in directing the executive to deliver on the socio-economic rights of children. She presented her findings at the Children in Danger Conference, which was held at Oxford University in the United Kingdom in July 2008. She found that the Constitutional Court in South Africa views all rights as justiciable, including socio-economic rights, and that the court is prepared to examine the state's role in respecting, protecting, promoting and fulfilling its obligations. Although on a plain reading, section 28(1)(c) of the Constitution appears to provide for unqualified access to socioeconomic rights by children, the Constitutional Court has read this in the context of section 26 and 27 socio-economic rights, which are subject to progressive realisation. In the *Grootboom* case, the Constitutional Court's view was that children who are living with their parents must look to their parents for housing. The state only has the obligation in the alternative to provide shelter when, for example, children are removed from their families. In addition, the state has the responsibility to ensure a regulatory and practice environment that allows for the fulfilment of rights, and has a responsibility to deliver on section 26 and 27 rights to all people (including children living with their families) on the basis of progressive realisation. In the *Treatment Action Campaign* case, the court broadened the scope of the state's duties to include situations where children were not physically separated from their parents, but also when "the implementation of the right to parental or family care is lacking". The position of children living apart from their parents has been viewed differently by the courts. Two high courts have ruled that they have a direct and immediately enforceable right to have their socio-economic needs met. Although this has yet to be tested in the Constitutional Court, it seems to be a logical corollary to their statements about the duties of the state to provide socioeconomic rights in the alternative, for example, when children have been separated from their parents, or where such care is 'lacking'. The jurisprudence will no doubt continue to develop, perhaps in the future reaping greater socio-economic results for children. In the meantime, the government will have to keep its policy and legislative promises and the new legislation will have to be effectively implemented if the living conditions of children in South Africa are to improve.

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## Centre for Human Rights

### Protecting the rights of sexual minorities in Africa

The Centre for Human Rights conducted a study on the potential and actual relevance of international human rights law and domestic law for the protection of the rights of sexual minorities in African countries south of the Sahara. The study was conducted on behalf of the Office of the High Commissioner for Human Rights. Information was collected by way of desktop research and on-site visits to four countries: Mozambique, Kenya, Cameroon and Côte d'Ivoire. The researchers found that violations against members of sexual minority groups occur on an extensive scale in the region. The major claims of sexual minorities bring into play the governments' duty to protect and respect their rights. At a minimum, sexual minorities demand protection from the state against the numerous and often violent violations of their rights by other individuals. The study recommends that governments must protect the rights of sexual minorities. There must not only be effective prosecution of crimes committed by non-state actors against gays, lesbians, bisexuals and transgender persons, but also meaningful efforts to sensitise the population to the plight of sexual minorities. Politicians should refrain from exploiting popular intolerance to gain support. Anti-discrimination laws and effective enforcement of these laws should be put in place and existing laws should be applied without bias.

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### Religion, law and human rights in Zimbabwe

In this study, the researcher examined key issues such as the legal framework in place for the protection of freedom of conscience, including court jurisprudence, the religious demography of Zimbabwe, and the place of religion in politics, education and the Zimbabwean lifestyle. It also scrutinises the co-existence of ideologically antagonistic practices, such as Pentecostal Christianity versus indigenous beliefs and practices. The researcher argues that the subject of religion is not a sensitive one in Zimbabwe. Hence, it does not easily occur in political or general debates. Drawing from his own experiences, he concludes that, apart from looking after spiritual needs, churches play a significant role in subsidising the state's obligations in the provision of socio-economic rights such as health, education and food. For this reason, churches have an important place in national politics as partners in development.

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## Sexual offences legislation in Southern Africa

The researcher presented the findings of her research project on sexual offences legislation in Southern Africa at the United Nations Division for the Advancement of Women expert group meeting in Vienna in May 2008. The aim of this meeting was to analyse different approaches in the law for addressing all forms of violence against women, with particular attention to experiences in different legal systems and the scope of such legislation, to assess lessons learned in the implementation of legislation on violence against women, with particular attention to effectiveness of legislation, legislative reforms over time, the reasons for such reforms, and methodologies for evaluating the effectiveness of legislative frameworks, and to identify good practices in the law and recommended standards for legislation on violence against women, with particular attention to different forms of violence against women. In her paper, she highlighted the key features of sexual offences legislation in South Africa, Lesotho, Namibia, Swaziland, Zimbabwe and Tanzania, including the definition of rape, the inclusion, or lack thereof, of rape in marriage as an offence, compulsory HIV testing of accused sexual offenders, sentencing and legislated care for survivors. She found that the majority of states in the Southern African Development Community (SADC) do not have specific sexual offences legislation, despite obligations in international law. This discords with the pervasiveness of sexual violence in the region. While the limitations of the law, with respect to violence against women in particular, are recognised, the enactment of respective legislation is not least an international human rights obligation of states; moreover, it is a necessary step in the creation of an enabling framework for the promotion and protection of women's rights. States must move beyond inaction and tolerance for sexual violence, especially in the face of the HIV pandemic in Southern Africa. The struggle against gender inequality and all its manifestations, of which sexual violence is one, must move from the rhetoric of policy into law, providing not only for punitive measures for perpetrators, but for protection and remedies for survivors. The laws should be guided by international human rights norms, including General Recommendation 19 of the Committee on the Elimination of Discrimination against Women (CEDAW), the Beijing Platform for Action and the African Women's Rights Protocol, all of which identify comprehensive measures, including legislation, to be taken by states with respect to violence against women. Campaigns for the universal ratification of the Women's Rights Protocol within SADC must continue with vigour. While new legislation provides an opportunity to address HIV in relation to sexual violence, the implications of HIV-related provisions in law must be well considered and guided by international human rights norms, with the best interests of the survivor at the forefront of each intervention. Compulsory testing and consideration of HIV as an aggravating factor in sentencing should not be replicated as best practice. Provision of post-exposure prophylaxis (PEP), on the other hand, at state expense, is promising in the South African model, but needs to be amended to remove limitations and should be improved upon by those states yet to enact laws on sexual offences. It also needs to be accompanied by a comprehensive package of care. The

absence of a legislative framework that comprehensively addresses violence against women in Southern Africa sends a message of tolerance for crimes that perpetuate gender inequality.

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## The African Peer Review Mechanism: the first reviews and the way forward

The aim of this research project was to provide a tentative analysis of the process on how the African Peer Review Mechanism (APRM) can fulfil a complementary role with regard to the promotion and protection of human rights in Africa. The aim of the APRM is to prompt states to draft a national programme of action (PoA) to remedy identified governance deficiencies. The review process takes place under the auspices of the African Union (AU) and its development framework, NEPAD. The researcher found that a weak feature in all the first country reports submitted to the panel for review is the fact that there is no correlation between the analysis in the report, the recommendations and the PoA. He recommended that the panel should assist in framing the issues in the PoA, but that a state should have the right to approach an issue differently from that suggested by the panel, as long as it explains the motivation behind the divergent approach. In addition, the reports also display a lack of consistency. Ideally, to allow for easy comparison, the same issues should be dealt with under the same objective. It is essential that the PoA becomes an integrated programme for change and not an à la carte wish list. The PoA should also be realistic. Recommendations by the panel on priorities in the PoA could be helpful both for the country under review and for international donors. Accuracy is very important in a process of this nature. Unfortunately, self-assessments, country review report findings, panel recommendations and government responses include sweeping statements that, on close scrutiny, sometimes turn out to be questionable and occasionally wrong. In terms of human rights, the researcher



An analysis of the African Peer Review Mechanism identified participation as important for achieving its goals.

found that issues have been addressed to some extent in the country review reports. However, the lack of a human rights focus in the self-assessment could influence a lack of such a focus in the country review report. This lack of human rights perspective follows from the emphasis on self-assessment in the APRM process. Improvements in approach would include a greater reliance on human rights standards and principles in devising proposed actions to deal with identified problems. International human rights norms could also be relied on to define the indicators to measure progress in the PoA. It should be noted that the APRM process, both in its analysis and in actions to remedy deficiencies, relies heavily on formal institutions. Not much attention is given to the important role that informal institutions play in Africa. The APRM framework documents identify participation as an important factor in achieving the goals of the process. For effective participation, there is a need for a free and strong national civil society.

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## Procedural Law

### Unexecuted contract or merely a stay of execution?

In this project, the researchers dealt with the notion of an unexecuted sale in execution and its consequences in a subsequent sequestration of the judgment debtor's estate. They focused on two aspects: the position of the sheriff, the trustee and the purchaser of immovable property with regard to the execution procedure after the sequestration of the estate of the judgment debtor, more specifically regarding the treatment of unexecuted pre-sequestration sales after sequestration, with a few comparative remarks regarding the same position following winding up, and the effect of the transfer of immovable property subsequent to sequestration in terms of an unexecuted pre-sequestration sale in execution. They used *Warricker v Senekal* for their case study. In this case, the Sheriff of the High Court (Brits) conducted the sale of a property. The purchaser paid the deposit over to the sheriff. The terms and conditions of the sale included a surety clause whereby a director of the purchaser bound himself as surety. He signed the conditions of sale on behalf of the purchaser with full knowledge of the surety clause. In the conditions of sale, the sheriff described himself merely by his office, without stating specifically who had sold the property. It was evident that the property had been sold pursuant to a sale in execution. The estate of the judgment debtor was provisionally sequestrated. The plaintiffs applied to the Master of the High Court for permission to sell the property. However, the sheriff allowed the property to be sold in execution prior to sequestration, to be transferred after sequestration without the court's consent. In addition, he paid the deposit over to the trustees, but the balance of the purchase price was not collected from the purchaser. The trustees subsequently sued the defendant for the balance of the purchase price because he had bound himself as surety. The trustees attempted to claim the balance of the purchase

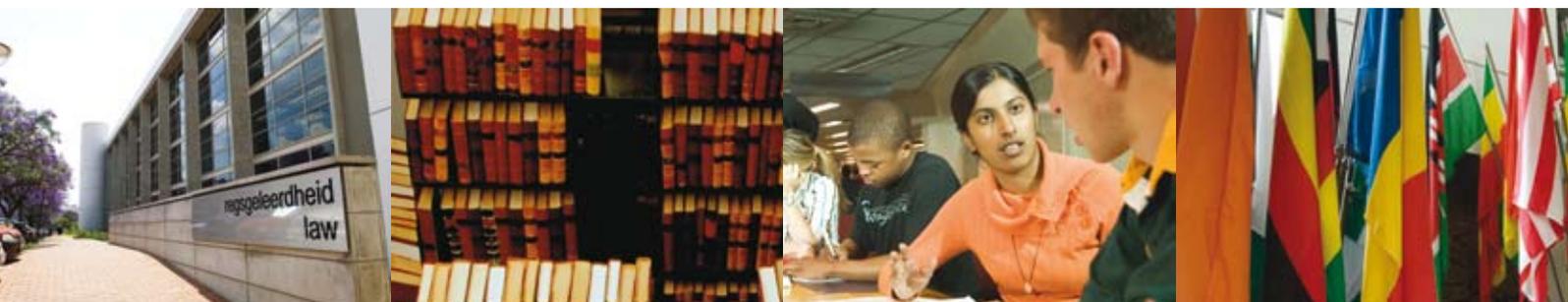


Ms Carina du Toit (left) and Dr Ann Skelton conduct research that plays a role in the courts of the country.

price from the surety even though the sheriff had sold the property on behalf of the judgment creditor and affected transfer after sequestration into the name of the purchaser. The court ruled that the execution procedure, including the sale, was stayed as from the moment of sequestration and this procedure could only proceed with the consent of the court. Therefore, the trustees did not take over the obligations of the sheriff regarding the sale in execution and had no locus standi to claim the balance of the purchase price. The researchers found that this area of insolvency law should be reformed, and recommended that the construction of the treatment of 'unexecuted' in insolvency law should be used as a basis for such reform.

### The reform of administration orders

The Department of Justice and Constitutional Development commissioned the Centre for Advanced Corporate and Insolvency Law (CACIL) to embark on a research project to identify ways to improve section 74 of the Magistrate's Courts Act. This section allows certain debtors, who are able to pay their debts, to apply for administrative orders. An administrative order can be described as a debt relief measure and, if an application is granted, it means that the



debtor must make regular payments to an administrator, who in turn is obliged to draw up a list of creditors and to pay them on behalf of the debtor. The researchers found that although this order has merit, it is often abused. The researchers made a number of recommendations to address problems associated with the process. A time limit for repayment of debts must be included in the act. International laws make provision for a three-year to five-year repayment schedule. The researchers recommended a ten-year period. The system of blacklisting practices by credit bureaus needs formal regulation. Debtor education needs to be introduced on a large scale. Financial institutions should create proper credit-rating systems. A national debt register should be introduced as soon as possible. Finally, alternative debt assistance services must be introduced.

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### National Credit Act: cancellation of instalment agreements

The former Credit Agreements Act contained specific provisions to deal with the cancellation of an instalment sale transaction. It also contained specific provisions that dealt with interim interdicts and attachments pending the cancellation procedures. The enforcement procedures of the National Credit Act (NCA) first of all need interpretation, whether they apply to cancellation at all. The researchers found that the enforcement procedures also apply to cancellation. Although the NCA is silent with regard to interim interdicts and attachments, it is the submission of the researchers that such relief can be applied where the actions of the consumer threaten the rights of the credit provider in the goods sold, as long as the request for interim relief is still based on the common law substantive principles. The NCA also provides, like its predecessor, for a type of notice before the debt enforcement procedure may ensue. However, different time periods are involved. The provision that prescribes certain conditions under which a court may not determine a debt enforcement procedure will cause difficulty in practice. The researchers found that it will become the duty of the parties to provide the required information to the court, but that the NCA is silent on the procedure to be followed in this respect. In addition, they found that the NCA affords equal protection to the consumer regarding the exercise of the contractual rights by a credit provider to cancel a credit agreement as

its immediate predecessor, the Credit Agreements Act. However, the provisions in the NCA that deal with this aspect are to some extent less clear than the repealed provisions and their judicial interpretation will have to be awaited.

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### Assessment methods used in clinical legal education programmes

Law clinics in South Africa were established in the early 1970s, mostly due to the political and social circumstances prevailing in the country at the time. It was only in the late 1980s and early 1990s that most universities began to recognise the academic value of these programmes and began to impose academic requirements for students participating in such courses. Several leading university law clinics began designing academic curricula and implementing assessment methods that are in line with university requirements. Accreditation as a course in a law faculty curriculum depended on summative assessment processes having been implemented. Assessment can be defined as taking a sample of what students do, making inferences and estimating the value of their actions. Selecting an appropriate assessment method is a crucial part of the students' learning process and is inextricably linked to what the desired outcomes of the programme is stated to be. Assessment methods must be valid and reliable. The researchers identified a need to determine the outcomes of the programme and then asked themselves if the assessment determined can actually measure the achievement of the objectives. Assessment purposes can be categorised as summative and formative. Summative assessment is used to measure the extent of learning. It is also used for grading purposes after completion of a piece of work or module. Formative assessment is used during the learning experience to provide feedback to students so that they have the opportunity to improve. Formative assessment methods are purely educational, and while they may be scored, they are not used to assign grades or rank students. As the clinical pedagogy demands a variety of skills to be taught in clinical legal education programmes, there is



no one assessment method that can be implemented to evaluate the skills learnt, but rather a series of methods. The researchers recommended that when considering which assessment methods to adopt, one should reflect on the goal and outcome design of each programme, the teaching methodology implemented, student numbers and the organisational structure of the clinic and its programme.

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### In search of sentencing guidelines for child rape: an analysis of minimum sentence legislation and case law

The aim of this research project was to consolidate local judgments (scattered over many years in different law reports), minimum sentence legislation and selected foreign practices in order to offer more readily accessible guidelines that will contribute to greater uniformity in the judicial approach during the sentencing process. These guidelines embrace general and specific principles, as well as relevant aggravating and mitigating factors, and are intended to guide the judicial officer in the exercise of his or her discretion. Sexual abuse of children includes the offences of rape and sexual assault, although guidelines may overlap. Child rape is an emotionally laden offence that courts increasingly have to deal with during a complex sentencing process. In contrast to the situation during the trial, in the sentencing phase, the judicial officer has to function in a quasi-inquisitorial way by taking on a central and active role. In addition, behavioural science – a discipline of which the judicial officer has little understanding – acquires greater importance in this phase. In the sentencing phase, the focus falls not only on issues regarding the motive of the accused, danger and degree of culpability, but also on issues relating to the impact of the crime on the victim. During sentencing, the court is required to consider whether a finding of substantial and compelling circumstances (in terms of section 51(3)(a) of the Criminal Law Amendment Act) could be made in order to deviate from the prescribed term of imprisonment and thereby avoid a grossly disproportionate sentence. Since the beginning of 2008, regional court magistrates have been authorised to impose life imprisonment, inter alia, in cases of rape involving children, and are therefore no longer required to refer such cases to the high court for sentencing purposes after conviction. Regional courts are thus required

to determine substantial and compelling circumstances and to subsequently grade these offences themselves. Notwithstanding the above developments, judicial discretion during sentencing (within the legal framework) has always been hailed as something to be jealously guarded and has been described as a crucial aspect of our law of sentencing. However, although it is accepted that this will have the effect that sentencing outcomes will/ may differ to a certain degree, judicial discretion has also given rise to unacceptable and unjustified disparity in the sentencing process, as well as in the actual sentences imposed in child rape cases. This disparity has been caused by diverse judicial approaches to the seriousness of these offences, to the recognition and interpretation of mitigating and aggravating factors, to the relevant circumstances of the offender and the victim, and to the relative weight given to each of these factors.

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### Mistaken belief in consent

This research project focused on a defence strategy often used by a person accused of sexual assault. Against the background of *S v Zuma* 2006 BCLR 790 (W), the research project focused on the problematic aspects of the defence. The researcher evaluated the application of the defence in Canadian and English law and set out a number of guidelines that aim to ensure the fair and equitable application of the defence by South African courts. The researcher also considered the effect on the defence of the Criminal Law (Sexual Offences and Related Matters) Amendment Act (Act No 32 of 2007). The researcher found that the defence of mistaken belief in consent aims to protect those who have not been proven guilty of sexual assault from the social stigma attached to sexual offenders. Although the doctrine underlying this defence has been criticised for defining sexual assault from the perspective of the accused, as opposed to that of the complainant, it is also recognised that it cannot be entirely abolished. An attempt was made to point out some of the difficulties arising from the defence of mistaken belief in consent against the background of the *Zuma* case. It has been suggested that law reform initiatives aimed at alleviating secondary victimisation of complainants in sexual assault cases may be one of the reasons for the potentially increased availability of this defence – an indication that success and failure exist side by side when it comes to

inevitably controversial reforms of this kind. In the final instance, it has been argued that the process of determining which evidence may be relevant to support a defence of mistaken belief may have to be limited in order to ensure the sexual autonomy of complainants and the equal protection of the law for victims of sexual assault. It has been indicated that certain categories of evidence, such as the evidence of the complainant's previous sexual history and the cultural beliefs of the accused, may have a particularly distorting effect on the fact-finding process. The preamble to the new act states that one of its objectives is "to afford complainants of sexual offences the maximum and least traumatising protection that the law can provide". The availability to an accused of the defence that he had genuinely, though mistakenly, believed the complainant to have consented to the sexual activity in question may pose complex challenges to these objectives. If these objectives of the new act are to be realised, the courts should remain constantly vigilant to these challenges.

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## Mercantile Law

### Jurisdiction and the National Credit Act

Section 90 of the National Credit Act (Act No 34 of 2005), sets out a list of unlawful provisions in credit agreements. One such provision is to be found in subsections 90(2)(k)(vi) (aa) and (bb) that forbids the consent to the jurisdiction of: "(aa) the High Court, if the Magistrate's Court has concurrent

jurisdiction; or (bb) any court seated outside the area of jurisdiction of a court having concurrent jurisdiction and in which the consumer resides or works or where the goods in question (if any) are ordinarily kept." The purpose of the research is to analyse and evaluate conflicting decisions regarding the interpretation of the above subsections. The critical question that the courts had to determine was whether these subsections oust the jurisdiction of a court by implication. In *Myburgh*, it was decided that the jurisdiction was indeed ousted, while in *Mateman and Stringer*, the court came to an opposite conclusion. After they had analysed and evaluated the above decisions, the researchers found that the high court's jurisdiction is not ousted by necessary implication and that the purpose of subsection (aa) was to forbid consent to costs on a high court scale. They found that in the case of subsection (bb), the court's jurisdiction is ousted if such court is not closest in distance to the consumer's residence, work or the place where the goods are ordinarily kept. If such interpretation is not awarded to (bb), the provision will be left ineffective and purposeless. In addition, they found that the conflicting decisions are the result of the legislature's failure to specifically regulate jurisdiction, as the predecessor to the National Credit Act (the former Credit Agreements Act) did, and that the legislature should clarify this issue.

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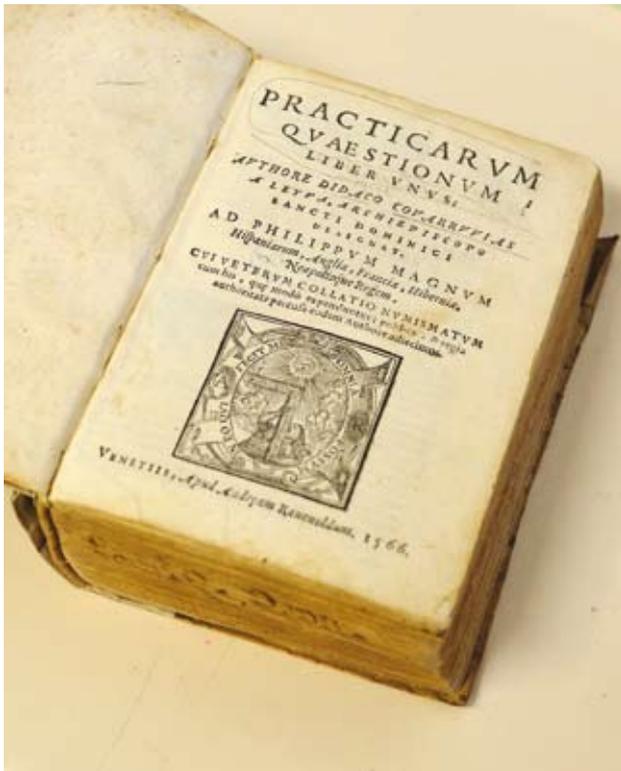
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### National Credit Act: instalment agreement

The aim of this research project was to evaluate and compare the transfer of ownership options provided for in the definition of an instalment agreement in the National Credit Act. An instalment agreement entails a contract of sale of movable property, where payment of the price, or part thereof, is deferred and is to be paid in periodic payments. Interest, fees or other charges are payable to the credit provider in respect of the agreement or deferred amount. Possession and use of the property is transferred immediately to the consumer or the party to whom the goods are sold under an instalment agreement. However, the contract contains an ownership reservation clause in terms of which the consumer only becomes the owner of the property sold once the contract has been fully complied with. Alternatively, the contract allows for ownership to pass to the consumer immediately, subject to the right of the credit provider to repossess the property should the consumer fail to satisfy all his/her financial obligations in terms of the agreement. It is apparent from the definition of an instalment agreement that a contract of purchase and sale of movable property (goods) is at hand. The definition of an instalment agreement affords a choice to the credit provider regarding provisions in the agreement that regulate the transfer of ownership. The credit provider can either reserve the passing of ownership of the thing sold or agree to a contract, whereby ownership passes to the buyer immediately. The researchers found



A study was done on the definition of an instalment agreement in the National Credit Act.



that, compared to the legal position of a seller in terms of a contract of sale containing an ownership reservation clause, the legal position of a seller in terms of an agreement allowing for the immediate passing of ownership subject to a commissary pact seems to be inferior and more complex, especially in relation to third parties. They concluded that sellers who wish to make use of this option when concluding an instalment agreement should acquaint themselves with the possible dangers involved when using this form of sale and should protect themselves accordingly.

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### Are civil courts misdirected?

The aim of this research project was to explore the overlap between the unlawful termination of a contract of employment and the unfair dismissal of an employee. The Supreme Court of Appeal has, in a sequence of cases, developed the common law contract of employment to include the implied right to a predissmissal hearing. Due to the fact that labour legislation already regulates unfair dismissal law, this in effect creates a dual system of dispute resolution in relation to the termination of contracts of employment. Employer-employee relations were historically primarily regulated by the principles derived from the law of contract. The

requirements for such contracts to have a binding effect rule in respect of the breach of such agreements, and remedies were regulated by common law principles. A jurisdiction based on fairness, which includes the right to a predissmissal hearing, was not recognised as common law. However, this all changed with the enactment of labour legislation that firmly entrenches the notion of fairness into the employment relationship. In South Africa, employees' rights are significantly enhanced by the Constitution and labour legislation such as the Labour Relations Act (LRA), the Basic Conditions of Employment Act and the Employment Equity Act. Under the right not to be unfairly dismissed, the onus of proving fair reasons and procedures has been shifted to the employer. In addition to this, a specialised dispute resolution framework has been established, which includes the Commission for Conciliation, Mediation and Arbitration (CCMA), the Labour Court and Labour Appeal Court, with the view of giving expeditious and affordable finality to labour disputes. One might have assumed that common law principles in respect of the termination of contracts of employment were replaced by corresponding provisions contained in labour legislation. The researcher found that this was not the case. The Supreme Court of Appeal has now confirmed that the common law contract of employment has been developed to include the right not to be unfairly dismissed. Therefore, despite the fact that the LRA regulates unfair dismissal law, the civil courts may be approached to determine disputes about the termination of contracts of employment on common law principles. Arguments are also advanced that favour the position that the civil courts may be misdirected in developing the common law to include the right to a pre-dismissal hearing. It is submitted that two main factors may encourage disgruntled employees to elect the route of the civil courts. First, unfair dismissal disputes must be lodged within 30 days of the date of dismissal (and unfair labour practice disputes within 90 days). Secondly, as trade-off for expeditiousness, the LRA imposes a cap of 12 months' remuneration on compensation for unfair dismissal. In terms of the Prescription Act, civil claims generally prescribe three years after the date of the incident that gave rise to a claim and there is no cap on common law damages in respect of breach of contract beyond the fact that actual loss must be proved. The researchers also found that it may be possible to appeal from the high court against a decision about unlawful dismissal, but that it is only possible to take a CCMA award on review. In addition to this, the untenable possibility arises for an employee to challenge the fairness of dismissal in the CCMA, and simultaneously, or after losing the matter, to dispute the unlawful breach of the contract of employment in the High Court. The Constitutional Court has shown a willingness to protect the exclusive jurisdiction of the Labour Court in respect of the overlap between administrative law and labour law principles. It is suggested that it would be a logical development for the same court to bring the dual system of dispute resolution in respect of the unlawful versus unfair termination of contracts of employment to its logical conclusion in the same fashion.

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## 6.7 Faculty of Natural and Agricultural Sciences

The Faculty of Natural and Agricultural Sciences annually makes a substantial contribution to the building of research capacity in South Africa by providing highly skilled graduates, as well as generating new scientific knowledge through its internationally recognised research publications.

### Message from the Dean

During 2008, the Faculty of Natural and Agricultural Sciences extended its boundaries and further established itself as one of the leading science faculties on the continent.

During the year under review, 166 MSc and 54 PhD students graduated. A significant number of the faculty's researchers enjoy international and national recognition. The faculty has 88 scientists who have been rated by the NRF. In addition, a number of academic staff members received special awards in recognition of their valuable contributions to research. Prof Brenda Wingfield, a lecturer in the Department of Genetics and programme leader in the Centre of Excellence in Tree Health Biotechnology, received the Distinguished Woman Scientist Award of the Department of Science and Technology (DST). Dr Wanda Markotter, a lecturer in the Department of Microbiology and Plant Pathology, received the L'Oreal South Africa Fellowship for Women in Science. Prof Pat Eriksson, head of the Department of Geology, was awarded the gold medal of the Southern Africa Association for the Advancement of Science ( $S_2A_3$ ) in South Africa and Prof Mike Wingfield, director of the Forestry and Agricultural Biotechnology Institute (FABI), received the gold medal of the Academy of Science of South Africa (ASSAf). Prof Nigel Bennett, a lecturer in the Department of Zoology and Entomology, received the gold medal of the Zoological Society. Senior researchers in the faculty were also selected to serve in various prominent positions. Prof Edward Webb was elected as president of the South African Society for Animal Science, Prof Norman Casey was elected as president of the World Association of Animal Production, Prof Janus Jansen van Rysse was appointed as editor-in-chief of the *South African Journal of Animal Science* and Prof Michael Somers was appointed as editor-in-chief of the *South African Journal for Wildlife Research*.

The faculty launched several new initiatives during 2008. The Aon Benfield Natural Hazard Centre, Africa, was established on 13 November in collaboration with Aon Benfield, a global independent reinsurance and risk intermediary. This multidisciplinary centre will promote research and contribute to the knowledge base regarding natural hazards with the ultimate aim of not only saving lives, but also of adding value to the lives of those most affected by natural disasters. The Department of Chemistry established a forensic drugs of abuse analytical group, led by Dr Tim Laurens. The group works closely with the Hatfield Court and its research is complemented by the Department of Geology's growing focus on forensic mineralogy, particularly as applied to precious metals.

The faculty also obtained some highly sophisticated research equipment, which will greatly enhance the work of its researchers. The equipment is used by various departments, as well as a number of private and state enterprises. The Laboratory for Microscopy and Microanalysis obtained a Jeol JEM 2100F transmission electron microscope with a point resolution capability of 0.25 nm that operates with a field emission source at 200 kV. It is fitted with a four-megapixel camera, as well as a conventional film camera with high-resolution photographic capabilities. An energy-dispersive X-ray facility for microanalysis is also available. A Zeiss Gemini Ultra Plus scanning electron microscope was installed in November. The microscope has a field emission electron source that gives it a 0.67 nm resolving capability. Furthermore, it is fitted with an energy-dispersive X-ray system. It also has an electron backscatter diffraction ability that allows crystallographic information to be obtained from samples. A state-of-the-art Bruker 400 MHz Avance III nuclear magnetic resonance spectrometer was commissioned by the Department of Chemistry. The spectrometer is critically important to researchers and students who work in the field of synthesis and the structure elucidation of natural products, as well as for the analysis of biological samples. The Mass



Prof Anton Ströh, Dean



Groundbreaking research is conducted in the University's bio-chemistry laboratories.



Litter may become something of the past with degradable polymer technology in plastic bags.

Spectrometry and Chromatography Laboratory, led by Prof Egmont Rohwer, was identified by Sasol as a strategic national asset, thereby obtaining significant funding for this research group.

Another major research highlight was the recent development of degradation-enhancing additives for plastic carrier bags and general plastic packaging, based on clay nanotechnology, by the Institute of Applied Materials. These plastic products, so common in the modern lifestyle, lead to severe littering problems, affect both wildlife and domestic animals in terrestrial and aqueous environments, and take years to degrade and decompose. Degradable polymer technology provides a possible litter reduction strategy, the idea being to accelerate the natural sunlight-mediated degradation pathways of a plastic object.

The new additives are nanostructured, brucite-like anionic clays that comprise fatty acid intercalated layered double hydroxides. The development of these new polymer additives relied on novel intercalation procedures invented at the Institute of Applied Materials. Laboratory simulations of natural exposure to sunlight of plastics containing the additives showed that breakdown began after only 100 hours in plastics containing as little as 0.1 percent of active additives. There are also potential spin-offs for recycling non-littered plastics using higher temperatures on plastics containing the nanoparticle-based additives.

During 2008, a number of the faculty's research programmes received major grants. The DST awarded a grant of R1.5 million to Prof Zander Myburg in the Department of Genetics as part of a project funded by the United States Department of Energy to sequence the genome of the eucalyptus tree. In addition, the South African Forestry Company (SAFCOL) funded a Chair in Forestry at the

University of Pretoria to the value of R7 million to expand postgraduate research to the broader forestry field.

The Agricultural and Food Policy Programme (BFAP) of the Department of Agricultural Economics, Extension and Rural Development received substantial funding from the Bill and Melinda Gates Foundation for a project on agricultural markets in the South African Development Community (SADC) as part of a consortium led by Michigan State University.

An extension of the Centre for Environmental Economics and Policy in Africa (CEEPA) coordinated a project to strengthen capacity in environmental economics and policy in Africa, which received approval of funding for Phase II of the project from the Swedish International Development Agency (SIDA). The funding supports a four-year extension of the project from 2009 to 2012 at a total budget of 11 million Swedish Korona.

A UP/Council for Scientific and Industrial Research (CSIR)/Agricultural Research Council (ARC) consortium, with Prof Robert Vlegaar, acting head of the Department of Chemistry, as the principal investigator for UP, gained a three-year R12.3 million contract from the NRF's Innovation Fund. The aim of this project is to develop new drug leads that can act as inhibitors against HIV/AIDS.

The research focus of the Department of Biochemistry is on both medical and veterinary biotechnology applications. Within its broader national and international networking, it commands a comprehensive functional genomics technology that can identify and validate vaccine and drug targets and markers for diagnostics in single PhD research programmes that span three years, with a bench-fee budget of around R500 000 per target or marker identified. In addition, it has acquired the



capacity to design and synthesise drugs or antigens through local and international collaboration with chemists.

Other research highlights include the publication of a book by Prof Jan Boeyens of the Unit for Advanced Study and Prof Demetrius Levendis of the University of the Witwatersrand, entitled *Number theory and the periodicity of matter*. This book attempts to decipher, clarify and communicate a fundamental principle to the scientific world. Its intended audiences transcend those who reside in the scholastic academic spheres to captivate even the non-specialists from other diverse fields.

The year under review also saw the celebration of FABI's tenth anniversary on 14 May 2008.

Prof Anton Ströh  
Dean

## Research highlights

### Animal and Wildlife Sciences

#### Molecular scatology as non-invasive tool for genetic analyses of South African cheetah

The aim of the study was to test the applicability of non-invasive scatology in population genetic studies of cheetah in South Africa. To validate the approach, DNA was extracted from *ex situ* cheetah faeces and the matching blood sample of each animal. Species-specific mitochondrial DNA control region amplification confirmed the cheetah origin of extracted faecal DNA. Polymerase chain reaction (PCR) success rates of the species-specific primer set and 12 cat microsatellite markers were examined. The quality of DNA was higher in fresh samples than in samples that were left to age for four days and two weeks respectively. Mitochondrial DNA amplification success was high. All fresh faecal samples had a positive result (100 percent). Four-day-old samples were 83 percent positive and two-week-old samples were 94 percent positive. Amplification success of the 12 microsatellites was 59 percent for fresh faecal samples, 20 percent for four-day-old samples and 2.4 percent for two-week-old samples. Genotyping errors were found when using DNA from the faecal samples, with rates of 16 percent and 7 percent for allelic dropout and false alleles respectively. Repeated extractions and four to five microsatellite amplifications are recommended per sample for accurate genotyping. For a preliminary field test, faecal

samples were obtained from the Thabazimbi area (Limpopo, South Africa), where cheetah roam freely on private land. Control region PCR successfully identified cheetah faeces and microsatellite alleles were in the same range as those from the *ex situ* study. In addition to the methods currently employed in cheetah conservation in South Africa, such as camera trapping and telemetry, scatology can provide a better understanding of the spatial distribution and levels and structure of genetic variation among wild cheetah.

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### Consumer Science

#### Customer service and service quality in appliance sales departments

Service quality, as an indication of a store's service excellence, has been a popular topic of investigation for quite some time. From a retail perspective, an insatiable need to prosper in a competitive marketplace probably explains why certain elements of a store's marketing mix are attended to more meticulously. This research implemented an established SERVQUAL scale and involved 296 respondents to investigate customers' judgment of the service quality in a specific context, that is, appliance sales in prominent department stores in Pretoria. Respondents' service quality judgments revealed a more basic assessment of the service offering in the context of this research. Exploratory factor analysis confirmed a collapse of the original five-dimensional scale to two dimensions, labelled 'supportiveness' and 'impressiveness' respectively. Customers' positive service quality judgments were, however, contradicted by pertinent shortcomings identified by managers of the stores during in-store surveys. These shortcomings were confirmed in sales personnel's suggestions for the optimisation of the service offering to enhance informed, responsible buying decisions through narratives in a projective technique. The research concluded that consumers in emerging economies seem more tolerant of ineffectiveness in the marketplace, probably due to lower



expectations. In order to improve the situation, retail needs to augment their service offering in terms of elements of the marketing mix that would benefit their customers, that is, to set the pace in terms of consumer education. The potential role of sales personnel would be to facilitate consumer decisions on the premise that they are encouraged and given the opportunity to be trained and that conditions in the stores are amended to discourage competition among sales personnel to excel in sales to the detriment of the wellbeing of their customers.

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## Food Science

### Bioplastic films from the sorghum prolamin protein kafirin

Prof John Taylor and his research team have developed methods to produce bioplastic films from the sorghum prolamin protein kafirin. Recently, Prof Taylor invented a simple, novel method for making kafirin protein microparticles (microspheres) together with Dr Janet Taylor. These protein microparticles have unique properties, including an extremely large internal surface area. Manipulation of the preparation conditions results in microparticles with differing characteristics. For example, they can be used to form very thin, edible, biodegradable free-standing films, bioplastic coatings, or ingestible encapsulation agents for micronutrients. The microparticles have many other potential applications in the food, biomedical and pharmaceutical industries. This is the subject of ongoing research. The invention is the subject of intellectual property protection.

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### Water quality vs food safety

The aims of this project were to determine the link between irrigation water quality and the food safety of fresh and minimally processed vegetables, to investigate which bacterial and viral contaminants are found in surface

water used for irrigation, and to highlight their potential risks, should they be present on vegetables cultivated by using surface water. Surface water (that is, water from dams and rivers) used for the irrigation of vegetables in South Africa is susceptible to contamination by pathogens, because this water is subject to waste and sewage that is disposed of in the rivers and dams. This water is not treated before the irrigation of fresh produce. The problem of the contamination of irrigation water and, subsequently, vegetables, might lead to the suspension of the exportation of produce and vegetables to the European Union (EU) and the USA. Furthermore, the consumption of vegetables contaminated with foodborne pathogens by South Africans might lead to outbreaks of foodborne illnesses, bearing in mind that a large proportion of citizens have immune system-compromised diseases like HIV and tuberculosis. The data generated will be used to create an awareness of the potential health risks. Urgent steps will be sought to prevent the pollution of surface water (water in rivers and dams). Aerobic and anaerobic spore formers were present in low numbers on the vegetables. At the Skeerpoort River site, the water could not be established as a source of contamination. However, at the Loskop Dam site, the Wilge River, in particular, had high levels of aerobic and anaerobic spore formers and definitely contributed to the presence of these organisms on the vegetables. All the pathogens included in the study were detected in the water samples at the selected sites. It is clear from the preliminary results that if the pathogen is present in the water, it will also be found on the vegetable samples at the various sites. Similarly, if the pathogen is not present in the water, it is not found to be prevalent on the vegetables. Incidences of the pathogens *Salmonella*, *L. monocytogenes* and *S. aureus* were higher in the water from the Loskop Dam site than in the water from the Skeerpoort River sites. At this stage of the project, the preliminary data clearly indicate that the quality of the water impacts on the presence of food pathogens on vegetables sampled during this study.

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The use of surface water for the irrigation of crops may lead to contamination of vegetables with foodborne pathogens.

## Plant Production and Soil Science

### Rainwater harvesting strategies to improve crop production in semi-arid areas

Rainfall in semi-arid areas is usually erratic and insufficient to meet crop water requirements, resulting in yield fluctuations and food insecurity. Rainwater harvesting, which involves the collection and concentration of run-off for production purposes, can be implemented to mitigate the effects of seasonal droughts. Field trials were conducted at the Hatfield Experimental Farm during the 2007/08 season to study rainfall run-off relationships on run-off plots of different designs, and to improve the soil water balance (SWB) model as a tool for designing optimal rainwater harvesting management strategies for a particular region. Eight rainwater harvesting treatments were compared, using maize as a test crop. Conventional tillage was compared to tied ridges and six other in-field rainwater harvesting treatment combinations of different designs (run-off to cropping area ratios) and soil covers. Infield rainwater harvesting requires a balance between the cropped area and non-cropped (run-off) area. The run-off area contributes water to the cropping area, but cannot produce any yield itself. The larger the runoff area, the more water is transferred to the cropped area. However, too large a run-off area can be wasteful, as excess run-off water will be lost through deep percolation, which does not contribute to production. The researcher found that one design cannot work equally well under all climate and soil conditions and designs need to be optimised for different conditions. The results from one season, which may be unusually wet or dry, may give misleading results. It is, therefore, useful to develop a model that can be used to predict crop response over a longer period with historical weather data. All rainwater harvesting treatments in this trial improved maize growth and grain yields. Run-off estimation procedures were successfully incorporated into the SWB model to facilitate crop yield prediction under different rainwater harvesting scenarios. Long-term model simulations for Pretoria and Chokwe

(Mozambique) revealed that smaller run-off areas are the best strategy in wetter areas or seasons, while larger run-off areas are best in drier conditions. This tool will be very useful to select best rainwater harvesting design strategies for different conditions to reduce yield fluctuations and food insecurity in semi-arid areas.

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## Biochemistry

### Functional genomics investigations of perturbed malaria parasites

Millions of people die as a result of malaria every year. The Malaria Research Group focused on the comprehensive investigation of the biological response (functional genomics) of the malaria parasite to drug-induced polyamine depletion, which results in growth arrest of the parasite (cytostasis), but not death. This includes the analyses of the parasite's transcriptome, proteome and metabolome, and biological validation of the observed effects. Polyamines provide the parasite with essential polycationic metabolites to allow successful DNA replication and therefore cellular growth and division. The aim of one of the research group's projects, Functional Genomics Investigations of Perturbed Malaria Parasites, was to develop multilevel, global response analyses of the malaria parasite after perturbation with inhibitors as an aid to identify and validate anti-malarial drugs and drug targets. As far as could be determined, this work provided the first report using such a comprehensive functional genomics approach to study the response of a multistage organism like the malaria parasite to an external perturbation. Results showed that cytostasis upon polyamine depletion produces a generalised transcriptional arrest, a phenomenon that could include other organisms/systems. The researchers provided conclusive evidence

for transcriptional level regulation in the malaria parasite in response to external perturbations, in addition to the widely reported post-transcriptional regulation. This contributes a new dimension to our understanding of the regulation of gene expression in the malaria parasite. The researchers also observed highly specific compensatory biochemical processes that were induced in response to the polyamine depletion at the transcriptome level and comprehensively biologically validated in both the proteome and metabolome. The work provided specific information on the role of polyamines in the life cycle of the malaria parasite and therefore enhances our understanding of and provides insights into the molecular mechanisms and biochemical processes controlling polyamine metabolism/homeostasis. Ultimately, the research group contributed to the validation of polyamine metabolism as an anti-malarial drug target. This expertise is now established as part of a functional genomics core expertise group of the South African Malaria Initiative for use in drug discovery endeavours.

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### Structure-based discovery of a novel polyamine biosynthesis for anti-malarials

The aim of this research project was to identify and design mechanistically novel inhibitory compounds using in silico structure-based approaches aimed at the polyamine metabolic pathway. The malaria parasite requires synthesis of polyamines for parasite growth, replication and survival. Polyamine biosynthesis in the parasite differs substantially from the human host and is controlled through the action of a unique bifunctional enzyme. Computer-based strategies (in collaboration with the Bioinformatics and Computational Biology Unit of the Department of Biochemistry) were used in the design of mechanistically novel inhibitors of one of these proteins, spermidine synthase. High-quality three-dimensional protein structures were produced and used in the design of dynamic pharmacophores, which are consensus structures representing the essential chemical elements for inhibitors of this specific malaria protein. Small chemical



The *Anopheles* mosquito, which is the vector of malaria.

compounds fitting these descriptions were identified through the virtual screening of chemical libraries. One of the nine compounds tested had a significant inhibitory activity and is also a novel inhibitor for this enzyme. Further studies are in progress to improve the properties of this compound to fit the general properties of a drug lead that can proceed to the next level in the anti-malarial drug discovery process.

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### MARTI saves lives

Approximately one and half million patients who suspect that they have tuberculosis (TB) annually report to clinics in South Africa. Of every 100 patients, 35 eventually turn out to suffer from active TB. Of these, 20 can typically be diagnosed inexpensively within three days, using microscopy of lung sputum samples. A six-month combination treatment is commenced with the TB patient becoming non-infective within a week, thus no longer posing a threat to the medical staff at the clinic/hospital and the community to which he/she returns. The problem is the remaining 80 patients who initially tested negative on smear microscopy. With no means of knowing how infective they are, they are hospitalised for a week. Typically, symptoms prevail in 45 patients, who are then subjected to a microbiological growth test from sputum, the results of which only become known after eight weeks, with a 30 percent underestimation of active TB when it co-occurs with HIV infection. During this period, TB-HIV co-infected and extreme drug-resistant patients die during their two-month stay in hospital, while putting medical staff at extreme risk of contracting drug-resistant TB. The MARTI serodiagnostic test for TB is an all-South African idea patented in 2005 by the University of Pretoria and published by the TB research team of Prof Jan Verschoor in 2008. It is a biosensor test that detects mycolic acid antibodies as surrogate markers of active TB. It is not affected by HIV/AIDS and delivers an answer on the same day as sampling, thereby doing away with the need for hospitalisation. It is the most accurate serodiagnostic TB test in high-burdened HIV and TB disease populations to date, due to the nature of the antigen and the high-technology way in which the antibodies are detected. The MARTI test only requires a droplet of blood from the patient. By not being restricted to sputum samples, the MARTI test may turn out to be the only test that can accurately determine extrapulmonary TB, which typically occurs in children and immune-compromised individuals, such as HIV/AIDS patients. The MARTI test could lead to the initiation of early treatment, stop transmission of TB from the day of reporting to the clinic, and reduce the emergence of drug resistance. The MARTI test is currently supported by South Africa's Biotechnology Regional Innovation Centres for development for the market, and has been nominated as a flagship project of the India-South Africa bilateral research agreement on health and biotechnology of 2009.

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## Plant Sciences

### Novel bioactive compounds

Researchers in the Department of Plant Sciences have successfully isolated and identified anticancer, antiplasmodial, antiherpes, antityrosinase and antidiabetic activities in medicinal plants. Plants used in the study were collected based on phytochemical information and their ethno-botanical use. An extensive bioassay-guided fractionation of plant extracts led to the isolation of known and novel chemical compounds, which show potential for use by people with diabetes and with skin hyperpigmentation problems. Two synthetically derived chemical compounds showed significant anticancer activity. The researchers found that these compounds were not toxic to lymphocyte cells. Pre-clinical studies are planned to test the anticancer compounds. All other tests that are necessary to develop products have been undertaken and samples are currently being considered for full human trial studies, which will be crucial for product development. Antidiabetic extracts have also shown good activity in mice in pre-clinical studies and a number of experiments are currently underway to substantiate the findings obtained thus far.

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### Analysis of primary protein structure of all known plant cysteine protease inhibitors (plant) cystatins

Differences in the primary structure of naturally occurring plant cystatins and their interaction with different cysteine proteases will provide valuable information for the specific interaction between the two proteins. A database containing all available information on structure, biochemistry, expression pattern and biotechnological application of all known cystatins is currently being developed. Comparison of the primary structures will reveal important information on the evolution of cystatins in plants. The database will also help to select the most suitable candidates for future biotechnological applications to prevent protein degradation during stress or senescence.

### Modelling of three-dimensional protein structure of plant cystatins

The aim of this research project was to create a better understanding of the structure-function relationship during the inhibition interaction of plant cystatins and cysteine proteases. Using advanced molecular modelling software, the three-dimensional structures of various plant cystatins, as well as mutated forms of these cystatins, are first solved. Using protein-protein docking, they are then bound to the cysteine proteases and the specific interactions are analysed in terms of binding

site interactions. The data is finally combined with biochemical data to form a model that will be used for the rational design and directed evolution of cystatins for improved and targeted activity against selected proteases in applications such as insect control or increased yield and production of recombinant proteins in plants.

### Selection of sites for directed mutations in plant cystatins

Binding of cysteine proteases and their inhibitors (cystatins) seems to depend on the conserved regions in the first and second loop, as well as in the N-terminal. The objective of this research was to investigate the interaction between conserved regions of plant cystatins and cysteine proteases. Natural forms of rice (OsCYS1) and papaya (CpCYS1) cystatin, however, show significant differences in the amino acid sequence of the first loop. Substitution of the sequence in rice with the one found in papaya and vice versa will help evaluate the role of the conserved regions for their interaction with proteases. Detailed knowledge about the interaction between the two proteins will be needed for more target-specific application of cystatins in pest and pathogen management, as well as control of recombinant protein production in plants.

### Characterisation of non-expressor of pathogenic resistance (NPR) genes in banana

The non-expressor of pathogenesis-related gene 1 (NPR1) is an essential positive regulator of salicylic acid (SA)-induced pathogenesis-related (PR) gene expression and systemic acquired resistance (SAR), which is important in broad-spectrum pathogen resistance in plants. The research team has identified and isolated two novel full-length NPR1-like genes, MNPR1A and MNPR1B, from banana through the application of southern blot analysis, polymerase chain reaction (PCR) and rapid amplification of cDNA ends (RACE) techniques. Expression of the MNPR1 genes was directly related to PR gene expression known to be involved in fungal resistance after the treatment of banana plants with various elicitors. Expression of the two genes in various Arabidopsis mutants will, in particular, unravel the NPR1 protein activation process.

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## Forestry and Agricultural Biotechnology Institute (FABI)

### Eucalyptus genomics projects

In 2007, the United States Department of Energy announced the funding of a project to sequence the genome of *Eucalyptus grandis*, a fast-growing forest plantation tree species, which is considered a potential bioenergy crop. It will only be the second forest tree genome to be sequenced after that of the poplar tree. Prof Zander Myburg of the Department of Genetics is the principle investigator and the University of Pretoria is the lead partner organisation



The eucalyptus genome project team will have completed the genome by July 2009.

for this international project. The eucalyptus genome project team recently announced that it has completed 77 percent (448 million bases) of the expected genome (580 million bases) and that the genome will be completed by July 2009. In parallel, the International Eucalyptus Genome Network, a worldwide network of more than 130 scientists, is developing a series of genomic resources (genome libraries, expressed gene libraries, genetic maps and DNA markers) that will allow researchers to utilise the genome sequence for biological research and innovation. In 2008, the DST awarded a strategic grant of R1.5 million to the University to support its leadership role in the eucalyptus genome project and to fast-track local eucalyptus genomics projects. Prof Myburg and his research team, in collaboration with the University's Bioinformatics and Computational Biology Unit, have embarked on a project to sequence the transcriptome of a South African eucalypt plantation tree to obtain a complete catalogue of expressed genes for this tree and to discover thousands of DNA markers that can be used for the molecular breeding of eucalypt trees in South Africa.

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## Mammal Research Institute

### Does glucose influence the conception of sons and daughters?

Traditional wisdom suggests that mothers may be able to influence the sex of their offspring by altering their diet. Recent research in the Mammal Research Institute (MRI)

indicates that these myths may not be so far-fetched. Evolutionary theory proposes that mothers would maximise their descendants if they had sons when they had excess resources to invest, and daughters when there are limited resources. While recent reviews of studies in mammals have supported this notion, it has not been clear how such variation might arise. Researchers have proposed that glucose levels might play a role in mediating the development of newly fertilised eggs. Researchers at the University of Pretoria and the University of Nevada, Reno, USA, experimentally tested whether the manipulation of glucose levels (using a steroid additive in drinking water) during early development influenced sex ratios. Surprisingly, the team's study confirmed the role of glucose. The glucose levels of steroid-treated females dropped, and these females only gave birth to 42 percent sons compared to the untreated females who gave birth to 54 percent sons. This is the first study to show a causal link between glucose levels and offspring sex ratios in a living animal.

### Impact of wealth on sex-ratio manipulation

The Mammal Research Institute also undertook a study on the sex-ratio manipulation of human children. They focused on whether there was any indication that humans with extra resources (indicated by wealth) gave birth to more sons. Billionaires were identified using the Forbes List, and their ratio of sons to daughters was recorded. The study indicated that billionaires gave birth to 60 percent sons, compared to 51 percent in the rest of the population.

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## Mathematics and Applied Mathematics

### Energy properties preserving schemes for Burgers equation

The Burgers equation, a simplification of the Navier-Stokes equations, is one of the fundamental model equations in gas dynamics, hydrodynamics and acoustics, which illustrates the coupling between convection/advection. The kinetic energy enjoys boundedness and monotone decreasing properties that are useful in the study of the asymptotic behaviour of the solution. A family of non-standard finite difference schemes, which replicate the energy equality and the properties of the kinetic energy, is constructed. The approach is based on Mickens' rule of non-local approximation of non-linear terms. More precisely, the research proposes a systematic non-local way of generating approximations that ensure that the trilinear form is identically zero for repeated arguments. Numerical experiments are provided that support the theory and demonstrate the power of the non-standard schemes over the classical ones.

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### Evolution integrals

A very useful approach to quantum physics is via Feynman path integrals. It provides an alternative to the canonical approach (in terms of a Hamiltonian) to time evolution of quantum dynamical systems. On the other hand, in the context of operator algebras, one can consider so-called non-commutative dynamical systems that provide a mathematical abstraction of quantum dynamical systems and are very convenient for studying structural and conceptual aspects of quantum dynamical systems. These non-commutative dynamical systems are, however, essentially based on the canonical approach. In this research project, an analogue of path integrals, called evolution integrals, was introduced for non-commutative dynamical systems. Evolution integrals are not an abstraction or generalisation of path integrals, but rather an analogous mathematical construction that provides a different point of view on non-commutative dynamical systems, although they are not necessarily of use in physics.

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### Flows of non-Newtonian fluids

Polymeric liquids exhibit phenomena such as shear-thinning, normal stress differences and pressure dependence of viscosity, which do not occur in the so-called Newtonian fluids such as water and air. In addition, polymeric liquids do not always satisfy the no-slip boundary condition at solid surfaces. Dr Christiaan le Roux and his co-workers obtained exact solutions for a number of special flow problems for non-Newtonian fluid models with Navier slip boundary conditions. The fluid models considered in these problems were a

generalised fluid of complexity, which included the Navier-Stokes fluid, the power-law fluid and the second-grade fluid as special cases, a Navier-Stokes-like fluid in which the viscosity is a function of the pressure, and a generalisation of the Burgers model for a rate-type viscoelastic fluid. One of the findings is that, in contrast to the Navier-Stokes fluid model, boundary layers can exist even if the flow is sufficiently slow for inertial effects to be negligible. On the other hand, boundary slippage has the effect of diminishing any boundary layers.

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### Heat flow for closed geodesics on a Finsler manifold

This work deals with an interesting geometric problem, the deformation of a closed curve into a geodesic on a Finsler manifold. Finsler manifolds originated in the groundbreaking inaugural address of Riemann in 1854 and are characterised by the assignment of a metric that does not only depend on the points on the manifold, but also on the tangent vectors to the manifold. What will later be known as Riemannian manifolds are the simpler case when the metric depends only on the points. After some important work by Finsler, Cartan, Berwald, Chern, Rund and Abkar Zadeh until 1960, the field remained dormant for almost two decades and underwent a resurgence, mainly due to Chern and his students. Certain questions that have found solutions in the Riemannian frame turned out to be extremely difficult to solve in the Finslerian case. One of these problems is that of Harmonic maps from a Finsler manifold into a genuine Finsler manifold. Successful results so far concern the case of a Riemannian target manifold or by endowing a target Finsler manifold with a Sasaki metric, which gives a Riemannian structure to the manifold. The current work treats the case of a one-dimensional Finslerian source manifold as a genuine target Finsler manifold. The study uses the celebrated Eells-Sampson heat flow method.

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## Geology

### Limpopo Mobile Belt

The Limpopo Mobile Belt, which lies across the border between Zimbabwe and South Africa and extends westwards into Botswana, is one of earth's most ancient high-grade orogenic belts and has been the subject of controversy for decades, particularly with regard to its age. This belt is one of the most fundamental crystal structures in Southern Africa and reflects the suture between the Kaapvaal craton of South Africa in the south and the Zimbabwe craton in the north. The central part of this large, complex suture zone is constituted by the so-called Central Zone, an apparently exotic small crustal plate that was emplaced through early plate tectonic processes on earth. Conventional dating and metamorphic petrological techniques applied over decades have failed to resolve the

age controversy, that is, whether the Limpopo Belt reflects two major orogenic events, at c. 2.7 and 2.0 Ga, or only one at about 2.0 Ga. Recent and ongoing research on this problem, led by Dr Martin Rigby, is applying the most up-to-date techniques of the pseudosection approach to thermobarometry through the use of Thermocalc software. The results have clearly indicated that there was only one major collision and suture, at about 2.0 Ga, between the Zimbabwe craton and an already co-joined Central Zone-Kaapvaal assembly, probably of c. 2.7 Ga vintage. This reflects an important step forward in the understanding of one of the earth's oldest and most enigmatic mobile belts, which also forms one of the really fundamental crustal features related to most major subsequent geological events in Southern Africa and its very large mineral deposits.

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### Ancient river systems of the Palaeoproterozoic time period

South Africa probably has the best Precambrian rock record of any comparable terrain on earth. Among this record is a superb succession of sedimentary basins from the c. 3.1 to 2.7 Ga Witwatersrand gold-bearing depository (the oldest large basin preserved on earth), to the c. 2.7 Ga Ventersdorp basin, the c. 2.67 to 2.1 Ga Transvaal Basin, and the c. 2.0 to 1.8 Ga Waterberg basins. Mainstream science supports a viewpoint whereby change in the chemical composition of the hydrosphere-atmosphere system on the planet, from an early reducing environment to one that gradually became more oxygenating, was marked by what is often termed the 'great oxidation event' at some time between about 2.3 and 2.0 Ga. A detailed study of the nature of the very large braided channel systems that are preserved in the Waterberg basins by Dr Adam Bumby and PhD student Markus van der Neut suggested a possibly unique fluvial style at that time. Expansion of these studies into the Transvaal basin by Prof Pat Eriksson confirmed the idea that Palaeoproterozoic fluvial styles were somewhat unique, characterised by palaeo-gradients that resemble no modern river systems. Modelling of the concomitant palaeo-atmospheric conditions in cooperation with Prof Hannes Rautenbach, head of the Department of Geography, Geoinformatics and Meteorology, suggests that a reducing greenhouse atmospheric setting must have continued for much longer than originally thought, and has placed a question mark on the universal nature of the so-called 'great oxidation event', at least for the Kaapvaal craton of South Africa.

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## Physics

### Beetles' bright colours may influence new light technology

The brightly metallic-coloured scarab beetle, *Gymnopleurus virens*, which is mainly found in Southern Africa, reflects almost entirely left circularly polarised light – the only known example of this phenomenon in nature. Scientists in the Department of Physics discovered the reason for this asymmetrical preference. The beetle's shell consists of many layers of microfibrils aligned parallel to each other, with each layer rotated slightly relative to the layer above. This forms a helicoidal stack twisting in the left direction, which then causes left circularly polarised light to be reflected. The colour of the beetle is determined by the thickness of the layers, and defects in the structure broaden the reflectance band. These results may find practical applications in the fabrication of nano-engineered chiral reflectors used in display and laser technologies.

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### The nano-mechanics of silk fibres under stress

Silk has been used as a textile for more than 3 000 years and as a biomedical suture material for centuries, but in the second half of the 20<sup>th</sup> century it was replaced by new synthetic fibres with highly reproducible properties. Today there is a renewed interest in natural polymers as biotechnological and biomedical resources because of their unique properties, which include non-toxicity, biodegradability and biological compatibility. In collaboration with the research group of Dr Philippe Colomban in Paris, France, the research group used micro-Raman spectroscopy to study the changes that occur in silk fibres during the application of stress, as structural changes at the molecular level will influence the performance of the fibres in any application. Silk consists of proteins in helical, random coil and anti-parallel  $\beta$ -sheet structures. The properties of the silk (elasticity and strength) depend on the relative amounts of configurations present, as well as the amino acid sequence of the protein backbone. Under stress, helical coils are transformed into  $\beta$ -sheets. If the stress increases, the fibre breaks. The researchers chose to study the silk of the domestic silkworm, *Bombyx mori*, used for sericulture, the wild South African and Namibian silkworms, *Gonometa rufobrunnea* and *Gonometa postica*, and the spider silk from Madagascar, *Nephila madagascariensis*, as this provided them with the opportunity to compare the results of two well-characterised silk fibres, *Bombyx mori* and *Nephila*, with unknown silk from the *Gonometa* species. They found significant differences between degummed and untreated silk fibres of different origins, which will be helpful in choosing between silks for different applications.

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## 6.8 Faculty of Theology

The Faculty of Theology is the largest residential faculty of its kind in South Africa. Lecturers from diverse denominational backgrounds provide training for the ministry in various churches, both locally and abroad. All the programmes of the faculty contribute to the development of people.

### Message from the Dean

By its nature, the faculty is involved in people-centred activities. The training of ministers in religion, as well as the sensitising of students for the world view and religious affinity of other people, adds up to this reality.

As an internationally recognised research and teaching facility, the faculty is committed to attracting and retaining excellent students, as well as members of staff who can provide these students with a balanced education, developing the whole person. Because of its unique perspective on reality, the faculty is well equipped to contribute in this regard. It therefore appropriates in its own way the University's aim to optimise teaching strategies and to encourage the principle of lifelong learning. Within this framework and with its excellent scholars, the faculty develops scholarship in a wide spectrum of theologically relevant disciplines. It strives to provide students with an inclusive education in order to prepare them for constructive citizenship, as well as for responsible leadership in faith communities.

Academic research prevails as one of the firm pillars of academic activities. Research outputs are, therefore, vital for the sustainability of academic programmes. Two accredited academic journals of the faculty, *HTS Theological/Theologiese Studies (HTS)* and *Verbum et Ecclesia (VE)*, played an important role to stimulate and disseminate local and international research. Both journals are recognised and indexed on the most important international catalogues. Editors of both journals were part of the Editors' Forum of the Academy of Science of South Africa (ASSAf) and serve on the executive of the newly established Editors' Forum for Theological and Related Journals, as chairperson and secretary.

Staff, students and research associates published more than 130 papers in national and international academic journals during 2008. Additionally, the following books were published: *Partnership in Mission* (GA Duncan: VDM Publishers), *Biblical Interpretation in the Russian Orthodox Church* (AI Negrov: Mohr Siebeck), *Das Lukas Evangelium* (M Wolter: Mohr Siebeck) and *Hermeneutik der Gleichnisse Jesu* (R Zimmerman: Mohr Siebeck).

The Faculty of Theology considers community engagement to be one of its key priorities and core functions. It is not treated as a separate function, but naturally forms an integral part of the faculty's teaching and research programmes. The specialist centres that reside within the faculty attest to its important service to various local communities. These include the Centre for Theology and Community, which endeavours to build bridges between the faculty and the local churches,

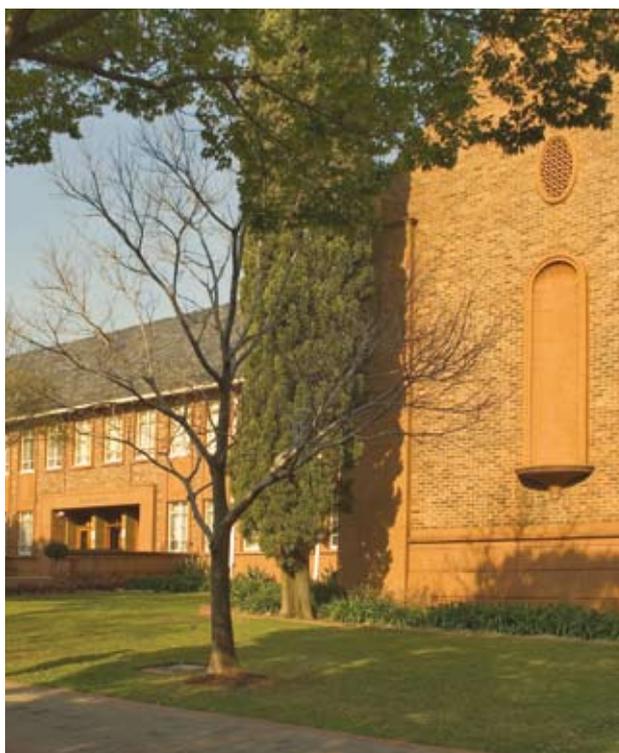
as well as the broader community, the Institute for Missiology and Ecumenical Research (IMER), which offers research and support to missionary and ecumenical activities, the Centre for Ministry Development (CMD), which offers opportunities for continuing education to students and pastors in the Dutch Reformed Church, the Reformed Theological College (RTC), which was established in conjunction

with the Reformed Church to train theological students for practical service in the church, the Centre for Business and Professional Ethics (CBPE), which is housed in the Graduate School of Management as a joint initiative of the Faculty of Theology, the Faculty of Economic and Management Sciences and the Department of Philosophy in the Faculty of Humanities, and the Centre for Contextual Ministry, which offers theological training to a wide range of ministers and leaders in South African churches.

The faculty's international involvement manifests itself in a host of ways. It has cooperation agreements with a number of respected equivalent institutions in Africa, Europe and North America and regularly receives research scholars. It actively participates in international academic projects and hosted international conferences on the Pentateuch, Psalms, the New Testament and ethics in 2008.



Prof Cas Vos, Dean



Theology Building

Three senior staff members received prestigious international awards.

Two special projects deserve to be mentioned. The first is Small Survivors of HIV/AIDS, a project funded by the NRF, the Centre for the Study of Aids (CSA), the University of Pretoria and the South Africa-Netherlands Research Programme on Alternatives in Development (SANPAD). This project is interdisciplinary in nature and is conducted in collaboration with the faith-based organisations (FBOs) Heartbeat and Hospivision, and Pretoria Evangelism and Nurture (PEN) in the greater Pretoria area. The project aims to address the role that the church and FBOs can play in addressing and alleviating the spiritual and bereavement needs of HIV and AIDS orphans. The second is the Enabled-Technology and Human Resources for Industry Programme (THRIP) Managed Health Care Project. With a range of techniques and in collaboration with a medical aid scheme service provider, the project team reduces the cost of providing health benefits to poor African households, while simultaneously improving the quality of care rendered.

Prof Cas Vos  
Dean

## Research highlights

### Dogmatics and Christian Ethics

#### God our King

The aim of this research project was to determine whether the metaphor of 'king' can still be used in Christian God-talk. The researcher argues that modern people only know kings from fairy tales or ancient histories. If they happen to live in a country with a royal family (kingdom), as is the case in Great Britain and the Netherlands, they know their queen as a ceremonial figure who merely symbolises the unity of the people or the nation. If she has any power at all, it is very limited, delegated to her by the people. The daily life of the queen does not influence the lives of the people. Calling God a king in this sense would reduce Him to a distant, irrelevant ornament in our lives. On the other hand, the traditional understanding of God's kingship implies that God completely dominated people's personal lives and history as a whole. He was the ultimate ruler above all earthly kings, people and nations, who determined and directed all their actions. According to the researcher, God's power cannot be adequately understood if it is separated from His authority. The power of God as king is precisely the power to exercise His authority. This means that God's power is power-over: power over other powers and power over God's creatures. This power-over is a different power to His power-to, His capacity to act. This power-over becomes particularly clear in God's rule, which presupposes beings that are liberated, commanded, controlled and judged by God. Without the authority of the liberating God, in which God's power-over is grounded, this power is misunderstood as despotism. In addition, God's power should also be understood from His ultimate purpose and goal: justice, peace and love for all. God's power over the powers of evil and sin is revealed in the way He has fought against them and triumphed over them in the life, death and resurrection

of His Son, Jesus Christ. The deepest word for both God's ultimate goal and for His way of achieving it is the love of God. This means that our understanding of God's power must be in accordance with God's love. Modern people easily identify power with oppression and violence. Moreover, in modern times, the phenomenon of power as such has become suspect because power is so often exercised arbitrarily and by means of manipulation, threat and coercion. The researcher argues that if we identify power with arbitrariness, oppression, violence, manipulation, threat or coercion, calling God powerful would make a monster of God. Stated differently: if we accept modern notions of power, we have to say that the loving Father of Jesus Christ can have no power. On the other hand, the concept of a powerless God would contradict the Biblical witness about God's present kingship and God's coming kingdom. Fortunately, the modern definitions of power are far from self-evident. Power in general and the power of God in particular can be understood in better ways. Firstly, it should be noted that the exercising of authority and the right use of power are necessary conditions for communication between human beings in an order of justice and peace. Secondly, it must be remembered that God's power is not quantitatively, but qualitatively different from human power. According to the research, if we understand God's power quantitatively as an infinite amount of the force we find in physical reality and the influence we find in human society, we wrongly apply a zero-sum conception of power to God. This conceptualisation implies that the more power one has, the less power others have, and vice versa. If we apply this conception of power to the relation between God and man, any power of God would threaten the power of human beings and vice versa. God's power-over, though, does not destroy, but demands and creates free human obedience and cooperation. This shows that God's power is exercised on another level than that of the physical force or human influence. Apparently, God's power can cooperate with human power without diminishing it. In order to further specify the power of God, our king, the researcher distinguished five means by which power-over is realised: moral influence, coercion, oppression, physical force and physical violence against people. According to the researcher, when we ask which of these are implied by God's power over other powers and over God's people, the following can be said on the basis of the Biblical witness about God's kingship and coming kingdom: God surely has influence over people through His law and His Spirit, but God's command and inspiration do not coerce them, because God demands free obedience and wants to cooperate with them. Oppression is excluded, because God is no despot, but the liberator who wants the salvation of His people, and ultimately of mankind. The realisation of God's coming kingdom will require a form of force, just as the creation did in the beginning, but it is impossible for us to understand this creative force because the physical force we know is an element of created reality. It is doubtful whether God's ultimate victory over and His judgment of the powers of evil will be possible without any form of violence against God's enemies. In the meantime, the exercising of God's authority as king in human history is not violent because it is the rule of both the Father and the Son in the mode of the Spirit. Eventually, God will defeat all the powers that wage war against His kingship and He will be acknowledged as king by all His creatures. In this way, God will create justice and peace for all, and all will enjoy God's love.



Images that illustrate biblical stories find expression in various public media.

### Time and eternity

In this research project, *Binne of Buite die Blokkie? 'n Poging om lets oor Tyd en Ewigheid te Sê (Inside or Outside the Box? An Attempt to Say Something about Time and Eternity)*, the researcher investigates the dialogue between theology and science, with special reference to eschatology. He examines the relation of time and eternity as a leitmotiv and bases it on the view that the latest insights from physics enrich the theological debate and vice versa. He argues that neither discipline is indispensable to the other. According to the researcher, the perception that the asking of factual questions is the domain of the natural sciences and that theology's role is only to make value statements is no longer relevant. 'What?' and 'How?' questions complement each other in almost every field of science – including theology – and assume that the nature of the subject being investigated will determine the methodology and vice versa, and that the methodology will impact on the result. This is a circular argument from which science cannot escape. The researcher stresses that cognisance should be taken of the fact that both science and theology are in their own unique ways involved in the search for answers to questions regarding reality. It is therefore important that science and theology engage in conversation with each other on this topic. The research proposes a network that will result in an interaction between the time of man (endogenic time), the time of the world (exogenic time) and the time of God (transcendental time): a possible solution to understand the conflict between science and theology. According to the researcher, there is a

growing interest to incorporate the understanding of the Trinity as a heuristic model to solve the problem of time and eternity. He argues that we should turn our attention to the Creator and stop fixating about the creation. Because time is an attribute of the Trinity, whose immanent being is neither static nor timeless, eternity is therefore not timeless either. Creation was therefore not the beginning of time, but rather the transformation of time. This also applies to the recreation when Christ will be everything in everyone.

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### New Testament Studies

#### Misunderstanding, irony and mistaken identity in references to Jesus as *Kurios* in John's Gospel

Part of the difficulty of dealing with the Christology of John is the question of how the *kurios* references should be interpreted in terms of Jesus. *Kurios* is the Greek word for 'God', 'Lord' and 'master'. Some scholars assume that *kurios* does not have the same central significance for John as it does for Paul. Hence, the important role of the *kurios* terminology in John's Gospel is sometimes either overlooked or underplayed. With the discovery of the Genesis Apocryphon at Qumran, it became clear that *kurios* was not only used as a polite term to address

people in authority, but also without linguistic distinction in terms of God. The first Christians also transferred to the risen Jesus the respectful address as 'my Lord', and thus gave the resurrected One this designation. One can expect that the term *kurios* would never be read in a simplistic manner by post-Easter Christians whenever it is used to refer to Jesus. Even when characters mistook Jesus's identity, addressed him politely as *kurios* and misunderstood the metaphors and imagery on the surface level, a Christological undertone remains present from the reader's point of view, encloded in irony. Although the characters in the narrative might find themselves in a situation of mistaken identity when it comes to the true nature of who Jesus really is, both the author and the reader are looking back at the situation with deeper knowledge and insight. From their perspective, addressing Jesus as *kurios* in different situations by those characters is the ironic confirmation of His identity, without the characters themselves knowing who He is. There are thus some reasons to believe that the narrator might have intended a double meaning in his use of the term *kurios*. The narrator's use of techniques, such as misunderstanding, irony and mistaken identity, masterly reveals the true identity of Jesus as a divine being, bringing out the true meaning and succeeding in explaining more fully the matter he is actually dealing with. From the perspective of a post-Easter reader, when characters address Jesus

as *kurios*, it is an ironic situation. Although the character's intention is to address Jesus politely as a human being, the reader knows the Christological meaning of the term. One can assume that the narrator might have intended the use of *kurios* ironically as recognition and confession of Jesus's identity. There is a progressive revelation of the true identity of Jesus, which finds its climax in Thomas's confession when he uses this term (20:28). By the time that John's Gospel was written, it was a loaded term that could not have been detached from the established Christological sense that it gained after the Easter event. Firstly, its divine connotation was made in the LXX where it was used for Yahweh. Secondly, the use of *kurios* as a form of address elsewhere in New Testament literature confirms the Christological meaning that it gained through early Christian tradition. The reader knows more and reads the narrative behind the shoulder of the first intended reader. This is a post-Easter book that emphasises the divinity of Jesus. They address him as *kurios* without knowing that he is "I am"; indeed The Kurios. As readers move from one level of understanding to another, they are undergoing a social transformation. Jesus is pictured against the backdrop of being the Logos who came into the world. No one can see God, but Jesus is actually the revelation of God (14:9-11). The narrator leads the characters and the reader towards recognition that Jesus is the Lord. He presents himself as the fulfilment of the human need for the ultimate relationship with God. Skilfully utilising misunderstanding, irony and mistaken identity, John moves the reader towards orientation with regard to Jesus, the incarnate Son of God.

### An overview of the extent and diversity of methods utilised by the author of Hebrews when using the Old Testament

The focus of this study is particularly on the methods that were applied in using Scripture by the unknown author of Hebrews. He made use of a diverse range of techniques when interacting with and presenting his Old-Testament material. This includes a catena of explicit quotations, expansions on existing quotations from the tradition, a hymnic reworking of quotations, and his own added commentary (Midrash) on quotations, paraphrases, references and allusions. Although this unknown author selected a large number of passages from the early Jewish (Dead Sea Scrolls and Philo) and early Christian (Pauline) traditions, it is clear that some of these found their way into his document due to his own contribution. There is good reason to believe that the quotations formed the backbone or original structure for the author's argumentation in the book of Hebrews. They are clearly presented in two sets of seven pairs each. The first set consists almost exclusively of hymnic texts, whereas the second set alternates consistently between a quotation pair from the Torah and a Prophet, and a quotation pair from the Torah and a Psalm. Some further observations surfaced during the researchers' survey. The exegetical methods seem to be close to those used in the Jewish traditions. The midrashic sections of the document and the use of messianic texts mirror a profile that is closer to that of Qumran. The absence of allegory is striking and also differs from Philo in this sense – although both were using the same texts for their Torah quotations. Most of the themes discussed in Hebrews are linked to 'promise texts'. Hebrews 11



The first Christians addressed the risen Jesus respectfully as 'my Lord'.



should be read alongside this tendency. Not only the two sets of seven explicit quotations, but also the midrashic sections and the history list of Hebrews 11 are all well planned and well structured. The catena of Hebrews 1, with its seven quotations, seems to be closer to a mystical tradition. The conflated quotations show tendencies of parallelism, symmetry and hymnic inclinations. (Is this perhaps pointing to liturgical traditions? What role did knowledge of the Jewish festivals play here?) The unknown author of Hebrews is a skilled exegete who creatively used and interpreted his Scriptures. The book presents itself not as a discourse with random ad hoc phrases and quotations from memory, but rather as a well-planned, well-structured and well-thought-through exposition, based on a thorough knowledge of the Jewish Scriptures.

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### Jesus's parables of the kingdom of God: a social-scientific and ideological-critical interpretation

The parables of Jesus are creative and powerful ideological symbols of the kingdom of God. This definition of Jesus's parables is based on a number of presuppositions. All knowledge is ideological in that it represents the vested interests and viewpoints of particular social groups in specific situations. This is also true with regard to Biblical texts: the ideas they communicate are related to and are expressions of the specific interest, perspectives and goals of the groups or individuals from which they emerge. Ideology refers to the articulation of a social group's views and values that legitimate and reinforce or challenge the present order and practice against competing groups. Ideology, therefore, relates to a social construction of reality. Ideology is expressed by means of social and metaphysical core values. Core values manifest in social norms in order to give meaning to the activity of the group, its identity and ethos. In the first-century Graeco-Roman context, the concept 'kingdom' denotes 'Empire language', which had the connotation of the maintenance of patronage and power, and marginalisation of clientele. For Jesus, the kingdom of God was a core value. The parables of Jesus articulated the kingdom of God, which subverted the ideology of power in symbolic terms. Understood as such, the parables of Jesus are symbols of the kingdom of God. The parables of Jesus are diaphoric symbols. A parable juxtaposes two

contrasting entities (diaphors), and thus has the power to create something new. The main function of the parable is not simply to instruct, but rather to challenge. This challenge is provided by juxtaposing two conflicting views on reality (God as merciful and just patron of the kingdom vis-à-vis the Holy God as patron of the temple) so as to provide new insight. Jesus's use of parables as symbols of the Kingdom of God also relates to the distinction made by the sociology of knowledge between a symbolic universe and a social universe. The term 'symbolic universe' refers to an all-embracing frame of reference that, through symbols and language, defines and creates a 'world', that is, real worlds or textual worlds. The term 'social universe', on the other hand, refers to the way in which the understanding of a symbolic universe precipitates in a specific arrangement of social institutions (economy, politics, religion and kinship). One's understanding of the symbolic universe (God), thus leads to a certain ordering of society. Graeco-Roman Empire ideology is comparable to Judean/Israelite Temple ideology. Temple ideology resulted in an understanding of the politics or ideology of exclusiveness (the separation between socially and religiously 'pure' and 'impure'). Jesus's understanding of his heavenly Father in terms of the Kingdom of this Father is expressed in parabolic language. Jesus's understanding of his heavenly Father as just and merciful resulted in a politics of open commensality and inclusivity. The social universe depicted in the parables of Jesus, therefore, subverted the social universe as advocated by the Temple and the Graeco-Roman Empire. The parables of Jesus thus challenged people to adhere to a different ideology with regard to the God of Israel. Findings thus far are that the parables of Jesus are (ideological) symbols of the kingdom, that Jesus was against any kind of violence, that Jesus advocated generalised reciprocity, that the Jesus of the parables can be typified as a social prophet, that the parables are not theocentric, and that Jesus sided with the marginalised and criticised the system of patronage.

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### The RDP of the soul – violence, revenge, tolerance and Paul's appeal for endurance

In this research, Prof Andries van Aarde investigates the consequences of violence that deprive people of both dignity and freedom. He uses the five categories identified by the philosopher Fanie de Beer, an extraordinary honorary



professor in the Department of Information Science at the University of Pretoria, to define the impact of violence. These are: a crisis of being and existence, which amounts to the destruction of a person's being, a crisis of meaning and value, which amounts to a person becoming a no-thing, a no-being, a worthless being, in other words it destroys his or her worth, a crisis of language, referring to 'cursing', which leaves people 'speechless', an 'us' crisis, which means the 'loss of love' and a loss of the togetherness that binds people together in a social context, and a life crisis, which amounts to people taking their own lives in 'utter desperation'. Violence manifests in so many forms and degrees that reflection on the problem could leave one with a feeling of desperation. Crime, rape, the mistreatment of children and xenophobia are threatening to not only quench the soul of people trying to be a living being in South Africa, but also to extinguish the rainbow nation's light. Addressing the problem calls for a drive that transcends the interests of political groups and requires multidisciplinary and interdisciplinary input from thinkers and doers from almost all scientific fields. He asks the question whether or not Christianity can play a role in breaking the cycle of violence in the country, citing the spiritual journey of the apostle Paul as an example of how love can overcome hate. Paul linked the concept of 'tolerance' to future hope – as he also did in his last letter to the Romans (Romans 5:3). In his last letter, however, also writing from Corinth almost a decade later, his thoughts on the matter were radically different from when he had written his letter to the Thessalonians a decade earlier, also from Corinth. At that earlier stage, his thinking had been that the love for one another in the inner group would earn the respect of the outside group: those outside the Christian faith community (1 Thessalonians 4:12). However, he found it impossible to show love to the outside group: those who were so murderous and who had shown so much violence and hostility towards his people, to himself, the earlier prophets and also towards Jesus (1 Thessalonians 2:14-16), but to deliver them unto the apocalyptic vengeance of God's wrath. During Paul's spiritual life journey, a change in attitude set in as far as the initial undisputed distance between an inner group and an outer group was concerned. What has happened here? It appears as if 'tolerance' was given a new definition, because 'hope for the future' had been internalised. In obedience to the philosophy of Christ to turn the other cheek, Paul implemented this in his own life, not because he was motivated by tradition or good manner, but

because he wanted to transform himself into a role model for others to follow. Within the Pauline paradigm, faith, love and hope are gifts from God. When you have internalised those in such a manner, you would unlimitedly grant life to others, and as God, the Spirit and Jesus did, you will begin to turn the other cheek, rather than take revenge through violence and murder. What is the appeal? Perhaps love can conquer hubris. Strong moral leadership – by the President and the people of South Africa – can make a difference when Christians truly internalise tolerance and hope for the future. He appealed to churches to continue to speak out against violence, to stand with those who are wronged, and to rise up in outrage and compassion against injustice and suffering, even if it causes embarrassment to those in power.

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## Old Testament Studies

### Historical commentary on the Old Testament

The objective of this project is governed by the aims and goals as outlined by the editors of the series *Historical commentary on the Old Testament*. In this commentary, the relationship between the genesis of the text of Isaiah 1 to 12 and its final form is examined: between the centuries-old history of exegesis of these texts and their contemporary expressions. Explicit attention is devoted to the history of the interpretation of the book of Isaiah and specifically chapters 1 to 12 – as can be discerned in the Hebrew canon itself and as has continued subsequent to the close of the Old-Testament canon. This commentary's research question is thus twofold: it is firstly of a literary nature, and secondly of a historical nature. The research found that this research question has led to the formulation of the following hypothesis: the text of Isaiah 1 to 12 is the product of a multi-stage redactional-compositional process. A thorough text-immanent (intratextual) analysis, combined with an inter-textual and extratextual analysis, indicates a developmental history of the text of Isaiah 1 to 12 in different layers. In spite of the fact that chapters 1 to 12 of the book of Isaiah are presented as a single block of literature that occurs at the beginning of the book of Isaiah, a detailed analysis of its content demonstrates that it is a composite work written over



The rotavirus leads to diarrhoea in infants, which especially causes conflict in the poorest communities.

the course of some centuries. The many interrelationships between the various parts of the book of Isaiah indicate successive re-readings of the Isaianic tradition in the light of later historical circumstances.

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## Science of Religion and Missiology

### The impact of diarrhoea in infants

The objective of this research project was to obtain a comprehensive understanding of the impact of severe diarrhoea in babies on the quality of life of a selected group of low-income households. Diarrhoeal diseases continue to be an important cause of illness and death worldwide. One major cause of infantile diarrhoea is the rotavirus, an airborne virus to which almost all children in both the developing and developed world will be exposed at least once. The study, as well as the clinical trials and cost studies, was commissioned by GlaxoSmithKline to assist in the decision-making processes regarding whether and how to implement a newly developed vaccine against rotavirus through national immunisation programmes. The study was qualitative, explorative and descriptive in nature. A recently developed quality of life (QoL) assessment instrument, based on a comprehensive list of fundamental needs developed by development expert Manfred Max-Neef, was used to assess the impact of diarrhoea in babies on households. The QoL instrument includes 125 open questions related to the basic necessities and activities, localisation, relationships and consciousness of household members. In addition, group and individual interviews were held. Twenty-nine households with

children younger than two years of age who had experienced diarrhoea in the previous two months were selected. By means of a number of medical questions related to the duration of the diarrhoea and related symptoms, babies with severe diarrhoea were purposively sampled. After analysing the data, these babies were classified as follows: 20 had severe diarrhoea, six had moderate diarrhoea and three were diagnosed as having mild diarrhoea. Two babies had previously been admitted to hospital. Of the 29 households surveyed, 22 households were interviewed using the QoL assessment instrument, and seven households were interviewed by means of group and individual interviews. The researchers found that poor housing conditions exacerbated the effect of diarrhoea in infants on the primary caregiver, as well as the other household members. Household members complained about the sound of the babies crying and almost half of the mothers reported that they felt stressed or ashamed about the quality of the air in their dwellings. One mother said that the smell was so bad that she could not eat her food because it caused her to vomit. The lack of basic necessities, for example the shortage of water in a number of households, intensified the struggle to cope with the diarrhoea. It was found that the burden of care fell mainly on the mothers of the babies with diarrhoea. The pressure experienced by some mothers seemed to be related to the way they experience their identity. Mothers indicated that they felt responsible for tasks in and around the household, including the duty of caring for their children. This places a physical and emotional burden on the primary caregiver. Diarrhoea was the cause of tension and conflict in a number of households, not only because of inflated financial costs related to efforts to cope with the illness, but also because of differing views among household members regarding the most suitable treatment: Western or traditional medicine. Mothers identified different causes of the diarrhoea, including teething, heat, wrong food and 'the problem of the fontanelle'. It became evident that some mothers believed that a sunken fontanelle was the cause of diarrhoea, and this was believed to be best treated by traditional healing methods. The researchers concluded that a vaccine against rotavirus diarrhoea could benefit the households by reducing the emotional and physical burden of care on the mother and reducing the financial burden that childhood diarrhoea imposes on households. The researchers cautioned that the findings showed how rotavirus vaccines could be an adjunct to the primary prevention approach for diarrhoea diseases in children. A vaccine will not provide a substitute for all the other important requirements of a respectable quality of life, such as love, care, education, healthy nutrition, a regular, safe water supply and good sanitation. It is also important to interpret the findings in conjunction with other rotavirus vaccine clinical trials and cost-benefit studies.

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## Use of condoms to fight HIV/AIDS

Correct and consistent condom usage remains a pivotal strategy to reach the target set by the South African government to reduce new HIV infections by 50 percent in the next five years. Studies have found that there has been an increase in condom usage by some categories of the population, but usage has not yet reached the desired levels to meet the target. In this project, the researchers focused on condom usage in eight communities in North West, which was part of a wider HIV/AIDS programme evaluation commissioned by the North West provincial Department of Health. The main aim was to assess accessibility to condoms, and knowledge, attitudes and practices around condom use by four sampled communities in North West. Eight focus group discussions were held and 50 households were interviewed. The study found positive results regarding accessibility and awareness of condoms. However, this often did not lead to the desired behavioural change of using condoms in risky sexual interactions. The majority of respondents still resisted condom usage, used condoms inconsistently, or were not in a position to negotiate protected sexual intercourse. The main reasons reported for this were reduced pleasure, perceived and real physical side effects, myths, lack of information, status, financial reasons, distrust in the efficacy of condoms, family planning, cultural reasons, gender-related reasons and trust. Many of the barriers to consistent condom use cannot be overcome by strategies that target the individual. Interventions need to address underlying developmental factors such as the non-biological factors that increase the susceptibility of women to HIV infection. As this falls outside of the scope of the mandate of the Department of Health, various partnerships with other key role-players need to be established and/or strengthened, such as those with local government, non-governmental organisations and faith-based organisations.

## The African agent discovered

The aim of this research project was to investigate the participation of the African biblical interpreter in Bible translation. It is widely acknowledged that the church in Africa is well established. Even so, it is still necessary to note that, to a large extent, the church is in the process of establishing itself as an African church. The African church continues to validate itself as truly African and not some foreign religion. The presence of the Bible, including the process of Bible translation, is integral to this process. As a result of the way in which the Bible was appropriated to use during the process of colonialism, as well as the way in which the Bible accompanied Western missionary endeavours that often operated hand-in-hand with colonialism, some of those in the African church view the Bible with scepticism. In the light of this, the participation of the African biblical interpreter in Bible translation is not yet fully understood or appreciated. As long as the African church does not properly own the translation process, the Bible could be viewed largely as a foreign book. It will then not be viewed as being sufficiently relevant for the African church or even the African continent as a whole. The effectiveness of establishing the African church as truly African depends on the involvement of an African agency in the interpretation of the Bible. The translation of the Bible into African languages is one of the key factors in this process. The production of accurate and culturally understandable translations, including the acceptance and application of the Bible by the African church, will be enhanced by the involvement of the African biblical interpreter in the Bible translation process. The researcher argues that even though not readily acknowledged by the African church, ownership of and involvement in Bible translation are important to the appropriation of the Christian message. Assessing the data examined in this research, the researchers came to the



The participation of the African Bible interpreter in Bible translation is important. Pastor David Mahlangu (left) and Pastor Mabetha Petrus are engaged in the translation of bibles into African languages in the Faculty of Theology.

conclusion that an African agency, albeit the African church, does not yet acknowledge or understand the role of the African biblical interpreter in Bible translation. On the other hand, foreign agencies acknowledge and understand the role of the African biblical interpreter in the translation process. It is important to take note of this dualism, as it will have an effect on the appropriation of the Bible into the life of the African church, and the African church could remain vulnerable to the agenda of foreign proponents of Bible translation. An African agency can make a valid contribution to the Bible translation process. It is acknowledged that the surface of this field of study has hardly been scratched. There are many areas that still need to be explored. Some of these areas are the role of African women in Bible translation, the involvement of an African agency in the appropriation of the Bible, the story of African involvement in Bible translation, which should be told, the hindrances to the indigenous discovery of Bible translation, and translation tools developed by African biblical interpreters. These areas should be identified and made available to the worldwide process of Bible translation.

### Ancestor worship – is it biblical?

Ancestor worship is practised in different forms around the world today, even in societies participating in the modern global economy. Ancestral beliefs are deeply dependent on the premise that the souls of the dead may return to the living and influence their lives, that it is possible and acceptable for the living to communicate with the dead, and that the living are able to exert an effect on the destiny of their deceased ancestors. The following issues are most relevant to ancestor worship: death and the afterlife, the possibility of communication between the living and the dead, and the destiny of believers who die. The researcher investigated these issues from a Biblical perspective, offering Biblical guidelines in assessing ancestor worship and its cosmology and interpreting ancestor worship theologically. According to the researcher, the ritual practices associated with ancestor worship are heavily reliant on the premise that the dead are able to return to the living and have an influence on the lives of the living, that it is acceptable for the living to communicate with the dead, and that the living are able to exert an influence on the destiny of the deceased ancestor. He argues that the Bible condemns necromancy and associated practices, and ancestor worship is therefore not in alignment with the principles of the Bible. Secondly, he points out that although some individuals experience what appears to be the spirits of deceased ancestors, the Biblical evidence that has been presented makes it clear that these experiences or apparitions should not be taken 'at face value'. Furthermore, the Bible makes it clear that once a person has died, it is impossible for him or her to return to communicate with the living. It is clear from Romans 6:23 that all men die and that death is the wage of sin – an inevitable consequence. The only incident in the Scriptures that has been the source of dogmatic controversy is the incident where Samuel 'appeared' to the Witch of Endor (1 Samuel 28). The explanations that have been put forward have made it clear that what was 'seen' was a result of the special working of God's power, by His permission and for His purposes. As the Bible clearly admonishes, those who dabble in necromancy or spiritism commit what is considered to be spiritual prostitution. The

abode of the dead, which is expounded in the Scriptures, is known as hades or purgatory. Hades and purgatory refer to the common grave of mankind, where all souls are destined to go once they have died a physical death. The final destination of the righteous souls is heaven. Therefore, the analogy of Lazarus and the rich man cannot be construed to prove that the living can communicate with the dead or that the living can have a bearing on the destiny of the dead. It was not possible for the rich man to communicate with his living relatives to warn them of their imminent fate if they did not mend their ways. The Scriptures clearly indicate that the righteous who die are immediately reunited with Christ (cf Luke 23:43, Philippians 1:23). At the resurrection, those who have died will be changed and resurrected with a spiritual body to allow them to enter into a fuller state of fellowship with God. The notion of the immortality of the soul is a major precept of the ancestor cult. However, the New Testament's promise of a resurrection refers to the resurrection of the whole body. The notion of the soul existing in an intermediate state or a deep sleep, which is fundamental to the ancestral rites, is contradictory to the teachings of the New Testament. Passages in the Bible that deal with death as a sleeping state, such as Matthew 9:24, 1 Corinthians 15:51 and 1 Thessalonians 4:13, could be construed as a metaphorical description to ensure that mankind does not fear death, rather than a description of an intermediate state. Some scholars have tried to prove that Christ descended into hades after his death to minister to the dead or to proclaim his victory over them. It became clear, however, that scriptural proof of such doctrine is contentious and that the meaning of 1 Peter 3:18-20, the classical scriptural reference, is obscure. The living is not able to effect a change for the good of the dead. The salvation of mankind is based on Christ's ransom sacrifice on the cross and sacrifices that are made for the dead are therefore of no value. The researcher argues that the notion of vicarious baptism, which has been suggested by some scholars, does not have sufficient evidence in exegetical or hermeneutical terms to make it a credible argument. Paul denies the interpretation of vicarious baptism when he says in 2 Corinthians 5:10: "For we must all appear before the judgment seat of Christ, so that each one may receive good or evil, according to what he has done in the body." Therefore, it is clear that the final destination of each individual is dependent on their own faith and actions while they were alive. Each individual is accountable to God. Once a sinner has died, the wages of his or her sins cannot be paid by the living. In other words, the central premise, which underpins the theology of ancestor veneration, is flawed. It is impossible for the dead to communicate with the living and it is impossible for the living to improve the destiny of their deceased ancestors. The New Testament is clear that there is no way for the dead to change their fate. The researcher concludes that ancestor worship is incompatible with the Christian faith.

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## 6.9 Faculty of Veterinary Science

The Faculty of Veterinary Science aims to increase the number of postgraduate students and make research a primary thrust to stimulate and focus the faculty's research programme on unique South African animal disease problems.

### Message from the Dean

The year 2008 was the third year of the five-year strategic plan of the Faculty of Veterinary Science.

The faculty's research endeavours again showed steady growth over the past year. The subsidy units earned from the Department of Education for publications have been steadily increasing since 2004, with only a slight drop in 2007. All the faculty's publications were again placed in the higher category of journals accredited by the Institute for Scientific Information (ISI). There was also a substantial increase in the number of master's and PhD students over the same period (from 150 in 2004 to 216 in 2008), accompanied by an increase in the funding available for postgraduate bursaries. Although the number of postgraduate students has also been steadily increasing over this period, the time to qualification of master's students is of the highest in the University. This is receiving attention. The faculty received several large international research grants during the year.

The number of NRF-rated staff members increased from 15 in 2006 to 17 in 2008. Unfortunately, the faculty lost three of its NRF-rated researchers at the end of the year: one due to retirement and two as a result of emigration. Excellence in research performance was again recognised through the identification of the faculty's top ten researchers. These awards are presented at the annual Faculty Day, when the Researcher of the Year and Young Researcher of the Year awards are also made. The Researcher of the Year award, which is made on the basis of productivity, as reflected in subsidy units earned, was presented to Prof Johan Nöthling. The Young Researcher of the Year award, which is made using slightly different criteria, was presented to Dr Eran Dvir.

Faculty Day has formed the focal point of the faculty's academic programme for some 24 years. It provides a forum for staff and postgraduate students to share the excitement of their research findings or experience with both students and colleagues, and has contributed significantly to the faculty's research effort over these years. The Sir Arnold Theiler Memorial Lecture, which is presented by an esteemed veterinary scholar, scientist or researcher in honour of Theiler's contribution to veterinary science, remains a highlight of the proceedings. This year, Dr Gideon Brückner, Deputy Director of the World Organisation for Animal Health (OIE), Paris, and also an alumnus of the Faculty of Veterinary Science, was invited to present this lecture in recognition of his outstanding contribution to international animal disease control. His highly relevant and most interesting lecture formed the background to 11 oral and 16 poster presentations by staff and students.

A final highlight of the year was the Onderstepoort Centenary Pan-African Veterinary Conference that was presented at the faculty from 6 to 9 October 2008 as part of the centenary celebrations of the Onderstepoort Veterinary Research Institute. This coincided with the centenary of the University of Pretoria. Some 15 international and 15 local speakers delivered lectures that covered historical aspects and present-day research on animal diseases in Africa, as well as future challenges. Associated social functions included the opening of a National Veterinary Museum, the launch of a book on the history of Onderstepoort and a commemorative stamp, as well as a gala dinner attended by President Motlanthe.



Prof Gerry Swan, Dean

Prof Gerry Swan  
Dean



Arnold Theiler Building



## Research highlights

### Companion Animal Clinical Studies

#### Radiological tracheal dimensions of the normal thoroughbred horse

Radiological tracheal dimensions of the horse can be used effectively to evaluate upper and lower respiratory tract conditions due to the gradient of pressure changes between these areas. Lateral radiographs of the trachea of 15 clinically normal sedated thoroughbred horses were made at inspiration and expiration, and magnification corrected mean airway heights measured. The ratio of tracheal height to the thoracic inlet was respectively 0.15 and 0.15. Although not statistically significant, there was a trend towards a higher tracheal height at expiration. No correlation was found between tracheal height and body mass or height at the withers. Radiographic tracheal height evaluation can be made independent of the respiratory phase in sedated horses. It is recommended that ratios of tracheal height to an adjacent vertebral body length are more reliable for comparison between horses, and tracheal height measurement should be made at C5, due to a lower standard deviation. If only thoracic radiographs are made, measurements of tracheal height can be made at the thoracic inlet.

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#### *Babesia rossi* and its association with outcome

Acute phase proteins (APP) are ideal biomarkers for inflammation due to their stability, relative ease of assay and the apparent relation between their concentration and the extent of the insult to tissue. C-reactive protein (CRP) is a positive major APP in dogs and can be used as a predictive marker for risk of disease and to monitor the response to treatment. Increased concentrations in certain diseases are associated with poor outcome. This cross-sectional, observational study of 75 dogs naturally infected with *Babesia rossi*, a cause of virulent canine babesiosis, was designed to examine the relationship between CRP concentration at admission and the magnitude of CRP change 24 hours after admission, with outcome. Dogs were excluded if there was evidence of concurrent inflammatory diseases at the time of admission, infection with subtypes

other than *B. rossi*, concurrent *Ehrlichia canis* infections or euthanasia for reasons other than poor prognosis. Diagnosis was confirmed by polymerase chain reaction and reverse line blot. CRP concentrations were determined by an automated human CRP Turbidometric Immunoassay (TIA) on serum samples collected by jugular venipuncture on admission, prior to any therapy, and thereafter daily until discharge or death. The researcher found that there was no significant difference in mean CRP concentration between survivors and non-survivors at admission. Using the exact logistic regression, adjusting for age and sex, there was no association with outcome. Multiple regression analysis failed to show a significant relationship between admission CRP concentration and the number of days of hospitalisation in the survivors, adjusting for age and sex ( $p=0.65$ ). Similarly, no significance was found in the relationship between the magnitude of change in CRP concentration 24 hours after admission and the number of days of hospitalisation in survivors ( $p=0.34$ ). Using an admission CRP concentration cut-off of 60 mg/l, survival proportions between the two groups were no different ( $p=0.34$ ). When applied to the group of dogs that survived, it was not associated with length of hospitalisation ( $p=0.25$ ). The researcher concluded that CRP concentration, as a measure of the acute phase response, is not associated with outcome in canine babesiosis, and inflammation is unlikely to be the only cause of severity of disease. Other causes, including individual susceptibility, parasite phenotype and tissue hypoxia, are speculated to play a more important role.

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### Paraclinical Sciences

#### Nile crocodile deaths in the Kruger National Park

Between June and September 2008, the carcasses of approximately 150 Nile crocodiles, *Crocodylus niloticus*, were discovered in the Kruger National Park's Olifant Gorge. However, researchers believe that a large number of carcasses might not have been detected because of the remoteness of the area and that the actual number of deaths might be as high as 500. The total population in the gorge was estimated at approximately 1 000. This means that half the population died within a short period of time. Another worrying factor is that all the dead crocodiles were large (more than three me-



tres in length), mature animals. The loss of most of the reproductively active animals may seriously influence the ability of this population to recover in the near future. Post-mortem and histopathological investigations indicated that the crocodiles died of a condition called pansteatitis, also referred to as yellow fat disease. It can be described as a generalised inflammation of body fat and usually involves subcutaneous as well as intra-abdominal fat deposits. It is commonly found in animals that live on a diet high in polyunsaturated fatty acids. The researchers found that all the dead crocodiles from the gorge were very fat and, except for the fat lesion, no other pathology was observed. Clinical signs include a general hardening of body fat and a change in colour from white to yellow. These changes in all body fat deposits cause the crocodiles to become stiff, causing a reduction in mobility and even an inability to swim properly. Affected crocodiles become reluctant to enter the water and do not move away when approached. This leads to a slow death due to exposure, starvation and even drowning. At this stage it is not yet clear what triggered the pansteatitis outbreak in the Olifants Gorge. It is thought that the pansteatitis in the Olifants Gorge crocodiles could have been started by illegal fishermen from the Massingir Dam using their gill nets in the gorge. They most probably dumped unwanted or petrified fish or intra-abdominal organs in the water. Another possibility is that the crocodiles used the opportunity, with the gill nets in the gorge, to 'steal' large numbers of dead fish from the nets. Pieces of gill nets were found with some of the crocodiles. In addition, cannibalism might also have played a contributing role in sustaining the mortality by triggering the same reaction in crocodiles eating affected crocodiles. The large volume of oxidised fat in a sick crocodile is most probably enough to trigger the reaction in other crocodiles feeding on a pansteatitis case. This is the most logical explanation for the ongoing crocodile mortality in the gorge. No fish die-off was observed in the gorge before the pansteatitis outbreak started. However, post-mortems done afterwards on several fish species from the gorge clearly indicated that they were not very healthy. Blood smear and histopathological abnormalities were commonly observed. The significance of these findings in the fish from the gorge is still under investigation. A possible connection with the pansteatitis is that sick fish would be easier to catch and that crocodiles could overeat if slow-moving fish are abundant. A cyanobacterial bloom was observed before and during the early stages of the outbreak, but the relationship with the crocodile pansteatitis and the fish pathology is still unclear. Another hypothesis is that healthy crocodiles eating pansteatitis-positive crocodiles (cannibalism) are most probably taking in enough oxidised fat

to trigger the same reaction, especially the intra-abdominal fat that is easy to consume in large quantities. This is the most likely explanation for the ongoing crocodile mortality in the Olifants Gorge and the Letaba and Olifants rivers.

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### Small-scale fodder production

In North West, there are small black communities living on commercial farms who have a right to live there, but who are unemployed and have no source of income. Some own cattle, sheep and goats, which are managed under an unproductive subsistence system. On the other hand, commercial livestock farmers, especially dairy farmers in the province, often experience a shortage of feed for their animals during winter. The aim of this project was to encourage commercial farmers to establish fodder plots that can be managed by unemployed residents on the farms. The farmers will be assisted with the planning of their fodder plots. They will receive start-up funds for the establishment of such plots and will settle the labour costs incurred. Fodder plots will be planted with carob trees, prickly pears, Japanese radishes and pumpkins. Once the plots are established, the workforce will not be paid any more, but they



Researchers are investigating the deaths of a large number of crocodiles over a short period.



Veterinary students examine a horse.

will be entitled to retain the produce for their own use, for consumption by their livestock, or they may sell it and retain the income. However, the farm owner will have the first option to purchase the fodder. This project will benefit previously disadvantaged communities by providing them with a source of income and by providing food for them and their animals. The commercial farmers will provide assistance to very poor, unemployed and demoralised communities living on their land, and will provide fodder for their livestock. In addition, new small-scale farmers will be trained to become proficient in sustainable, low-input agricultural production.

### Bovine arthrosis

Farmers and local veterinarians in the Vryburg area reported a new disease syndrome where cattle developed swelling in the weight-bearing joints and severe lameness. They eventually had to be slaughtered. The condition was identified as osteochondrosis, a form of defective formation of articular cartilage that is well known in several domestic animal species, but has not previously been reported on such a large scale in cattle. Preliminary investigations suggest that the cause is an imbalance of phosphorus and various trace elements in commercial mineral feed supplements. Controlled trials on a research station and a commercial farm have identified various trace minerals that might be involved. An experimental supplement is being formulated to correct the imbalance. The supplement is being tested under field conditions. If it is successful in preventing the condition, it will be made available under licence to an established feed manufacturer for commercial production.

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### Chemical immobilisation of wildlife

Wildlife is our natural heritage in Africa. In South Africa, the wildlife industry has grown tremendously during recent years. Consequently, the number of game animal species that are immobilised for various reasons has also increased. Many of the drugs that are routinely used for the immobilisation and tranquilisation of wildlife are considered to be 'old drugs' and are potentially dangerous. It is therefore important that innovative drug combinations and new and improved wildlife manipulating agents are investigated. A research project to evaluate butorphanol, a mixed opioid receptor agonist/antagonist, as an adjunct to etorphine in the immobilisation of wildlife, was carried out in various species, specifically the white rhinoceros, *Ceratotherium simum*. White rhinoceros were immobilised with a combination of etorphine and azaperone or etorphine, azaperone and butorphanol to evaluate the effect of butorphanol on blood gas parameters. The butorphanol was given at ten times or twenty times the etorphine dose. Preliminary data shows that there is a statistically significant improvement in both the oxygen saturation of red blood cells and the partial pressure of oxygen in the blood when butorphanol is given at twenty times the etorphine dose, but not at ten times the etorphine dose.

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## Veterinary Anatomy and Physiology

### The vaginal region of ratites

The ostrich and emu industries are major contributors to the South African economy. The focus of reproductive research on these ratites has shifted from natural forms of breeding to artificial insemination. Although semen is generally deposited in the cloaca, it is the vaginal region of the oviduct that plays an important role in the survival of spermatozoa. Anatomically, the vaginal region in birds is homologous to the cervical region of mammals. A gross anatomical assessment of the oviducts of the mature ostrich and emu revealed the presence of mucosal folds in the vaginal region, which form a structure similar to the mammalian cervix. It is generally accepted that the mucosal folds in the cervical region of mammals impede the progress of defective spermatozoa. Based on the similarity of the mucosal folds in the vaginal region of the ratites studied and the cervix of mammals, it is possible that the functions of these two regions are comparable. Ultrastructurally, the epithelium lining the mucosal folds in the ostrich and emu was a combination of mucin-laden ciliated and non-ciliated cells. Research conducted on mammalian species has shown that cervical mucus either blocks or facilitates spermatozoal migration, depending on its viscosity. Physiological studies need to be carried out on ratites to determine the role of vaginal mucus in sperm survival.

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## Veterinary Tropical Diseases

### Molecular technology in action

Corridor disease, caused by the tick-borne protozoan parasite, *Theileria parva*, is of major economic importance. A real-time polymerase chain reaction (RT-PCR) test for detection of *T. parva* DNA in African buffalo and cattle was developed to improve the sensitivity and specificity of the official diagnostic package in South Africa. The RT-PCR assay requires less time to perform, is more sensitive than the other molecular assays previously used in *T. parva* diagnostics and can reliably detect the parasite in carrier animals with an extremely low piroplasm parasitaemia. A novel *Theileria* species, which was recovered from canine blood specimens, was characterised molecularly. This adds yet another micro-organism to the growing list of haemoprotozoa known to infect dogs. A novel *Babesia* parasite from a sable antelope was characterised molecularly and its phylogenetic affinities were determined. The RNA small segment 10 nucleotide sequences of African horsesickness (AHS) virus isolates were determined and their phylogeny investigated. The small size of the gene and the conserved terminal regions facilitate easy and rapid sequencing. This will be an essential resource for elucidating the epidemiology of AHS. Sheep were inoculated with a virulent strain of bluetongue (BT) virus serotype 4 to develop a reliable model for experimental reproduction of fulminant BT to better characterise the pathogenesis of this important disease of sheep.

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A rhinoceros being immobilised.



## 7. Community engagement



## Community engagement

The Department of Community Engagement advocates, initiates, facilitates, coordinates, promotes, supports, monitors, evaluates and reports on all the University's community engagement activities. It was established in 2007 and ceremonially launched in 2008.

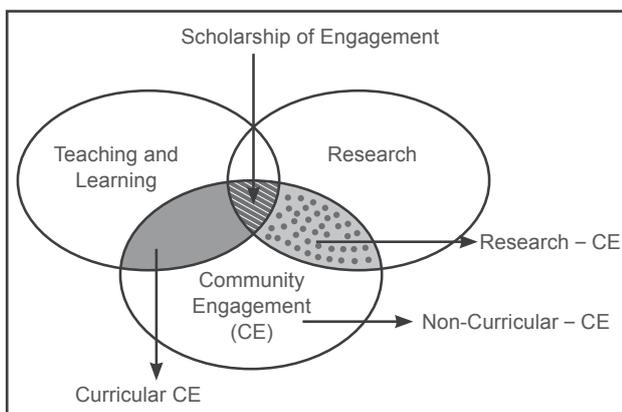
The department is structured in a manner that seeks to fulfil its mission. The Curricular and Research-related Community Engagement (CRCE) division is internally focused and seeks to integrate and embed community engagement into the scholarly endeavours (teaching and research) of the University, while the Community Engagement Programmes and Projects (CEPP) division seeks opportunities with external partners, whereby students can fulfil the obligations of their curricular community engagement modules.

The overall thrust of the department is towards a 'scholarship of engagement' that seeks to complete and sustain the loop of knowledge generation through community-engaged research. This focuses on the identified challenges faced by the University's own constituencies, which feed back into the curricula in the various disciplines to further empower scholars to engage new or different challenges that may be encountered.

### Curricular community engagement

The University has three core functions: teaching and learning, research, and community engagement. It acknowledges that there is some intersection among them. Curricular community engagement takes place where the roles of teaching and learning, and community engagement intersect. Research-related community engagement, on the other hand, takes place where research and community engagement intersect. Where there is no intersection, non-curricular community engagement takes place, for example volunteerism and community projects, which proceed as separate activities.

The CRCE division has established a contextual and conceptual framework for curricular and research-related community engagement based on qualitative institutional and curriculum research. This framework is developed for academic pro-



A model for curricular and research-related community engagement

grammes and is regarded as a methodology of teaching, learning and research that requires knowledge-driven, mutually beneficial partnerships with external entities, so that the University can benefit from more academic staff engagement with and in communities, as well as enhanced student learning and research productivity. The external community, on the other hand, benefits from increased knowledge and capacity to address community issues.



Prof Denver Hendricks,  
Director: Community Engagement

Curricular community engagement is a credit-bearing, educational experience and encompasses a curriculum (learning content), teaching, learning, research and scholarship activity that engages academic staff, students and community service agencies/organisations and community members in mutually beneficial and respectful collaboration. Their interactions address needs and assets that have been identified by the community, deepen students' civic and academic learning, and enrich the University's scholarship.

At the University of Pretoria, curricular community engagement can be divided into various types of community activity, such as community-based learning, academic service learning (an example of best practice), community service, internships, clinical practicals, practicums, work-based learning, experiential education, community-based education, cooperative education, community-based projects and community outreach.

### Mamelodi Campus

The Mamelodi Campus is a hub of community engagement activities and related research. Curricular community engagement activities are a major aspect of the academic activities on the campus with the focus in 2008 on a pilot after-school Mathematics programme for Grade 10 to 12 learners. Learners (n=130) took part in a survey to evaluate the programme, to implement improvement plans and to expand it to the areas of Science, English and Accountancy. The results reveal that the learners agree or strongly agree with the statement "My understanding of Mathematics and marks have improved because of the after-school Mathematics programme" (45 percent of Grade 10 learners agree, 63 percent of Grade 11 learners strongly agree and 42 percent of Grade 12 learners strongly agree). Learners indicated the following as the most important lessons learnt: (in terms of Mathematics content) knowledge and skills, (in terms of personal and social) learners enjoyed working with and meeting pupils from other schools, and (in terms of student teachers) learners felt that the student teachers explained Mathematics well and were good teachers.

## Research highlights

The following three research projects demonstrate the qualitative research that has been conducted on the contextual and conceptual frameworks and curriculum inquiry for curricular community engagement.

### The exploration of conceptual models for community engagement at higher education institutions in South Africa

A critical conceptual analysis of the South African higher education context reflects the lack of a structural and functional framework for the conceptualisation of community engagement in higher education. Dr Gerda Bender of the Department of Community Engagement has explored and published a framework and model for the conceptualisation of community engagement for a better understanding of community engagement at higher education institutions in South Africa. The silo, intersecting and infusion (cross-cutting) models for community engagement were presented and the attributes of a community-engaged university were affirmed. The conceptual analysis confirmed that engagement is fundamentally a dynamic and relational process (partnership), that it 'happens' at multiple levels in higher education institutions and in multiple sites in and over time, that it involves a political and an ethical dimension, and that it is a fundamentally educative practice.

### Curriculum enquiry about community engagement at a research university

This research study, with its analytical and theoretical enquiry into community engagement, revealed the four main dimensions of curricular community engagement: purpose or outcomes for the academic programme and module, content (syllabus), collaborative partnership (with a service provider and community), and educational community engagement practice. This study, conducted by Dr Gerda Bender of the Department of Community Engagement, dealt with the manifold interactions among these four dimensions, as well as the nature of each dimension. Given that the curriculum is based on the interaction, not on the individual parts, future research should determine the dynamic interaction of the academic programme with module outcomes, content (syllabus), collaborative partnerships and community engagement practice. Curricular community engagement encompasses theory and practice, so it must respond to the appeals of education action researchers that curriculum enquiry should deal with practice and curricular settings and be done by practitioners. Curricular community engagement practitioners should involve the service agency and community members in curriculum research and thus conduct cooperative and participatory action research, aimed at enhancing the scholarship of engagement.



The Mamelodi Campus is a hub of community engagement activities and related research.

### Community engagement at higher education institutions in South Africa: from a philanthropic approach to a scholarship of engagement

In researching the shift in attitude from a philanthropic approach to a scholarship of engagement in higher education institutions in South Africa and providing a conceptual framework, it is acknowledged that curricular community engagement requires new methods and strategies, which in turn require training and skills-building for the University and the community with which it builds a partnership. This research led to a proposal that creating and developing an academy of community-engaged scholars to deepen knowledge, share methods and improve practices would be a priority for the professional development of academic staff. The research finds that changes such as the introduction of academic service learning (ASL), which includes greater institutional engagement and responsiveness to community and societal needs, is becoming more central to institutional change at many universities in South Africa. It has been found to promote academic excellence, which is significant because the involvement of academic staff members is essential if ASL is to be embedded in academic programmes. It is suggested that the research university addresses this by institutionalising ASL and making the curriculum responsive to these needs.

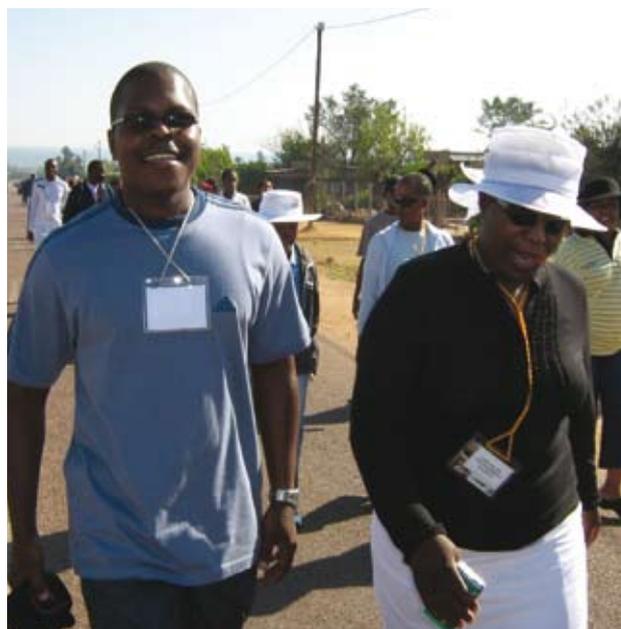
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### Community-based research

There is a growing body of research and project reports indicating that there are changes occurring in the way that research is organised and pursued at universities as they engage with external research partners from various communities. These changes in research design and methodology are represented at all levels. For instance, they are reflected in the way that research projects and programmes are defined and planned. They are reflected in the kind of output, outcome (in the short, intermediate and long term) and relevant local impact that are expected. They are also reflected in the support, organisation and management of the research. These changes manifest themselves to some extent at the University of Pretoria.

Community-based research, also known as participatory action research, is a particular research model in which community agencies/organisations, community members and civic leaders partner with academic researchers (academic staff and students) to produce knowledge that is used for the benefit of the community. In contrast to practices in which community members were simply 'human subjects' and passive recipients of information, community-based research values the local community's perspectives and active engagement at each phase in the research process.

The following three cases of community engagement performed by staff and students were selected for this year's research report. Community engagement at the University of Pretoria focuses on all sectors of the South African population, and is not limited to any particular racial group.



The Walk for a Book launch on community-driven projects.

### Engineering, Built Environment and Information Technology

#### Community-driven projects: reflections on a success story: a case study of science education and information technology in South Africa

The Siyabuswa Education Improvement and Development Trust (SEIDET) and the Department of Informatics have had a long relationship in terms of research and community development projects that are related to a socio-technical view of information technology. In May 2008, the Department of Informatics published a book on the work done at Siyabuswa, Mpumalanga, over nearly 20 years. With this book, *Community-driven projects: reflections on a success story: a case study of science education and information technology in South Africa*, the co-author, Dr Jackie Phahlamohlaka, a subject of the late King Mayisha III of the Ndzundza Ndebele people in Mpumalanga and systems modelling expert at the Council for Scientific and Industrial Research (CSIR), illustrates that tradition and science do mix. Abject poverty and illiteracy in Siyabuswa set the scene for the establishment of a community-based project aimed at bridging education imbalances, while promoting science, physics, mathematics and information and communication technology in the poverty-stricken area. A thought-provoking challenge by King Mayisha III to Phahlamohlaka led to the establishment of SEIDET and the history of this project is recounted in this book. King Mayisha III had challenged Phahlamohlaka to improve the conditions in the village after returning from Canada where he had completed his master's degree in the early 1990s. The successes of the project became the catalyst for the book. The book was launched under the theme: *A walk for a book*, and Dr Phahlamohlaka, other researchers, the local community and local government officials joined in the walk as part of the launch of the book. To date, SEIDET has been the subject of four PhDs at the University of Pretoria: three from the Department of Informatics (including one from the current

head of the department, Prof Carina de Villiers) and one from the Department of Physics (supervised by Prof Max Braun). Three master's degrees have also resulted from dissertations covering SEIDET. In addition, between 15 and 20 medical practitioners from the area went through the SEIDET Saturday supplementary tuition programme and completed their training at UP. Nearly all of them are practising in Mpumalanga and Limpopo. Through collaborative research involving the departments of Information Technology, Electrical and Electronic Engineering, and Curriculum Studies at UP, the role of telecommunications as an enabling factor in the development of a required network infrastructure for distance teacher education support was established. The research focused on establishing a self-sustainable computer laboratory at the SEIDET community centre in order to explore computer-supported cooperative learning (CSCL). In addition, a distance teacher education support model was designed and implemented using interactive information technology and television communication to enable the facilitation of distance teacher education support for in-service teachers. SEIDET has become an information and knowledge hub for the people of KwaNdebele, while its success continues to attract research interest from scientists and engineers from all corners of the world. It has become part of an ongoing research project and the talk-of-the-town for many communities, including the information systems research community. SEIDET is a 'living laboratory' where ideas are tried and tested out.

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During a seminar, educators shared their experiences of pastoral support.

## Education

### A university and school-based community collaboration: teachers as fulcrum of support to vulnerable children in various communities

In November 2008, the University of Pretoria's Unit for Education Research in AIDS and the Department of Educational Psychology hosted a seminar featuring stories of their collaboration: an intervention study chronicling educators' use of an asset-based approach in psychosocial support. The purpose was to share the partners' mutual experiences of pastoral support (as educators), to build their capacity to provide psychosocial support (as educators), and to transfer this knowledge to peers in their respective schools. The project has been ongoing since 2003 between researchers and postgraduate students in the Department of Educational Psychology and 50 teachers from five schools with the teachers as primary partners (10 teachers per school): three primary schools in the Nelson Mandela Metropole in the Eastern Cape, one primary school in Gauteng and one rural secondary school in Mpumalanga. Methodologically, researchers framed the intervention from a participatory reflection and action approach and theoretically developed the intervention from an asset-based approach. In this regard, teachers partnered with lay people in communities (unemployed parents), formal school systems, faith-based organisations, health care, government agencies and corporate institutions to identify assets available to the schools. The modus operandi of the teachers afterwards was to continuously identify available and relevant assets, initiate partnerships with people related to the identified assets in order to provide psychosocial support, establish school procedures to identify vulnerability, refer vulnerable children and families for support to pertinent partners, and maintain partnerships. Teachers provided support over a range of vulnerabilities, not solely the children's vulnerability to HIV/AIDS. Teachers' psychosocial support initiatives included children experiencing extreme poverty as manifested through hunger, ill-health and neglect, children outside of school boundaries, and families of children identified as vulnerable. The asset-based approach that is being followed in the project has enabled teachers to establish and sustain psychosocial networks in the different school communities. These networks release teachers to perform their primary role as facilitators of learning. The participating schools' status as caring, sensitive and accepting institutions has been confirmed through increased disclosure by parents and children, as well as increased learner enrolments.

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## Theology

### Basa njengo Magogo for carbon credits

The development of Basa Magogo is a joint effort between researchers from various disciplines, community members, industry and government. It proves that continuous close interaction between people from outside the community and people from the community itself can be the creative step that can trigger a massive positive result. The fact that a programme in the Faculty of Theology received the Technology and Human Resources for Industry Programme (THRIP) Excellence Award for work with social significance from the Minister of Trade and Industry in 2005 serves as recognition and confirmation that this approach is indeed viable. The Functional Household Programme (FHP) is a joint venture between the Faculty of Theology and the Nova Institute. Nova is an independent non-commercial (Article 21) company that specialises in developing and promoting smart solutions for low-income households. A smart solution is an innovative, tried and tested solution with discernible value to all stakeholders concerned. It complies with the highest criteria for excellence. It should be desirable, beneficial, affordable, effective, replicable, sustainable and quantifiable. Energy is one of the focus areas of the FHP. In this focus area, the researchers are concerned with the



The Basa Magogo project aims to reduce air pollution caused by the domestic use of coal in communities.

energy usage patterns of households. The Basa Magogo project is one of its flagship projects. It illustrates the merit of its research and development approach. The Basa Magogo method was named after a community member of eMbalenhle near Secunda, South Africa, Granny Nebelungu Mashinini. She perfected the method when it was introduced and tested in 1998. This top-down ignition was one of a number of technologies that has the potential to reduce air pollution caused by the domestic use of coal, which was evaluated in actual conditions. These tests formed part of an intensive participatory research and development process conducted during the 1990s with support from Sasol Synfuels and later THRIP. Basa Magogo means "Light up, Grandmother!" It has been promoted by the Department of Minerals and Energy under the name Basa njengo Magogo, which means "Light up like grandmother". Recently, the method was taken up as part of the Department of Environmental Affairs and Tourism's Clean Fires Campaign. As a method, Basa Magogo is quite simple. Instead of starting the fire with paper and wood at the bottom and then adding coal on top, the opposite procedure is followed: the paper and wood are placed on top of the coal and the fire burns from the top downwards. It must, however, be done correctly. To date, it has been found that the only way people can be convinced to use Basa Magogo is through direct demonstrations, person to person. In 2007 and 2008, the FHP gained 60 000 new users in townships from Qua-Qua to Middelburg. The local churches and church members provide the social networks to reach all these households. The projects have also drawn support from the Fair Climate Programme of the Protestant Church in the Netherlands, bringing the overseas churches and the local congregations and church members into a partnership. The benefits to households that use Basa Magogo are substantial. The cleaner burning results in cleaner air, better health, higher productivity, a reduction of greenhouse gas emissions and savings to residents because they use less coal. Savings on coal have been well documented and are, on average, R380 per household per annum, which translates into R22.8 million per annum for the 60 000 users of the method introduced in 2007 and 2008. Savings in health care costs are more difficult to quantify, but based on several well-documented surveys, could be five to ten times more. All residents, including those who do not use coal, experience cleaner air and much better health, but the users of this method benefit the most. The reduction in greenhouse gas emissions is about 1 ton of CO<sub>2</sub> per household per annum. These reductions can be measured, validated and audited according to international standards for greenhouse gas reductions and can be traded internationally. Income from trading greenhouse gas emission reductions can be used to expand the scope of existing projects and to develop more smart solutions for and with low-income households.

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**Middle (left to right):** Suna Redelinghuis, Department of Education Process Coordinator, Piet van der Westhuizen, European Union Funding, Dirkie Joubert, Administrative Support, Stanly Ehlers, Intellectual Property and Contracts Office, Didi Botes, NRF (knowledge fields and focus areas), Ntsatsi Mantsho, Research Projects Support

**Back (left to right):** Botini Mazibuko, Messenger, Melanie Botha, Database and Website, André van der Westhuyzen, THRIP Funding, Rita Swanepoel, Intellectual Property and Contracts Office

**Insert:** Mr Dhesigen Naidoo, Director: Research and Innovation Support (left), and Prof Jonathan Youngleson, Head: Innovation Support (right)



