

# University of Pretoria

## Research Report

### 2009



UNIVERSITEIT VAN PRETORIA  
UNIVERSITY OF PRETORIA  
YUNIBESITHI YA PRETORIA

Denkleiers • Leading Minds • Dikgopololo tša Dihlalefi





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# Introduction



## 1.1 Message from the Vice-Chancellor and Principal



Prof Cheryl de La Rey

This research report gives testimony to the status of the University of Pretoria (UP) as one of South Africa's leading research universities.

The University of Pretoria has retained its position as the top ranking university in terms of the number of accredited publication units. Especially pleasing is the fact that the number of UP researchers with ratings from the National Research Foundation (NRF) increased from 223 in 2008 to 251 in 2009, and so too has the University's visibility in Thomson Reuters (ISI) indicators.

Although the University gives attention to bibliometrics as a means of tracking its own research performance, assessing research in quantitative terms only gives a rather narrow perspective of the University's wide-ranging research activities. Therefore, this report contains feature articles that go beyond the numbers by giving a richer, more qualitative account, rather than just a sample of the range of excellent research projects conducted by its staff and students.

University reputations and prestige are dependent on people. The numbers, the citations and the rankings are an outcome of hardworking, talented people who are in an enabling environment where they can ask questions, pursue answers and push the boundaries of knowledge, thereby contributing to the development of humanity. The University of Pretoria's biggest asset, as it continues to expand and deepen its research endeavours, is its people – its staff and its students. There are highly talented and hardworking people at UP.

I am deeply appreciative to all the academics and students who have contributed to UP's research output over the past year.

Thank you for your contribution to the academic standing of the University of Pretoria. Thank you, too, to Prof Robin Crewe, Vice-Principal: Research and Postgraduate Studies, for his leadership, and to the Director of Research and Innovation Support, Mr Dhesigen Naidoo, and the Research Office team for providing invaluable support and for producing this 2009 research report. The research showcased in this report would not have been possible without the generous support of numerous funding agencies, sponsors and donors, to whom we are most grateful.

Prof Cheryl de la Rey  
Vice-Chancellor and Principal

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



Prof Robin Crew

The future, it is reviewing its support for students engaged in graduate studies in order to make it more attractive to undertake postgraduate work on a full-time basis. This will contribute to the development of strong research teams with staff and students interacting on a daily basis.

In addition to offering postgraduate education to South African students, the University has a significant number of postgraduate students from other countries. The presence of these students indicates the impact of the University's research expertise as an attractor of talent, primarily from the continent, but also from other parts of the world. These students provide both intellectual and cultural diversity that is stimulating for the University community as a whole. These foreign graduates also constitute a future network of individuals who will support the growth of the University's research activities.

The contribution of the University's research activities to economic development can be realised through patenting and commercialising its intellectual property

The Department of Science and Technology (DST) has identified the production of larger numbers of PhD students as one of the critical elements that will contribute to the development of the country. It is also in the process of designing a human capital development programme that will address this requirement.

with the assistance of the newly established Technology Transfer Office. The staff of this office assist the academic staff and students with the patenting of their intellectual property and initiating the process of commercialisation. A good example of this has been the discovery that mycolic acids can be used to develop a rapid novel diagnostic test for tuberculosis. The commercialisation of this test for use in pathology laboratories is being undertaken.

Finally, the University library is a key element in creating a vibrant research environment by supplying the information needs of all the University's active researchers. In addition, it is in the forefront of developing digital repositories for research publications, theses, dissertations and data collections that provide an invaluable archival resource to the research community. It has also been active in creating virtual research environments that encourage collaboration between individuals and institutions across the globe.

This report provides an insight into the startling diversity of research contributions made by the University's staff and students, of which it is justly proud.

Prof Robin Crew  
Vice-Principal: Research and Postgraduate Studies

## 1.3 The fact file



Dhesigen Naidoo

The University's fact file supports the view that the University continues to function as a research-intensive institution. Its successful transition to higher quality is reflected in the increase in the number of articles published in accredited journals over the past decade.

The percentage of articles published in accredited journals, as defined by the Department of Higher Education and Training (DHET), has increased from 79.6% in 1999 to 91.3% in 2009.

The University has also seen an important change in the percentage of research output units published in ISI- and IBSS-listed journals from 51.3% in 2005 to 71.0% in 2009. International research collaboration is on the increase with UP researchers co-authoring papers with colleagues in 81 countries in 2009.

This has been reinforced by a healthy number of incidents of collaboration with African colleagues and African institutions. The UP research cadre has taken heart from the fact that in 2009, the University had 255 NRF-rated researchers, including nine A-rated researchers and five P-rated researchers. Contract research has been maintained at a healthy level in spite of an economic downturn. While the patent portfolio is still limited, the University remains confident that the new institutional arrangements and support measures will bear fruit in the coming years.

Dhesigen Naidoo  
Director: Research Support and Innovation

### Research outputs

The University has continually, since 1997, been the leading producer of research outputs among institutions of higher learning in the country. According to the latest figures released by the Department of Higher Education and Training (2008 audit), 1 183.92 audited units were approved for subsidy. These units comprise 1 109.29 units for articles, 15.76 units for books and 58.87 units for recognised conference proceedings. In addition, 71.25% of the journal units appeared in internationally recognised journals.

The University was awarded another South African Research Chairs Initiative (SARChI) research chair in 2009 and now has seven chairs in its portfolio.

Figure 1: Research output of universities

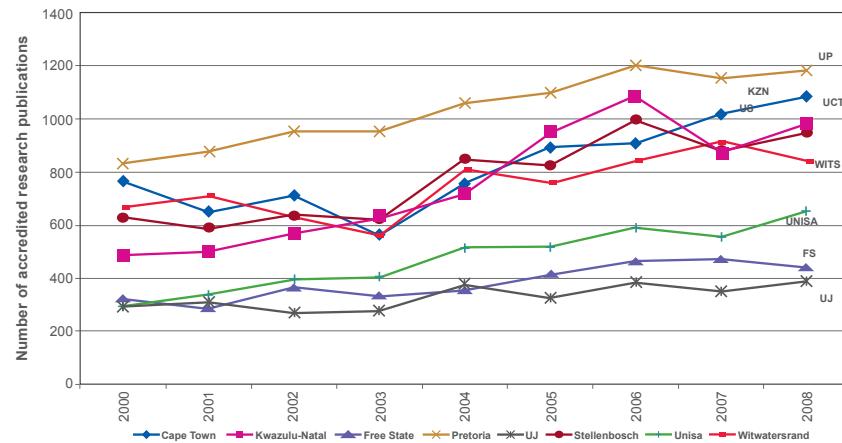


Table 1: Units earned per faculty for articles in accredited journals

Faculty	2008
Engineering; Built Environment and Information Technology	154.82
Economic and Management Sciences (including GIBS)	62.24
Education	42.81
Health Sciences	121.59
Humanities	150.93
Law	72.00
Natural and Agricultural Sciences	303.79
Theology	117.08
Veterinary Science	81.58
Support Services	2.45
Total	1 109.29

Table 2: Faculty distribution of audited publication units submitted in 2009

Faculty	Units
Economic and Management Sciences	81.66
Education	29.58
Engineering, Built Environment and Information Technology	150.36
Health Sciences	156.87
Humanities	142.77
Law	60.83
Natural and Agricultural Sciences	282.89
Theology	119.17
Veterinary Science	82.00
Gordon Institute of Business Science (GIBS)	6.16
Support services and interdisciplinary departments	4.99
Total for the University	1 118.28

Table 3: Researchers with more than ten articles published per annum

Researcher	Number of articles
Prof MJ Wingfield	48
Prof FD Auret	23
Prof BD Wingfield	21
Prof R Gupta	18
Prof E Pretorius	18
Prof GF Smith	17
Prof B Slippers	16
Dr AC Brent	16
Prof CE Cloete	13
Prof M Steyn	13
Prof JG Maree	12

Table 4: Student statistics for 2009

International students			
Regions	Undergraduate students	Postgraduate students	Postdoctoral fellows
SADC	1 165	720	2
Rest of Africa	180	430	11
Oceania	6	7	2
South America	12	13	0
North America	17	33	3
Middle East	11	24	0
Far East	58	56	4
Europe	156	88	18
Total	1 605	1 371	40

The number of undergraduate international students exceeds the number of postgraduate students, and there are some 40 postdoctoral fellows. More students come from the Southern African Development Community (SADC) region and the African continent, followed by Europe. However, more postdoctoral fellows come from Europe, which displays a high correlation with the collaborative partnerships.

The number of postgraduate students involved as authors or co-authors of peer-reviewed articles increased from less than 200 in 2002 to over 450 in 2009.

Table 5: Comparison of postgraduate students who authored or co-authored peer-reviewed articles

2002	2003	2004	2005	2006	2007	2008	2009
158	195	249	318	340	456	564	463

Table 6: Postgraduate qualifications for 2007 to 2009

Qualification	2007		2008		2009	
	Contact	Distance	Contact	Distance	Contact	Distance
Certificates	388	8	377	7	377	6
Honours degrees	1 690	654	1 789	941	2 083	1 249
Master's degrees	1 096	0	1 139	0	1 155	0
Doctorates	170	0	180	0	196	0
Total	3 344	662	3 485	948	3 811	1 255
<b>Grand total</b>	<b>4 006</b>		<b>4 433</b>		<b>5 066</b>	

## NRF ratings

Table 7: NRF ratings as at December 2009

Ratings	A	B	C	L	P	Y	TOTAL
2009	9	56	149	5	5	31	255

Table 8: Comparison of NRF ratings over the past five years

Ratings	A	B	C	L	P	Y	Total
2004	3	44	94	2	2	23	168
2005	3	46	101	2	1	23	176
2006	5	52	119	5	1	31	213
2007	4	55	119	28	4	3	213
2008	5	57	148	4	4	33	251

## Intellectual Property

In 2009, three new South African patents and one international patent family were registered. There were nine disclosures. One license was awarded to industry and five patents were provisionally filed.

## Funding

### External funding

In 2009, more than R361.2 million was made available for research from external funding sources. This included the following: R76.8 million from government sources other than the Department of Higher Education and Training, including R64.6 million from the NRF and the Technology and Human Resources for Industry Programme (THRIP), R5.2 million from the Medical Research Council (MRC) and R5.8 million from the Water Research Commission (WRC). R32 million was received from international funders, R65 million from research contracts and R108.5 million from research grants.

### Framework 7 Programme of the European Union

The University of Pretoria's participation in EU-FP7 projects is increasing at a steady pace. Due to its multinational character, the FP7 is yet another mechanism that allows scientists from the University to participate in state-of-the-art research and technology development and to rub shoulders with leading scientists and engineers from Europe and elsewhere. In 2009, 14 active projects addressed topics such as animal and human health, water resource management, food safety, genetics, the impact of climate change, multilateralism and issues related to globalisation. Experience gained thus far has enabled UP to participate in new FP7 proposals in the course of 2009. It is anticipated that several of these will lead to additional projects commencing in the course of 2010. Income from these projects amounted to R5.3 million in 2009.

Table 9: Participation in the European Union

Active FP7 projects 2009	Additional FP7 projects 2010 (estimated)	Main topics of research (2009)	Estimated income for 2009
14	4	Human health, animal health, water resource management, food production and safety, genetics, climate change, multilateralism, globalisation	R5.3 million

### Internal funding

The University allocated approximately R60.6 million from internal funds to the research budget. This budget was utilised for the upgrading and maintenance of research capacity and equipment (R25.8 million), for congresses and visiting scientists (R3.1 million), for research publications (R17.2 million), for postdoctoral fellowships (R4.6 million), for research fellowships (R0.8 million), for the Research Development Programme (R3.9 million) and for creative outputs (R0.1 million).

## International partnerships

During 2009, the University collaborated with 81 countries, publishing 385 internationally co-authored articles in academic journals. The total number of instances of collaboration numbered 639.

Figure 2: Top ten collaborating countries

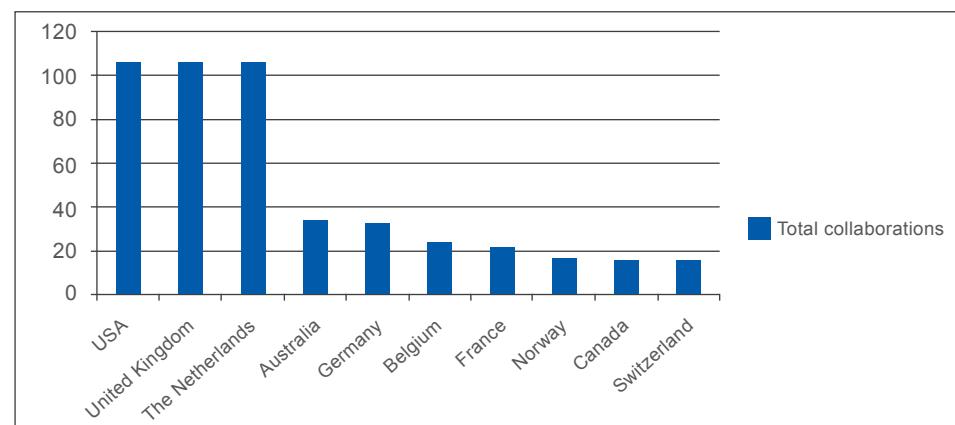


Figure 3: Collaboration according to continent

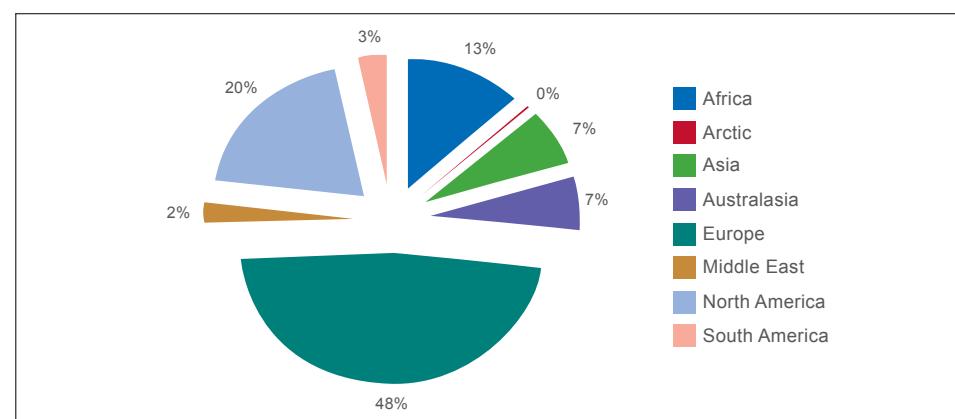
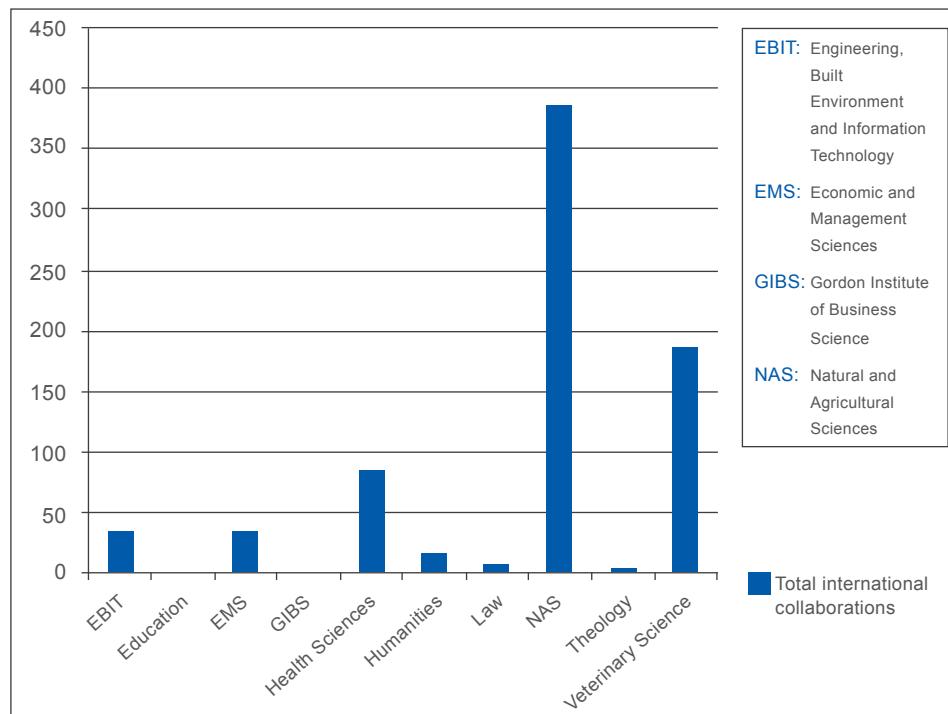


Figure 4: International collaborations according to faculty



From the graphs presented, Europe leads the collaboration efforts with UP with 48%, followed by North America with 20% and Africa with 13%.

## Collaborations

Table 10: National and international research collaborations in 2008

Type of Institution	International	National
Higher education: universities	582	258
International organisations	53	5
Non-governmental organisations, non-profit organisations and interest groups	36	33
Government: science, engineering, technology and innovation organisations and parastatals	24	129
Government: national	24	53
Private sector: multinational companies	20	36
Private sector: national companies	9	121
Other	9	10
Higher education: other	9	2
Higher education: universities of technology	8	29
Private sector association (industry/business)	5	74
Government: provincial		20
Government: local		7
Southern African conservation organisations		20
Total collaborations	779	



# Awards and Achievements

## 2. Awards and Achievements

In 2009, a number of researchers from the University of Pretoria received national and international recognition for their work. These include outstanding research contributions, awards and prizes at national and international conferences, prestigious fellowships, NRF-rated researchers, medals of the South African Association for the Advancement of Science, Women in Science Awards, the African Union Award, the NRF President's Award and UP awards.

### Outstanding research contributions

**Prof S Vandeyar (Humanities Education):** The Comparative International Education Society Award (CIES) award: Joyce Cain Award for Distinguished Research of African Descendants, which recognises excellence in scholarly articles that explore themes related to people of African descent.

**Prof JG Maree (Educational Psychology):** Stals Prize for Psychology, South African Academy of Science and Arts gold medal (certificate and financial award).

**Prof I Pikirayi (Anthropology and Archaeology):** The archaeological journal *Antiquity*'s best article prize for 2008. Every year the prestigious British journal *Antiquity* awards a prize for the best article published in its pages. In 2009, the panel of judges chose the article of Shadrek Chirikure (UCT) and Innocent Pikirayi (UP), 'Inside and outside the dry stone walls: revisiting the material culture of Great Zimbabwe' as the winner of the £1 000 prize.

**Prof BL Penzhorn (Veterinary Tropical Diseases):** Gold Medal of the South African Veterinary Association for exceptional, sustained scientific achievements as researcher, as well as academic commitment to an array of biological disciplines, including various fields in veterinary science, as well as in zoology and nature conservation.

### Awards and prizes at international conferences

**Dr CL Carbonatto (Social Work and Criminology):** Best Poster Award for a poster, *Social workers in health care in South Africa: challenges for specialised training*, at the Social Welfare Education Programme in Schools at the Seoul International Social Work Conference: Social Work Education and Practice Development in the Asia-Pacific Region.

Some of the recipients of the Exceptional Academic Achiever Awards for 2009, together with Dr Ben Ngubane, former Minister of Arts, Culture, Science and Technology and current chairperson of the South African Broadcasting Corporation (centre left), and Prof Cheryl de la Rey, Vice-Chancellor and Principal of the University of Pretoria (centre right).

**Dr M Botha (Business Management):** Best Paper Award (rank 2) at the Internationalising Entrepreneurship Education and Training conference in Monterrey, Mexico.

### Awards and prizes at national conferences

**Prof M Pretorius (Business Management):** Best AcES Paper Award. 2nd International University of Johannesburg Faculty of Management Conference.

**PT Matjila (Veterinary Tropical Diseases):** Senior WO Neitz Medal of the Parasitological Society of Southern Africa for the best PhD thesis, entitled *Molecular detection and characterisation of canine tick-borne pathogens*.

**Dr HADT Lombaard (Obstetrics and Gynaecology):** Best Oral Poster Presentation in the category at the national congress of the Society for Endocrinology, Metabolism and Diabetes of South Africa.

### Prestigious fellowships

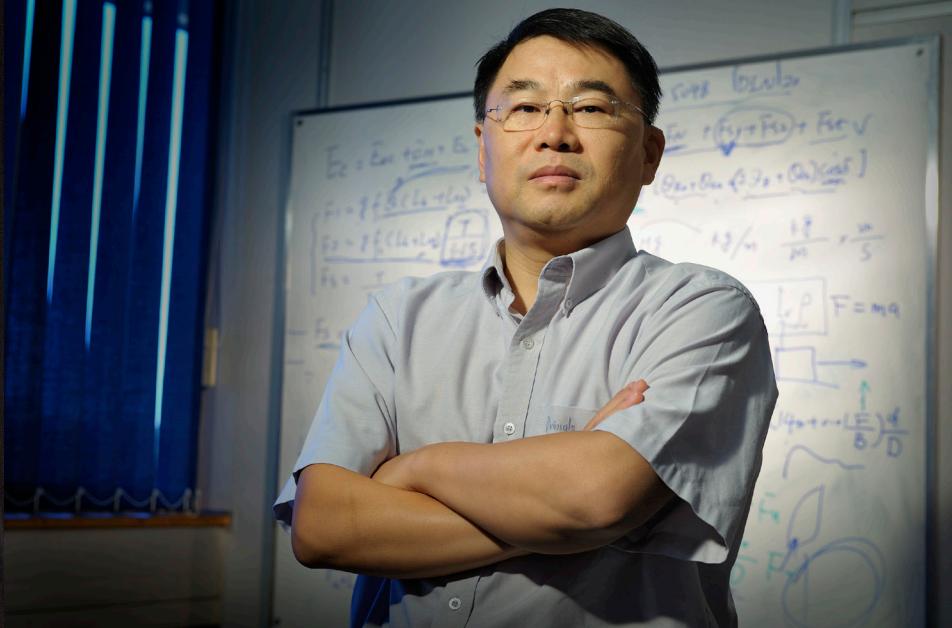
**Miss J Niemand (Biochemistry):** Erik and Ethel Erikson Trust PhD fellowship for 2009, Carl Storm International Diversity Fellowship for participation in the Polyamine Gordon Research Conference, Waterville Valley, New Hampshire, USA.

**Mr SB Reeksting (Biochemistry):** DAAD NRF Sandwich PhD Fellowship.

**Miss M Williams (Biochemistry):** Erik and Ethel Erikson Trust PhD fellowship for 2009.



Prof Kobus Maree (centre) receives the Chancellor's Award from Prof Wiseman Nkuhlu, Chancellor (left) and Prof Cheryl de la Rey, Principal.



Prof Xiaohua Xia, A-rated researcher.

## UP awards

### Chancellor's Award: Teaching and Learning

Prof JG Maree

### Exceptional Academic Achiever Award

Prof FD Auret  
Prof NC Bennett  
Prof TJD Bothma  
Prof M du Toit  
Prof AP Engelbrecht  
Prof JF Kirsten  
Prof JM-S Lubuma  
Prof JB Malherbe  
Prof JP Meyer  
Prof LH Nel  
Prof M Steyn  
Prof K van Marle  
Prof FJ Viljoen  
Prof BD Wingfield  
Prof X Xia

### Exceptional Young Researcher Award

Prof L Birkholtz  
Prof SC Boy  
Dr R Ferreira  
Dr AM Hofmeyr

### Exceptional Young Achievers – NRF P-rated researcher

Prof DCD Swanepoel

### NRF-rated researchers

### Exceptional Academic Achievers – NRF A-rated researchers

Prof NC Bennett  
Prof X Xia

### NRF-rated researchers

Dr W Altermann  
Prof TAS Aveling  
Dr HC Barnard



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



Jacomine Grobler, recipient of the S<sub>2</sub>A<sub>3</sub> bronze medal.

Prof ADS Bastos  
Prof NC Bennett  
Prof CJ Botha  
Prof DJ Brink  
Prof EZ Cameron  
Prof CE Cloete  
Dr R Cockeran  
Dr MPA Coetzee  
Dr NE Collins  
Prof TA Coutinho  
Dr JF Dalerum  
Prof E de Wet  
Prof AL Dick  
Dr KG Duodu  
Prof M du Plessis  
Prof ES du Toit  
Prof JWH Ferguson  
Prof RC Fisher  
Prof R Franszen  
Prof R Gupta  
Prof JJ Hanekom  
Prof NF Janse van Rensburg  
Prof KH Jordaan

Prof Y Jordaan  
Prof F Joubert  
Prof HJ Joubert  
Prof A Kijko  
Prof DG Kourie  
Prof KJ Kunert  
Prof HW Kunert  
Dr EN L'Abbe  
Prof A Lombard  
Prof M-CN Madekurozwa  
Dr C Maritz-Olivier  
Dr PT Matjila  
Prof KI Meiklejohn  
Prof D Meyer  
Dr WE Meyer  
Prof A Minnaar  
Dr V Naidoo  
Dr JM Nel  
Prof JC Olivier  
Dr LC Prinsloo  
Prof B Rand  
Prof JL Roos  
Prof EE Rosinger

Prof JP Schoeman  
Dr D Sivakumar  
Prof JT Soley  
Prof MJ Somers  
Prof BJM Steyn  
Prof DCD Swanepoel  
Prof E Taljard  
Prof NJ Theron  
Prof SW van der Merwe  
Prof SN Venter  
Prof BW Watson  
Prof X Xia

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

**Ms Jacomine Grobler** (Industrial and Systems Engineering): South African Association for the Advancement of Science (S<sub>2</sub>A<sub>3</sub>) bronze medal for original research at master's level. Ms Jacomine Grobler graduated in the Department of Industrial and Systems Engineering in 2009 under supervision of Prof VS Sarma Yadavalli and Prof Andries P Engelbrecht with a dissertation entitled: *Particle swarm optimisation and differential evolution for multi-objective multiple machine scheduling*.

## UP academics honoured by the Academy of Sciences for the Developing World (TWAS)

At its 20<sup>th</sup> Annual General Meeting, the Academy of Sciences for the Developing World (TWAS) three of the academics at the University of Pretoria were elected as fellows and two were selected as young associates.

### Fellows

**Prof Robin Crewe** is Vice-Principal of Postgraduate Studies and Research. He has done pioneering work on ant alarm pheromones, and on the social organisation in ponerine ants and honeybees. His work also led to the discovery of social parasitism through pheromonal mimicry. He is a fellow of the Royal Society of South Africa and the Academy of Science of South Africa, and has received the Gold Medal of the Zoological Society of South Africa and the rank Chevalier de l'Ordre National du Mérite of France.

**Prof Brenda Wingfield** is professor of Genetics and deputy dean of the Faculty of Natural and Agricultural Sciences. She is known for her excellent research on fungal systematic and population genetics of three pathogens. Her group recently came out with new taxonomic concepts for the important tree pathogen *Cryphonectria* and related fungi. She is a member of the Royal Society of South Africa and the Academy of Science of South Africa, and has received the University of Pretoria Exceptional Achiever Award twice, and the Department of Science and Technology Distinguished Women in Science Award.

**Prof Rashid Hassan** is a professor of Economics and Environmental Policy and Director of the Centre for Environmental Economics and Policy in Africa (CEEPA). He has contributed to our understanding of African agriculture by relating land productivity not only to the local ecology, but also to the institutions surrounding the use of land. His research has led to the inclusion of the effects of depreciation of mineral assets on the national accounts of Namibia and Botswana. He is a member of the Academy of Sciences of South Africa, and he has received the University of Pretoria Exceptional Achievers Award twice.

### Young associates

**Prof Thokozani Majozi** is associated with the Department of Chemical Engineering. He is a fellow of the Council for Scientific and Industrial Research (CSIR), and has been a session chair at several national and international conferences on industrial design and application and modelling and simulation. In 2008, he received the S<sub>2</sub>A<sub>3</sub> British Association Medal and the Leading Minds (1908–2008) Centenary Award from the University of Pretoria.

**Prof Bernard Slippers** is an associate professor at the Department of Science and Technology Centre of Excellence in Tree Health Biotechnology at the Forestry and Agricultural Biotechnology Institute and in the Department of Genetics. He is a member of the Southern African Society of Plant Pathology, South African Institute of Forestry, the International Mycological Association and the International Entomological Society. In 2007 and 2008, he received the University of Pretoria Exceptional Young Researcher Award.

### Women in Science Awards

**Dr Marieka Gryzenhout**, a research fellow at Forestry and Agricultural Biotechnology Institute (FABI), is the first runner-up in the category Best Emerging Young Scientist in the Women in Science Awards.

**Ms Mphilonhle Thethwayo**, an MSc (Applied Science: Metallurgy) student in the Department of Materials Science and Metallurgical Engineering, was awarded a Tata scholarship.

### African Union Award

**Prof Pat Eriksson**, head of the Department of Geology, received the Continental African Union (AU) Scientific Award on 31 January 2010. The AU Scientific Award Programme is a symbol of the commitment of AU heads of state and the government to raise community awareness and to engage African citizens in Africa's science and technology programmes, and to strengthen its research capacity.

**Prof Brenda Wingfield** was honoured with an AU Women Scientist Regional Award, which recognises her great scientific achievements and contribution through science to the socio-economic development of Africa.

### NRF President's Awards

**Prof Charles van Onselen** (researcher and historian) received an A-rating award.

**Prof Hans van Oort** (professor of Patristics in Theology) received an A-rating award.

**Prof Thokozani Majozi** (Department of Chemical Engineering) was awarded for his role in the transformation of the science cohort in South Africa.

**Prof Bernard Slippers** (Department of Genetics in the Forestry and Agricultural Biotechnology Institute) received a P-rating award.

# Feature articles



## Property taxation in Africa: challenges and opportunities

The African Tax Institute (ATI), co-founded by Prof Riël Franzsen in 2002, is located in the University of Pretoria's Department of Economics. It is devoted to training and research, as well as providing technical assistance, in the areas of tax policy and administration on the African continent. The ATI endeavours to develop independent capacity in African countries to address internal and cross-border tax policy and administration issues.

Since 2007, the institute has been involved in a joint venture with the United States-based Lincoln Institute of Land Policy, a leading international research organisation that facilitates the analysis of land use and taxation issues and is an important resource for policy-makers and practitioners in land use, regulation and taxation.

According to the United Nation's Educational, Scientific and Cultural Organisation (UNESCO), 33 of the 49 least developed countries in the world are in Africa. The continent's population faces pressing needs, which range from basic health care and education to improved governance and strengthened legal systems. According to Prof Franzsen, the dissemination of basic information on governmental systems, especially those concerned with revenue, finance and decentralisation, is one form of assistance that can help strengthen public institutions and promote policy improvements without imposing foreign solutions or bypassing indigenous reform.

Prof Franzsen's research interests include international property tax systems, local government finances and real estate transfer taxation. He was a David C Lincoln research fellow of the Lincoln Institute from 2001 to 2003 and has contributed seven chapters or commentaries in international textbooks on property and land value taxation since 1998. Collaborative research conducted with Dr William McCluskey of the University of Ulster in Northern Ireland since 1998 forms the basis of the current research that is being conducted with the funding of the Lincoln Institute.

The joint venture with the Lincoln Institute is aimed at obtaining basic data on property taxation – both as legislated and as practised – in the 53 African countries as a catalyst to improve tax policy. Not much research has been conducted on the systems in operation, and discrepancies that have been identified between legislation and practice make this an important

means of identifying opportunities to enhance revenue mobilisation from this revenue source that could improve the living conditions in Africa and in developing countries elsewhere in the world.

Property taxation is a vastly underutilised tool in most countries, but could support a variety of local government services. Understanding the current status is the crucial first step in determining how property taxes can contribute to a strengthened revenue system in a particular region or country. Information on property tax is extremely difficult to obtain in many African countries due to the linguistic barriers that prevail in the Arabic, Portuguese, French and English-speaking countries or regions. However, it could provide a basis for policy debate that has not been possible in the past.

In the first stage of this project, 13 research fellows were recruited to investigate tax legislation and practices in the Anglophone, Francophone, Lusophone and Arabic regions of Africa. These fellows hail from Cameroon, Chad, the Democratic Republic of the Congo (DRC), Egypt, Ethiopia, Kenya, Mozambique, Niger, Sierra Leone and Zambia.

Determining the actual application of property taxes in practice required both site visits and establishing a relationship of trust with the officials being interviewed. Since January 2007, the research fellows have gathered material from primary and secondary sources, made site visits to their assigned countries and prepared country reports on the systems in operation in about 40 countries.

They also compiled data templates and regional overviews in some cases, which will enable comparisons to be made between the different systems and the identification of systems that function effectively. Understanding the successes and failures of property taxes in other similarly situated countries may provide valuable lessons for countries contemplating the introduction of a property tax or the reform of an existing system.

Draft reports have been published on the web page of the Lincoln Institute to draw responses from other analysts and officials, both in Africa and elsewhere, who can contribute to the dialogue. Reports are also peer reviewed. Comments received will be incorporated into the final reports, which may eventually contribute to strengthening the revenue systems of individual countries or regions.

By the end of 2009, the research fellows had already visited 36 countries and completed 30 draft country reports. This hard work yielded a wealth of data that offered some surprising insights into the current status of property taxation in Africa. A number of trends were identified, including the decentralisation of property taxation, which could contribute to the generation of a suitable source of revenue for local government.

Perhaps the most significant finding was the level of continued support for property taxation in the face of decades of administrative neglect and meagre collections. This greatly underutilised fiscal tool has been the subject of reform legislation in a number of countries over the past 15 years, suggesting that further reform could be achieved if these nations chose to mobilise property tax as a significant source of revenue.

The initial reports demonstrate strong links between countries in specific language groups, largely reflecting colonial influence. Surprisingly, after half a century of independence and many intervening legislative reforms, this heritage still shapes many African governmental structures. As a result, language is far more significant than geographic location in understanding property tax systems. Colonial influence among language groups also strongly affects national approaches to legislative drafting and administration.

A surprising finding is the persistence of a value-based approach. Market value was found to be the most common base for property taxation, used in all Anglophone countries and in some Francophone and Lusophone nations as well. Recent changes in tax systems include revaluations in Uganda and Ghana, a move to a partial capital value tax base in Niger, and a shift from an area base to a value base in Cameroon and Rwanda. Local practice was also found to diverge widely from the provisions of enacted legislation. It is common, for example, for taxes to be collected only from higher value properties, even though lower value parcels are not technically exempt.

The data presented in the country reports raises questions that may encourage new approaches to studying African property tax systems. The ultimate goal of this research project is to assist in improving tax policy and lay the groundwork for exchange and collaboration between those concerned with property taxation in Africa. The development of



Prof Riël Franzsen, Faculty of Economic and Management Sciences.

knowledge and expertise among the research fellows themselves is one step on this path, for they will help form the nucleus of a professional community, committed to understanding the problems and potential of land and building taxes in Africa. The findings may also serve as a valuable source of information for organisations such as the World Bank and the International Monetary Fund, which provide multilateral funding to countries in need of assistance.

Understanding the legal, political and cultural role of property taxes can help identify future reforms if governments are prepared to make a commitment to the mobilisation of this source of revenue.

Janine Smit

## Escalating the production of PhDs in South Africa

Recently, South Africa embarked on initiatives to increase its diversity and the number of highly skilled knowledge workers. This is in line with international trends where the emphasis is on a knowledge economy, in which knowledge and education are viewed as business products or productive assets. In 2007, the Department of Science and Technology (DST) and the National Research Foundation (NRF) set a target of a fivefold increase in the annual number of PhD graduates from 1 200 in 2005 to 6 000 in 2025.

The Academy of Science of South Africa commissioned Dr Chaya Herman of the Department of Education Management and Policy Studies at the University of Pretoria to conduct a series of studies on the status and place of the doctorate in South Africa. The purpose of these studies was to provide evidence-based advice on how to increase the production of quality PhDs in the country. In one of the studies, Dr Herman conducted interviews with the supervisors of 16 exemplary PhD programmes over a range of disciplines and universities to identify the factors that contributed to their success and the extent to which these factors could be replicated as a means of increasing the number of PhD graduates.

The study examined the following programmes:

- Division of Plant Breeding, Plant Sciences, Faculty of Natural and Agricultural Sciences, University of the Free State
- DST-NRF Centre of Excellence in Tree Health Biotechnology, Forestry and Agricultural Biotechnology Institute, University of Pretoria
- Astrophysics and Cosmology Research Unit, School of Mathematical Sciences, University of KwaZulu-Natal
- Institute for Microbial Technology and Metagenomics, University of the Western Cape
- Doctorate in Business Administration, Gordon Institute of Business Science (GIBS), University of Pretoria
- DST-NRF Centre of Excellence in Strong Materials, University of the Witwatersrand
- Division of Polymer Science, Department of Chemistry and Polymer Science, University of Stellenbosch
- PhD in Policy Studies, Faculty of Education, University of Pretoria

- Consortium of Schools of Education in Southern African Universities, University of the Witwatersrand
- Centre for Materials Engineering, Department of Mechanical Engineering, University of Cape Town
- Wits Institute for Social and Economic Research (WISER), University of the Witwatersrand
- NRF Chair in Customary Law, Indigenous Values and Dignity Jurisprudence, University of Cape Town

- Molecular Mycobacteriology Research Unit, DST-NRF Centre of Excellence for Biomedical Tuberculosis Research, University of the Witwatersrand
- DST-NRF South African Research Chair in Computational Modelling of Materials, Materials Modelling Centre, School of Physical and Mineral Sciences, University of Limpopo
- Health Promotion and Behavioural Interventions Research Unit, Medical Research Centre, Maastricht University
- Marang Centre for Science and Mathematics Education, School of Education, University of the Witwatersrand

The programmes in the study were chosen from DST-NRF centres of excellence, recipients of National Science and Technology Forum (NSTF) awards specifically commended for graduating doctoral students, and chairs of research with an exemplary doctoral graduate track record. Furthermore, elements of snowball and convenience sampling were employed. The analysis was based on the programme leaders' perceptions, reflections and experiences with regard to the production of doctoral graduates. It does not evaluate the programmes or explore them from other stakeholders' points of view.

Doctoral education around the world is expanding and transforming in response to the new demands of the knowledge economy. Accordingly, the purpose of the doctorate is shifting from being driven by curiosity to becoming an important strategic source for countries' economic development. Students undertake PhDs for three main purposes: to train for academic careers, to train for industry and to train for a profession. PhD programme leaders in South Africa have a strong predisposition towards the traditional

view of the PhD having an academic purpose, but there is a growing acknowledgement of obtaining a PhD to prepare candidates for careers in industry and the professions.

The common and interlinking practices that sustain PhD programmes, which are important to consider in upscaling PhD production, are funding, the recruitment, selection and retention of quality students, the various supervisory arrangements, capacity-building and sharing of expertise, and the way the programmes are structured. In most successful and high-output doctoral programmes, the students are fully funded during their studies so that they can dedicate their time to their studies. Funding is obtained from multiple sources. Apart from university funds, the biggest share comes from government (including the DST) and statutory bodies (including the NRF). NRF funding is often not enough to see a student through an entire PhD. Therefore, other sources of funding – international foundations, industry, local organisations, non-governmental organisations (NGOs) and projects – need to be sought.

A major stumbling block for increasing the number of PhD graduates is the availability of quality students. Competition between universities for the best candidates is rife, especially in science and engineering. There is a view that because a PhD is perceived as a luxury in South Africa, programme leaders struggle to recruit and retain good black South African students.

Furthermore, even in successful PhD programmes, some students drop out. The supervisors interviewed mentioned various factors that, in their experience, influence students' decisions to suspend their PhDs. The circumstances of black South African students differ immensely from those of their white counterparts and make it difficult for them to remain productive students. Even generous funding provides a limited income if the student has a family to support. Full-time students are forced to find jobs when their bursaries run out after three years and they are unable to complete their PhDs while working. In the drive to escalate the number of PhDs, the aim should be to decrease the drop-out rate and retain the students who enrolled for the degree in the first place, especially black students.

Supervision is another factor that should receive attention if South Africa is to increase its output of PhD graduates. Several supervisory models are followed in the different programmes surveyed. Most of the programmes employ more than one model. The most generally used models are the apprenticeship (eleven programmes) and project-based (nine programmes) models. The distribution of other models is as follows: five programmes employ cohort cycles and course-based models, two follow competency and interdisciplinary models, while the PhD by publication, joint supervision and the research focus group are only employed by one programme each. An aspect that should be explored with a view to upscaling PhDs is the utilisation of the human resources at research councils, national facilities and in industry to expand supervisory capacity.

Based on the interviews conducted, Dr Herman reached a number of conclusions about the constraints and opportunities to increase the number of PhDs in South Africa. There seems to be a conflict between the purposes for which students enrol for PhDs. South Africa may thus need a diversification of doctoral degrees, mode of delivery and funding. This means that at least two types of doctorates are needed: one to prepare students for academic careers, and one to prepare them for careers in the professions and industry.



Dr Chaya Herman, Faculty of Education.

Apprenticeship, the model according to which programme leaders are their students' sole supervisors, was found to be the least efficient supervisory model for scaling up the number of students. The cohort – a critical mass of students and supervisors – is seen as the most efficient means of scaling up PhD production, as it provides the context for academic and personal development, as well as the structure of and targets for the doctoral journey.

Another finding is that the number of students who want to pursue doctoral studies is too small, and that it is vital to create a larger pool of students, especially young and black South African candidates. The study also shows that the pool of potential PhD students is limited because there is no strong belief in the value of the PhD. There is a need for strong advocacy for higher education in general and for the PhD in particular.

Dr Herman recommends the provision of more and improved funding to give students a better opportunity to finish their studies without having to seek employment. An expanded and coordinated effort is necessary to reach the target set by government. This includes strategic and significant funding, international and private partnerships, and the removal of barriers hindering the expansion of the South African higher education system.

Anneline du Preez

## Innovation

# in the local automotive industry

The research of Prof André Buys, Prof Tinus Pretorius and Prof Jasper Steyn of the University of Pretoria's Graduate School of Technology Management in the Faculty of Engineering, Built Environment and Information Technology is part of a larger international research project to develop an understanding of innovation in indigenous industries.

The project involves researchers from the University of Pretoria, Lundt University in Sweden and universities in China, India and Brazil. It consists of a comparative study of different countries' innovation-based strategies for globalisation. The project takes into account the indigenous industries' relative levels of development, the sectoral differences between them and the role of smaller local firms. It is hoped that the research will provide the knowledge needed to support indigenous firms and industries to acquire the competencies needed to upgrade from competing as low-cost providers to innovators. The final aim is to help policy-makers design policies that better target industry-specific needs.

### Innovation policy

Innovation, particularly technological innovation, is recognised today as a primary force driving economic growth and development. Governments and development agencies are therefore increasingly focusing their attention on innovation policies. Traditionally, governments focused on industrial policy, but this has expanded to include technology policy and more recently also innovation policy. Innovation policy focuses mostly on competence building, learning capabilities and networking.

Technology policy has largely been the focus of innovation policy in the developed world. This has mainly resulted from seeing research and development (R&D) as the starting point of the innovation process, hence emphasising radical product innovation. Governments have therefore tended to support mainly large firms in fast growing technology-intensive industries, such as information and communication technologies, biotechnology and nanotechnologies. There has been a tendency in developing countries to imitate the innovation policies of the developed world, ignoring the different ways in which different firms, industries, regions and countries innovate.

Current technology and innovation policies that focus on high technology and large firms are disregarding the economic reality that most economic activity does not take place in high-technology industries, but in small and medium-sized enterprises (SMEs). SMEs

are also the biggest employers, thus their survival and development are crucial for poverty reduction. The question is therefore how to support innovation and upgrading in SMEs.

Not much is known about the process that transforms dependent subcontractors into knowledge creators. What are the role and importance of learning, capacity-building and the accumulation of competencies through interaction with multi-national corporations (MNCs), other SMEs, customers and knowledge providers such as universities and research institutions? Previous studies suggest that, given the right conditions, indigenous firms can benefit from collaborating with MNCs. It is still unclear which type of strategic coupling is needed, and what the role of government should play.

Many countries have embarked on national innovation surveys to measure innovation and then utilise the findings for policy-making. However, such surveys that cover the whole industrial base have to be supplemented by more detailed subsector surveys that focus on particular sectors of interest.

### International research collaboration

The South African component of the international project focuses on a selection of clusters and regions in South Africa. It was decided to focus on three categories of clusters: complex product systems, specialised suppliers and services. The main criteria for the selection of the clusters were the following: all cases must display some degree of geographical concentration and clustering of SMEs, they need to have gone through an upgrading process or have the potential for upgrading, they should be inserted into global value chains and researchers need to have access to firms in the cluster. The South African automotive component manufacturing industry was selected as one of the clusters of interest that met these criteria.

## The local automotive industry

The South African automotive industry is small in global terms, supplying only about 1% of vehicles sold in the global automotive market. Nonetheless, it supplies components to many of the multinational automotive manufacturers. It is also very important to the South African economy. The turnover of the South African automotive industry is some \$25 billion, or 9.7% of the South African gross domestic product (GDP) (Statistics SA, 2009). The sustainability of the local industry is therefore important from both a national and a global perspective.

The turnover of the automotive component manufacturing industry for 2008 is estimated at R72 billion and employment at 76 000. The South African National Association of Automotive Component and Allied Manufacturers (NAACAM) represents the interests of the local automotive component industry. It has some 190 national member companies and 12 associate members who provide logistics, information technology and financial services to members.

## Innovation survey

In the research design, a sample of the South African automotive component industry was surveyed. Sixty-two firms were randomly selected from the 174 automotive component-manufacturing firms in the February 2009 database of the NAACAM. The internationally calibrated survey was conducted by interviewing senior company executives. The interviewers were postgraduate students from the University of Pretoria's Graduate School of Technology Management and Gordon Institute of Business Science. Some of the key issues that this survey investigated were the resources utilised for innovation, the type and importance of innovation, the strategies employed to access local and foreign markets, and innovation linkages and channels.

Research findings to date include the following:

- Most firms are involved in innovation activities, irrespective of whether they are local or foreign-owned or whether they have an official R&D department or not
- The two most popular accessing strategies, whether for accessing local, domestic or international markets, are those of quality and cost
- Linkages with parent companies have facilitated transfers of technology and skill, as well as organisation development, and they have provided access to international markets
- Linkages between assemblers and component manufacturers have been instrumental in driving technological development and setting industry standards
- An increasing trend towards integration into global production networks has resulted in various benefits for local industry in terms of technology transfer and related spill-over
- Statistically significant associations were found between the position in the value chain and innovation variables
- A strong relationship between marketing position and the type of innovation activities seems to exist
- A correlation was found between the Motor Industry Development Programme (MIDP) and innovation in logistics, and in organising external relationships, but not between innovation and the subsidies by the Sector Education and Training Authority (SETA)
- Significant product innovation occurred in other markets of related technology such as wind turbines



Prof Tinus Pretorius (left), Prof Jasper Steyn (centre) and Prof André Buys, Faculty of Engineering, Built Environment and Information Technology.

- Key factors conducive to integrating the industry into global networks have been the incentives provided by government and access to international markets through the parent company

This survey has revealed an industry that was inserted into the global automotive value chain, but it competes as a high-quality provider rather than an innovator. Much development and upgrading will be required to transform this industry from dependent subcontractors to knowledge creators. Further exploration of the rich information base is proposed, while expansion to the international database will enable comparison between countries.

# Sportainment: changing the pace of limited-overs cricket

Some years ago, Standard Bank of South Africa (SBSA) initiated the sponsorship of the new South African cricket format, Standard Bank Pro20 Cricket (SBPC). The need to deepen the understanding of sports marketing resulted in this case study. It drew on data from the documenting and analysis of the partnership format. Insight in the theory and practice of sports marketing was gained by exploring the format's strategy, execution and results. The SBPC sponsorship was found to be beneficial to the game itself, the stadium crowd, and those linked by broadcasting. The communal sense that developed between sport and entertainment justified a new term: sportainment.

## Sport business and research

The economic sector of sport business, at the individual, organisational and national levels, contributes greatly to economic activity and wealth creation. In 2004, the estimated global sponsorship industry was ~US\$28 billion. In South Africa, the figure, which increased fivefold from 1991 to 2000, recently reached an annual amount of ~R2.6 billion. It is believed that the 1984 Los Angeles Olympics, neatly generating a profit without any state support, initiated the trend of formal sports marketing. Sports teams are becoming manager-driven business entities, so that that a well-known sports brands' extension beyond "on-the-field" performance may be very lucrative.

Sports marketing may be categorised as marketing of sports, that is, events and equipment, and marketing with sports, for example, the promotion of non-sporting products and sponsorship literature. Meanwhile, sponsorship itself became a highly integrated market-orientated activity.

This single case study by Michael Goldman of the University of Pretoria's Gordon Institute of Business Science in Illovo, Johannesburg, and Kate Johns of SBSA (Bryanston) relied on four major sources of evidence: documentation, archival records, interviews and direct observations. Key informants were repeatedly interviewed to check data consistency.

## Standard Bank Pro20 Cricket

SBSA, established in 1863, is a leading financial services provider in South Africa and, as the Standard Bank Group, is the largest banking group in Africa in terms of assets, geographic spread and market capitalisation. It has been a sponsor for cricket in South Africa since 1997. In 2004, SBSA and Cricket South Africa (CSA) launched the

concept of a 20-overs-a-side cricket format competition (SBPC) to revitalise dwindling domestic cricket. Limited-overs games have been played for a long time, but the SBPC series was the first domestic first-class cricket tournament to use this format and to package it in such a commercial way. Some other countries then followed with similar 20-over domestic tournaments. The local series was initially a four-week tournament played between six provincial unions with 18 scheduled matches. The game lasts three hours and has been described as "action-packed, fast and furious, boundary-bashing, seam-splitting".

SBSA invested in Pro20 cricket with a view to building on its existing strong association with cricket and to demonstrate that its brand was progressive and evolving. Specifically, it wanted to shift the positioning of its brand to within the youth market. It was equally keen to partner CSA to develop a new cricket experience that attracts crowds to an exciting new format of the game. SBSA also viewed the investment as an opportunity to engage stakeholders, clients and staff in cricket activities.

The inaugural SBPC in 2004, as well as the subsequent annual series, was so successful that it did justice to the concept of sportainment (the combination of sport and entertainment). Meanwhile, SBSA announced an additional investment to create an international version of SBPC, based on the successful domestic formula. Then, in 2007, the prestigious first Twenty20 World Cup was hosted in South Africa. The SBSA/CSA partnership emerged as the clear leader and innovator of this specific format of the game.

## Pillars of experience

The SBPC series aimed at enhancing the cricket, stadium and broadcast experience, which together provided an integrated sportainment experience.

The cricket innovations included a faster pace of the game, more current and appealing kit designs for teams and umpires, and a rule change by way of a free hit for a no ball. Off-the-field entertainment elements included SBPC hard hats for spectators, a dunk tank experience for children, innovative electronic visual displays and – occasionally – professional dancers and fireworks at key scoring moments. A new broadcast experience, backed by SBPC and Super Sport, included the relocation of commentators to the grandstands where they could interact directly with spectators and interview outgoing batsmen after each wicket. Ultimately, heart-rates of players were presented in real time to add to the excitement for broadcast viewers.

## Integrated marketing

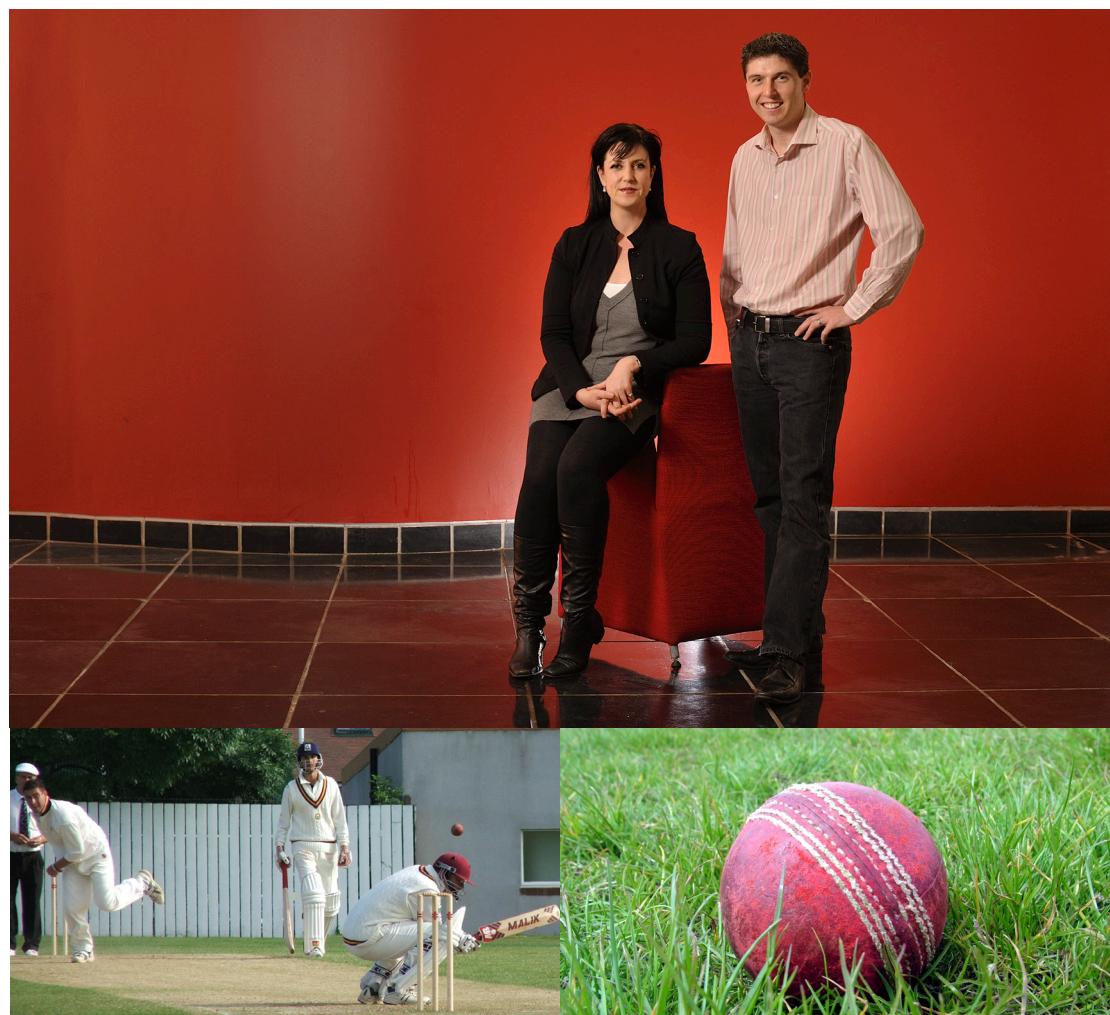
An exciting and visually powerful marketing campaign, including messages of entertainment, show business and action-packed fun, resulted in the successful launch of SBPC to the South African public. Leveraging of the sponsorship included funky strap lines, countrywide mega-billboards, and promotional advertisements on television and a popular youth FM station. Tickets could be won in ground promotions and stunts. Promotional activities included more than 200 000 flyers at strategic spots and the creation of a dedicated website for all-inclusive information, while 137 selected SBSA branches were thoroughly involved before each SBPC game. Special attention was given to the media and additional coverage was generated through key cricket events.

## Achieved objectives and results

The SBPC series fulfilled all the objectives agreed on by SBSA, DCA and Super Sport. In terms of brand association, independent researchers found that SBSA had, at 82%, the highest test awareness of local cricket sponsorship. A total of 36% of sports fans responded that SBSA was the sponsor of Pro20 cricket. There was a significant growth in the local cricket fan base, particularly among the youth and black supporter groups. While the average crowd attendances per region declined from 28 459 in 1996 to 7 935 in 2004, SBPC figures grew from 9 656 in 2004 to 12 490 in 2007. The three partners formed a closely-knit team that acted together in the design and execution of the tournament. The sportainment concept of three "pillars of experience" also contributed to achieving the sponsorship objectives.

## The way ahead

This study shows the value of viewing a sport sponsorship as a partnership. In fact, each of the three partners was able to contribute to and benefit from the success of the new format. Brand-building managers should thus attempt to share the strategic objectives of the sport and invite sponsors to contribute to its development. This study also shows that greater market penetration can be effected by shifting of brand positioning. In turn, sponsorship managers could strive for more of a partnership approach in order to develop the sport to the benefit of all.



Michael Goldman, Gordon Institute of Business Science, and Kate Johns, Standard Bank.

As part of the globalisation of cricket, similar case studies in India and North America would enhance the understanding of sport sponsorship. Locally, SBSA's other sport and art sponsorships have not developed a partnership approach. More research on other cases in other sports – and in other endeavours – is enticing.

Dr Danie Roos

## Tracking and taking on hormone disruptors

Dangerous chemicals that can disrupt the sensitive endocrine system (the hormones) in our bodies lurk in our everyday environment – often in unexpected places. They are routinely found in cosmetics, plastic water bottles and clingwrap. These chemicals find their way into our water sources via processes in the steel and plastics industries, while incinerators spew hormone disruptors into the air we breathe. Agricultural pesticides are some of the biggest culprits, while dichlorodiphenyltrichloroethane (DDT) – used for malaria control in parts of South Africa – is a major cause of concern.

Chronic exposure to these chemicals poses serious health risks – ranging from spontaneous abortions and birth defects to infertility, diabetes and cancer. To make matters worse, the combined effect of the cocktail of these chemicals and heavy metals in our environment adds up to a detrimental health impact far worse than the sum of the effects of the individual chemicals.

However, taking on the big industries involved in spreading these chemicals in the environment is risky in itself. It sometimes requires researchers to step onto a battlefield where big money will be invested to contradict research findings that expose these public health threats.

One researcher not shying away from this challenge is Prof Tiaan de Jager of the School of Health Systems and Public Health at the University of Pretoria. "South Africans are mostly unaware of the dangers of being exposed to hormone-disrupting chemicals and the other damaging effects of these pesticides in our bodies," he explains. "That is why producing world-class research is only the first challenge. Ultimately, policies and people's behaviour must change as a result of our findings." His research team is working hard on translating research findings into new guidelines for safer ways to control malaria and to reduce the exposure of people to other endocrine disruptors.

Much of Prof De Jager's work focuses on how male reproductive health is affected by DDT. While this organochlorine pesticide has been banned for agricultural use in most of the world (including South Africa since 1976), it is

still used legally in endemic malaria areas – specifically to control this disease. In parts of Mpumalanga, Limpopo and KwaZulu-Natal, about five to six million people live in huts and homes where the inside walls and rafters are regularly sprayed to kill or repel mosquitoes. However, this protection comes at a high price – to the people living there, as well as to their future children and the environment.

DDT and its metabolite dichloro-diphenyldichloroethylene (DDE) accumulate in the blood and fatty tissue of people who are regularly exposed to the chemical. According to Prof De Jager, his team found shockingly high levels of DDT and DDE in the blood of more than 300 men aged between 18 and 40 included in their recent Limpopo study – up to 90 mg per kg body weight. This is five times higher than levels found in populations in Mexico, where DDT spraying ceased in 2000, and about 500 times higher than DDT levels in a Canadian group who have not been directly exposed to DDT. Such a high "body burden" of DDT is the result of chronic exposure to the chemical over a long time.

DDT crosses the placenta in pregnant women and affects the development of the foetus, resulting in higher incidences of newborn boys with urogenital birth defects such as undescended testicles or problems with the urethra or penis. The developmental effects on the foetus are irreversible and affected children may experience learning difficulties caused by the effect of DDT on their neurological development. Affected adult men typically have decreased semen volumes and lower sperm counts. Breastfeeding mothers secrete DDT in their milk, putting young babies further at risk. People who are malnourished or HIV positive are even more vulnerable to the impact of DDT on their bodies. It takes up to 20 years for someone to be cleared of DDT once all exposure to this chemical has stopped. "Major international studies are confirming the detrimental effects of DDT and we cannot ignore it any longer," Prof De Jager warns.

DDT has similar effects on the reproductive health of other species. In birds, for example, it leads to thin and brittle eggs shells, with a devastating impact on reproductive success.

Prof De Jager's research on hormone-disrupting chemicals took off in 1994 with a PhD project under the leadership of Prof Riana Bornman from the University of Pretoria's Department of Urology. They are now research partners at the University of Pretoria. Prof De Jager went on to do postdoctoral work at Laval University in Canada, where he became interested in DDT investigation in a part of Mexico where people were also dependent on DDT to control malaria at the time. Prof De Jager came back to South Africa in 2000 to continue his work on the health impact of DDT, this time focusing on Limpopo, where DDT is still used extensively. He supervised Dr Natalie Aneck-Hahn, who took up this project as a postdoctoral study.

"We see the effects of DDT in populations, but we still don't have all the answers about how it damages human reproductive health," Prof De Jager explains. "That is why we are now searching for answers at the cellular and genetic level to find out if and how DDT compromises the integrity of the DNA in human cells."

The last place you may expect to find hormone disruptors would be in a pair of new shoes. However, a recent Swedish study of 27 types of shoes, including four from South Africa (*Chemicals – up close*, published by the The Swedish Society for Nature Conservation) found that one of the South African shoe brands contained the highest level of hormone-disrupting chemicals and heavy metals of all the shoes tested. These levels were much higher than levels deemed acceptable by the World Health Organisation.

Prof De Jager does not advocate the immediate banning of DDT, but urges for greater caution in the way it is used, and increased efforts to identify and use safer alternatives. He calls on the relevant authorities to make people living in villages where indoor spraying is carried out more aware of the risks and of ways to protect themselves from unnecessarily high exposure. "People should not leave open food in the huts that are being sprayed, the homes must be properly ventilated after spraying and young children should not touch the walls that have recently been sprayed," Prof De Jager explains. "We also see, for example, that control workers often don't wear protective clothing and masks, putting themselves at high risk."

Prof De Jager also warns against the indiscriminate and incorrect use of pesticides, the illegal use of banned agricultural chemicals and the use of chemicals after their expiry



Prof Tiaan de Jager (top) and colleagues at the School of Health Systems and Public Health.

date. "Often these old pesticides are no longer effective in controlling malaria, but still pose a serious health risk for people," he explains.

"Another reason why we have to find alternatives to DDT is that mosquitoes are becoming increasingly resistant to its effects," explains Prof De Jager. "We have to spray more DDT than ever before, and still malaria is on the rise in some areas."

In addition to focusing on DDT, Prof De Jager is also looking at the bigger picture of the toxicity of other malaria-control chemicals that people in certain parts of South Africa are routinely exposed to, as well as chemicals commonly used to manufacture everyday plastics and that are routinely present in our drinking water.

As public awareness of these health risks grows, Prof De Jager expects growing demands from the international community for a complete ban on DDT and new measures to limit human exposure to other endocrine disruptors. "We have to do much more to make people aware of how they can limit their own exposure to these dangerous chemicals, starting by educating children."

Prof De Jager himself tries to avoid drinking water or other liquids from plastic bottles (opting for glass instead), never uses plastic containers in a microwave oven, filters

all his drinking water and rinses all fruit and vegetables thoroughly. Food packaging can also play a role to help people make healthier choices. In South Africa, the Cancer Association of South Africa (CANSA) now endorses specific types of clingwrap that are free of certain endocrine disruptors.

Prof De Jager's research findings have already led to a decision to set up a multidisciplinary University of Pretoria Centre for Sustainable Malaria Control in the near future. This centre will aim to identify safer and more effective malaria-control chemicals and will monitor the long-term health impacts of these control measures. The researchers will also pool their expertise to develop a dynamic decision-making tool to help policy-makers identify the most effective and safest control mechanisms in specific areas and circumstances, for example after heavy rains.

Prof De Jager believes that South Africa should take the lead on the African continent towards developing an integrated and adaptive approach to malaria control, rather than continuing to expose people to the devastating long-term health risks of DDT and similar endocrine disruptors.

Marina Joubert



# A history in stone and paint

Volumes of the history of southern Africa's earliest inhabitants are captured in the sandstone and dolomite formations that comprise the region's natural environment. Rock art sites – in the form of engravings and paintings – cover most of this natural landscape and provide indisputable evidence of the way of life of the country's early San (Bushman) and Khoekhoen herder people.

Southern Africa's rock art sites form an important part of the country's cultural heritage and convey much information about the traditions and customs of the early hunter-gatherers and herders. More than 40 000 rock art sites have been discovered and recorded by archaeologists over the years, yet still nowhere near all of the archaeological sites of the subregion have been identified.

The two main types of rock art are rock engravings and rock paintings. Rock engravings are pecked, cut, scraped or incised into the rock, while rock paintings are made by adding paint to a rock surface. Both were made by hunter-gatherers or San (although South Africa is also home to several other rock art traditions). The question that begs to be asked, however, is why the artists chose two different mediums for their rock art. Studies of rock art over the past century have tended to focus on rock paintings. There are few studies that have examined rock engravings or the relationship between rock engravings and rock paintings.

Rock paintings are mostly found in sandstone shelters, while engravings are more common in the dolomite formations of the central interior. However, the relationship between engravings and paintings is not just topographic. There are cases in which the occurrence of paintings and engravings overlap, and even occur together. A number of such sites have been identified in the Limpopo Valley and the Eastern Cape in the vicinity of Steynsburg.

A research team of the University of Pretoria's Department of Anthropology and Archaeology, under the leadership of Dr Sven Ouzman, has documented 35 hitherto unrecorded rock engraving and painting sites in the area between Molteno and Hanover in the Karoo. These sites are beginning to provide an understanding of the past human dynamics and beliefs of this region. Evidence of the simultaneous occurrence of these two forms of rock art in the same area

– even on the same site – speaks of interactions between people and between places topographic and mystical.

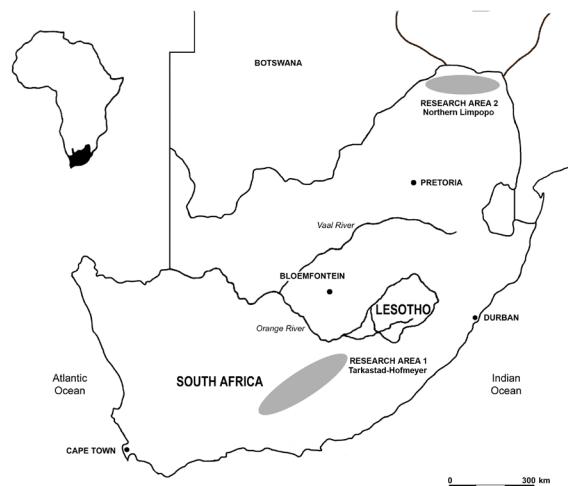
This research is exploratory and hopes eventually to find 100 sites where rock paintings and rock engravings occur within 100 metres

of each other. This statistically significant number of sites may confirm or challenge the initial hypothesis that the co-occurrence of engravings and paintings is not random, but socially significant. It may also provide the information needed for subsequent research. By means of field trips, sites will be located and mapped by means of geographic positioning software (GPS) and entered into a database that contains contextual information on each site, such as location, type of imagery, associated archaeology, oral traditions, geological context, dating potential and management issues. The database currently contains information on the 20 rock art sites, as well as five monuments (part of a spin-off project on the Great Trek and liberation struggle heroes), and includes slides, audio texts, notes and GPS data. The study area will be extended westwards through the Karoo in 2010 and 2011.

Dating forms a vital part of the research. Rock art is difficult to date as there is little organic material present in the rock art that can be dated, causing scientists to rely on associated archaeological evidence such as stone tools. By establishing a broad and relatively regional chronology, the team hopes to refine the dating of Karoo rock art.

Such refinement helps integrate the rock art with the region's ethnography and even with periods of recent memory as related in oral histories. Such ethnographies and oral histories suggest periods during which certain people were more interested in the engravings and their *genius loci* than usual. This strand of research also emphasises place – and how people over millennia have marked the same places in different ways.

By studying San art, researchers are able to come to a greater understanding of a past not conveniently captured by text, but written in stone. The Karoo engravings, for example, provide evidence of colonial contact, enabling history to be constructed



Location of the research region

## Pretty potent plants

In addition to recording history and being an artifact resisting colonialism, rock art performs a vital spiritual function. An analysis of the plants and animals known to have inhabited the Karoo indicates that the "images" in rock art are not merely an artistic expression of the physical environment. These "images" were – to many San – actual Spirit World beings emerging into this world from the Spirit World behind the rock face.

By examining the plants and animals that are depicted in rock art, it is evident that the artists were selective about what they chose to immortalise, as not all the specimens that were found in the inhabitants' physical environment are to be found in paintings and engravings. For example, faunal remains that have been uncovered in the region from archaeological excavations indicate a proliferation of dassies eaten by hunter-gatherers. However, the eland is the most commonly depicted image in San rock art, with fewer than three known depictions of dassies among the estimated 40 000 rock art sites in southern Africa. Ethnographic research conducted in the late 1970s to determine which animals are important in San rock art has found the eland to be the most important animal spiritually. Today, the spiritual and symbolic meaning of San rock art is well established, and new information supporting this understanding continually comes to light – sometimes from unexpected sources.

from primary field data. Interesting imagery, including fat-tailed sheep, armed horsemen, oxwagons and cattle raids, gives an insight into the San's view of European colonialism – rather than the usual "Western" view of colonialisation. The rock art provides the primary source of evidence, which is substantiated by subsequent history in the form of colonists' diaries. Much of South Africa's history, particularly from the point of view of the San, would be lost, had it not been for the country's rich heritage of rock art.

One such source is the recent discovery of a San rock painting site near Mortimer outside Cradock, near Olive Schreiner's grave, at which 25 depictions of aloes have been found. This is a major new rock art discovery. It also highlights a conundrum: why are so few plants depicted in San rock art? Although common in Zimbabwean rock art, there are only five known San rock art sites south of the Limpopo at which plants are depicted. Despite the statistical insignificance of plants in rock art, the absence of evidence is not necessarily evidence of absence. Some people argue simplistically that the Karoo has few plant species – an assertion at which botanists scoff. It is also known that up to 70% of the San's diet consisted of plants, not meat (although men talk a lot about "the buck that got away"). This relative absence is more proof of the art's symbolic importance. All of the rare plant imagery is either of medicinal or hallucinogenic plants.

In this regard, the Cradock site is no exception; rather, it confirms the artists' careful and spiritually motivated selection of which plants to paint. The fragile imagery at the Cradock site probably depicts *Aloe ferox*, noted for its host of medicinal uses and hallucinogenic qualities, which may have given users – known as medicine people or "shamans" – access to the spiritual world (what is called a "trance" or "altered state of consciousness" was, for the San, the actual Spirit World). Research will contextualise the other isolated sites where depictions of plants have been found (two in the Free State and one each in Lesotho, KwaZulu-Natal and the Northern Cape).

Because depictions of plants are so rare, research is focused on establishing the significance of the plants in the spiritual and physical lives of the San. An analysis of the plants that can be identified reveals their medicinal or hallucinogenic qualities. Another plant that features in San rock art is the Bushman's poison bulb or gifbol, *Boophane disticha*, a member of the amaryllis family, with its antiseptic qualities. It was commonly used by the hunters as arrow poison. Through this research, the notion of the San as a primitive people is scientifically contextualised and debunked by linking the relational processes of cause and effect in empirically verifiable contexts.

This plant painting research also focuses on social constructs, such as the role of gender. In San society, the male was generally the hunter and the female the gatherer – at least, so it has been recorded by European travellers and ethnographers over the last 250 years. By studying the paintings of plants, researchers are better able to understand the San's gender identities – the role of a female gatherer of hallucinogenic plants that granted access to the Spirit World would be important indeed – while simultaneously questioning today's perception of gender constructs. Certain plants, such as the cancer bush, *Sutherlandia frutescens*, a member of the pea family, are spoken of as though they were "hunted" and not "gathered". Cross-gendered activities, therefore, also receive attention. Finally, the role of indigenous intellectual property rights in relation to the San's botanical discoveries, as well as their rock art, forms another core component of this research.

Janine Smit



# Establishing minimum standards for regional human rights systems

Through its Centre for Human Rights, the University of Pretoria conducts research and engages in programmes to advance and strengthen human rights and democracy in South Africa, on the African continent and further afield. Prof Christof Heyns, Dean of the Faculty of Law, and Prof Frans Viljoen, Director of the Centre for Human Rights, conducted a major study for the United Nations on the human rights treaty bodies of the world organisation.

In a recent study, Dr Magnus Killander, research coordinator in the Centre for Human Rights, and Prof Heyns investigated the emergence, or as some would call it, the proliferation of regional human rights mechanisms across the world, which in some ways supplement the United Nations systems, and in other respects challenge the dominance of the global system. In their study, the two researchers propose that minimum standards be set for regional human rights systems. This research project originated with the participation of Prof Heyns as one of three international experts in a team put together by the United Nations (UN) to comment on the establishment of a regional human rights system for the Association of South East Asian Nations (ASEAN) region. During the course of this consultation, he came to the conclusion that standards similar to those used in respect of national human rights institutions should be made applicable to regional systems so that "protectors" could be distinguished from "pretenders". The study by Prof Heyns and Dr Killander developed and proposed such standards.

Human rights law, on the domestic level, regulates human rights practices under the jurisdiction of a particular state. Under international human rights law, these practices are under the collective supervision of a number of states through institutions that have been established for this purpose. The different international human rights systems often overlap as states may be subjected to monitoring at both the global and the regional level by intergovernmental organisations (IGOs). The same state may also be subjected to human rights monitoring by different regional systems, or by both regional and subregional systems.

The issue of hierarchy in international law has recently started to attract widespread attention. One aspect of this broader question is the relationships

between and within the different levels on which international law engages with human rights. Given the inherent limitations of any enterprise to establish a grand and uniform set of rules for the requirements of internationally recognised human rights norms, some degree of variance and conflict can be expected.

Regional initiatives have increased in recent years, and regional human rights law today forms a significant part of international human rights law. The Universal Declaration of Human Rights is the most ambitious attempt yet to give practical effect to the universality of human rights. Regional and subregional mechanisms, with all the potential for conflict they entail, play a vital role in making the human rights project more inclusive. The question that arises, however, is whether global and regional systems for international human rights monitoring strengthen or weaken each other. Although regional systems mostly complement the global system, they can also detract from the universal aspirations of the global system by posing different and even lower standards of protection.

In 1977, the United Nations General Assembly made an appeal for regional human rights mechanisms to be established in areas where such mechanisms did not yet exist. A few years later, the African system was established. More recently, the UN has supported the establishment of regional systems in Asia.

A realistic assessment of the driving forces behind the conduct of states indicates that it is inevitable that regional human rights mechanisms will serve partly as a platform for the realisation of the international understanding of human rights, and partly as a shield against global scrutiny. An example of potential shielding is the call in February 2009 by the Assembly of the African Union to examine the implications of the African Court on Human and Peoples' Rights being empowered to try international crimes. This could be seen as a response to the focus of the International Criminal Court on Africa with criminal jurisdiction of the African Court potentially being used to shield African leaders.

The use of human rights mechanisms as a shield behind which human rights can be undermined has become a real possibility, and unless the global human rights project is abandoned, the question to be asked is whether regional human rights mechanisms with certain features rather than others will lean more to the side of being "protectors" or "pretenders".

Against this background, this research identified some of the common features and best practices of the three established regional human rights systems in the Americas, Europe and Africa. In particular, the legal framework established for the functioning of the Inter-American Commission on Human Rights, the Inter-American Court of Human Rights, the European Court of Human Rights, the African Commission on Human and Peoples' Rights and the African Court on Human and Peoples' Rights were examined. It was suggested that "minimum standards", established by assessing the common features of the three older regional systems, could be used when calls for the possible reform of the existing regional systems are considered and when other regional systems are established or reformed. The research thus proposed guidelines that could be seen as a starting point to identify such standards. Among the suggested guidelines were recommendations as to the mandate, composition and independence of regional mechanisms established for the promotion and protection of human rights.

As the proposed guidelines can potentially be applied to existing, emerging or new regional systems, it was decided to apply them to the terms of reference of the recently established ASEAN Intergovernmental Commission on Human Rights and the mechanisms established under the Arab Charter of Human Rights. It was noted that these mechanisms do not include complaints systems and their contribution to international human rights law will therefore mainly be in the form of statements.

What emerged from this study is the need to establish minimum standards for regional human rights mechanisms to serve as a starting point for the further development of this important element of international human rights law.

The answer does not lie in minimising the role of regions and subregions in respect of human rights law. On the contrary, they play an important role in giving people who are far away from Geneva and New York a platform to determine what should be understood by the term "internationally accepted human rights standards" and to make such standards a reality.

Janine Smit

Prof Christof Heyns (left) and Dr Magnus Killander, Faculty of Law.



# The genome revolution

The completion of the Human Genome Project in 2001 was a landmark scientific achievement that took more than a decade and cost more than US\$3 billion. However, it was only the beginning of what has now become a revolution in biological research. Fuelled by the desire to sequence a human genome for less than \$1 000, companies, as well as academic laboratories, have been working feverishly to increase the speed and decrease the cost of DNA sequencing. They have been spectacularly successful in this exploit, and in doing so, have continued the revolution, the benefits of which are already being experienced in fields as diverse as human health, agriculture, environmental science and bioenergy production.

Next-generation DNA sequencing technology in the world now routinely generates more than three billion base pairs of DNA sequence per day, the equivalent of one human genome, at a cost well below \$10 000. This number of base pairs per day is the capacity of just one of the new technology "machines". A large international project aimed at sequencing 1 000 human genomes will soon yield a much more complete picture of genome diversity in humans and allow scientists to identify genetic variation underlying common as well as rare human diseases.

What exactly is in a genome and how is it sequenced? A genome comprises all the genetic information included in the DNA of an organism, which determines the unique biology and behaviour of that organism. In higher organisms, the DNA is packaged in a set of chromosomes that are normally faithfully copied from one cell to another and from one generation to the next. Changes or mutations in the DNA sequence occur at low frequency, but at rates high enough to give rise to the amazing amount of biological variation that we see in nature.

Scientists can determine the sequence of the building blocks of DNA, the nucleotide bases called adenine, thymine, guanine and cytosine, typically by making use of the cell's own DNA copying machinery and reading off the sequence as a new strand of DNA is built. The result is long stretches of DNA sequence (for example, gattcgaatcc...) with up to tens of millions of letters

per chromosome. Genes, as part of the DNA, serve as templates for the production of RNA and protein molecules that ultimately determine the structure and function of the cell.

Since the completion of the first human genome, genomes have been sequenced for many other organisms, including hundreds of bacteria and tens of fungi, mammals and plants.

The University of Pretoria has a rich history in genome sequencing. In the mid 1990s, Prof Henk Huismans from the Department of Genetics was instrumental in pioneering the sequencing of viral genomes, working on the viruses of African horse sickness and blue tongue disease.

More recently, the first bacterial genome in Africa, that of the heartwater agent *Ehrlichia ruminantium*, was sequenced by Prof Basil Allsopp in the Department of Veterinary Tropical Diseases. This was followed by Prof Teresa Coutinho and Prof Fanus Venter who were the first at UP and in Africa to sequence a tree pathogen genome, that of the bacterial pathogen, *Pantoea ananatis*.

Currently, two outstanding genome research projects are led by UP researchers in the Forestry and Agricultural Biotechnology Institute (FABI). The genome of *Fusarium circinatum*, a devastating pathogen of pine trees, is being decoded under the scientific leadership of Prof Brenda Wingfield, while Prof Zander Myburg is leading an international effort to sequence the genome of a Eucalyptus plantation tree.

## ***Fusarium circinatum* – the first fungal genome for Africa**

Recently, a draft genome sequence was produced for the tree-killing fungus *Fusarium circinatum* and partially annotated at the University of Pretoria

(with Inqaba Biotec as the service provider) as part of the Tree Protection Cooperative Programme and the Department of Science and Technology (DST)/National Research Foundation (NRF) Centre of Excellence in Tree Health Biotechnology (TPCP/CTHB). Prof Wingfield continued the annotation, which is identifying the position of genes all along the DNA sequence, in the USA with Prof Ian Korf at the University of California, Davis, and Prof Mark Yandell at the University of Utah, Salt Lake City. The *F. circinatum* genome is 44 million bases in size, of which some 95% have been sequenced to date. This project resulted in a threefold "first" for South Africa and Africa: the first eukaryotic genome, the first fungal genome and the first ascomycete. The latter is the name for a group of fungi that includes yeasts and penicillium, the mould commonly seen on bread.

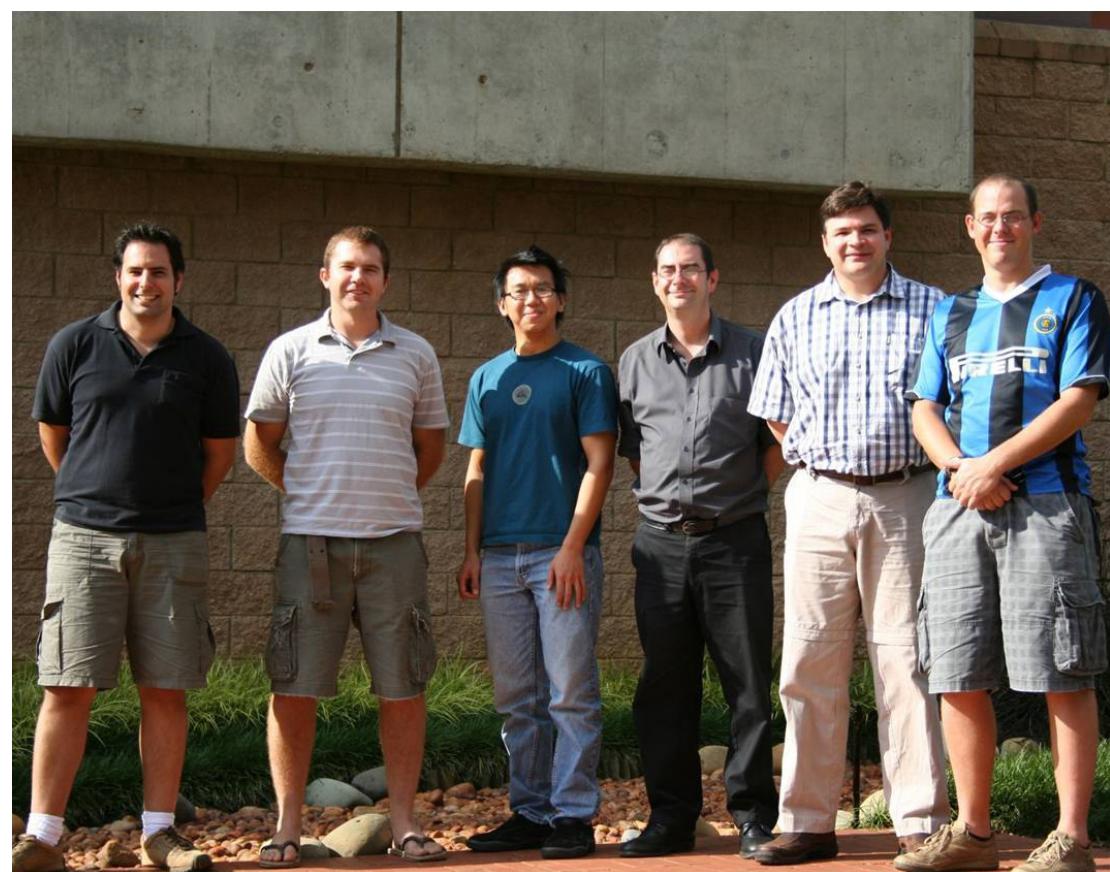
The pathogen *F. circinatum* causes a destructive pine tree disease. It reduces growth and often kills trees. The losses to nurseries and plantations sometimes exceed 50%. A complete cure for the disease is unlikely, but, by way of dedicated genetics research of both pathogen and tree, control may be realised. The skills gained from this project will be beneficial for higher levels of academic and research training at UP. It also has the potential to unlock practical applications for the South African forestry industry, as well as intellectual property of global value.

The project has thus far been funded by UP, the Oppenheimer Foundation, the NRF and the Department of Trade and Industry (dti) as part of the Technology and Human Resources for Industry Programme (THRIP). The larger goal is to promote bioinformatics and student training by further developing the capacity for sequencing and annotation of genomes in South Africa.

### Eucalyptus: the first genome of a global forest tree species

Eucalyptus tree species and hybrids are the most widely planted hardwood plantation crops in the world. The 600 million base pair genome of the fast-growing subtropical tree, *Eucalyptus grandis*, is currently being sequenced by the United States Department of Energy, which has identified it as a potential bioenergy crop. Prof Myburg is the principal investigator and UP the lead partner organisation for this international project with co-investigators in the USA and Brazil. In addition, more than 100 scientists from 18 countries in the international Eucalyptus Genome Network (EUCAGEN) are collaborating to generate supporting genomic resources for eucalypt trees. The Eucalyptus Genome Project will be completed by the end of 2010 and will lead to the publication of the draft genome sequence in 2011. The University of Pretoria's leadership role in the project has been supported by a strategic grant of R1.5 million from the DST and by funding from the NRF, dti, and Sappi and Mondi.

Prof Fourie Joubert, Director of the Bioinformatics and Computational Biology Unit at UP, is a key collaborator in the bioinformatic analysis of the Eucalyptus genome sequence, as well as being central to the fungal genome initiative. He and his students also played a major role in the sequencing, assembly and analysis of a transcriptome sequence for a South African-bred Eucalyptus tree produced at UP with the support of the DST.



The team of UP researchers from the Faculty of Natural and Agricultural Sciences, under the leadership of Prof Zander Myburg and Prof Fourie Joubert, who have been awarded a strategic grant to decode the transcriptome of a South African eucalypt plantation tree. From left to right: Eshchar Mizrachi, Charles Hefer, Philip Law, Prof Joubert, Prof Myburg and Martin Ranik.

The genome and transcriptome sequences of Eucalyptus will give scientists access to the genes and regulatory sequences that impart the excellent adaptability and productivity of eucalypts. The goal is to establish a platform for genomic research and innovation in the field of tree biotechnology that will be of strategic importance for the South African forestry industry.

Dr Danie Roos

## Suffering and hope during the exile

History deals with the ordinary lives of people. Historical investigation illuminates the many facets of our shared humanity. Historical understanding is a way of relating to life and its challenges; a way of discovering the meaning of life by understanding the lives of others; a way of understanding humanity's hopes and fears.

Although the Old Testament Society of South Africa (OTSSA) has been in existence for 53 years, and valuable and revolutionary research has been conducted since its inception, there is discord between the mainly Western scholarship of these studies and the relevance this scholarship has to the African situation.

Old Testament scholarship in South Africa is firmly embedded in the Western scholarly tradition. However, Africa demands relevance and information to help people cope with the typical problems of this continent, which Western scholarship apparently does not provide. One way out of this impasse is to stress the crossroad nature of this scholarship.

The early church in North Africa was a blend between the local and the universal. On the one hand, it was part of the huge Roman Empire, but also a remote and even forgotten province. It was situated on the intersection between two worlds, and was a classic illustration of co-existence and tension between the particular (African) and the universal (the Roman Empire, the "universal church"). Centuries later, this is still the context of biblical scholarship in South Africa. It lingers on the intersection between the particular (Africa/South Africa) and the universal (Western scholarship). Many Africans resist Western scholarship. How can knowledge of the Pentateuch's origins or the exile ever ease the pain of an AIDS patient or give food to hungry people? How can Western exegetical models reduce violence and corruption or solve the problems relating to land ownership? It is possible, but then the Western approach to Old Testament scholarship must really be appropriated. Old Testament scholarship of the past two centuries contains convictions, values and techniques that can shape our minds in such a way that a greater insight into society and ordinary life can be obtained.

This can be done by following the intellectual attitude of the early African theologians, who were excellent exegetes and forged an inseparable link between the Bible and

their contexts. To them, exegesis and actualisation were not two separate mental acts, but in a very particular way became one. A certain way of being relevant in Africa is to use a notion of history that can bring us closer to the past; to relive the experiences of the people in exile.

One result of the constant reflection on history since the nineteenth century is the discovery of the individual and individuality. When reading texts, each author has to be understood as a unique individual and the specific individuality of the author has to be grasped by going back to the origin of his or her thought. Everything boils down to the author's life history; to the researcher's ability to transform him- or herself into the other and grasp the individuality of an author or an era. Historical understanding thus takes place in the mind: one creates a kind of picture of the past "by recreating in one's own thought the past to which one is heir". This notion of re-enactment helps us to relive (through ourselves) the suffering of exiles.

The people of the exile experienced so much destruction due to God's rage that survival seemed unlikely. During the exile, the Zadokite intellectuals played a decisive role by reformulating and redesigning Israel's future in an ingenious way. This creative reshaping, however, resembled an event that occurred a few decades earlier when "judäischen Intellektuelen" developed a sophisticated theology as an act of resistance against the Assyrian overlords. It happened during the seventh century when neo-Assyrian pressure nearly crushed Jerusalem. According to Assyrian custom, the God Assur was enforced upon defeated nations and had to be honoured and worshipped by all. A counterconcept was, however, developed against Assyrian politics and this resistance was brilliantly executed: Assyrian ideas and terminology were borrowed and rewritten in such a way as to honour Yahweh alone. While resisting in this way, Israel discovered her own identity and realised the uniqueness of her own God. From this crucible came an intellectual tradition that also enabled the intellectuals of the exile to remake their lives amid depressing conditions.

During the exile, the Zadokite priests had to provide answers to very painful questions: Who was to blame for all the destruction and damage to human life? Did

Israel have a future? Did the exile imply the end of God's history with His people? Standing in the intellectual tradition of the priests responsible for the neo-Assyrian resistance, these priests created something new, fresh and original. The result was the first Deuteronomistic redaction of Deuteronomy (DtrD), which consisted of a Moses discourse (Dt 5; 9–10) and the Deuteronomic legislation (in Dt 12–26), both linked to Horeb, the Mount of God. This redaction also included the story of the golden calf, Moses' intercession and the reissuing of the Ten Commandments (Dt 9:9–21; 10:1–5). This sequence of events underscores the fact that despite the people's transgression of the main commandment, the covenant of Horeb remains intact, and this gives some hope to the exiles after the destruction of Jerusalem.

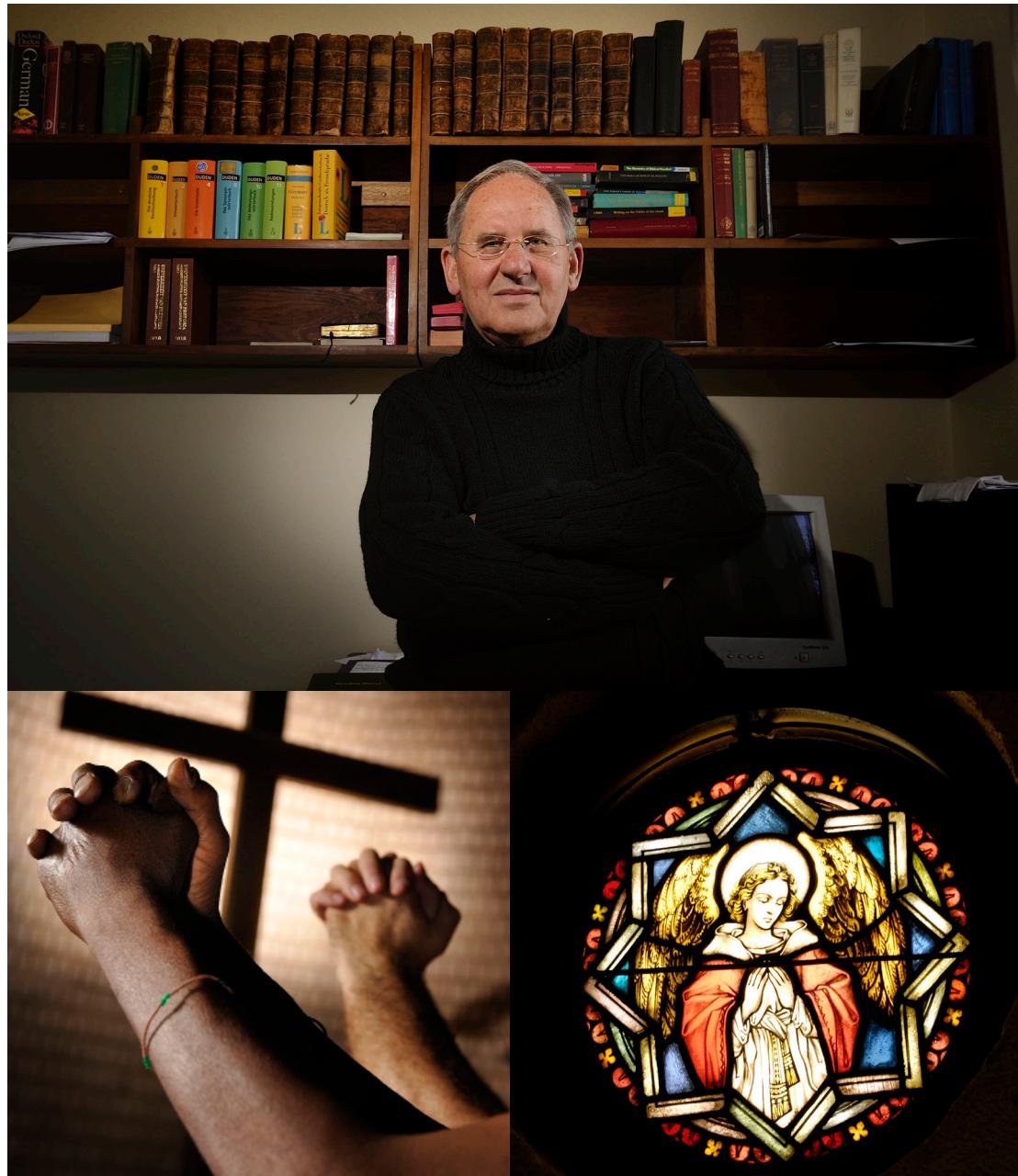
By means of the DtrD, the Zadokites wanted to establish a third foundation narrative for Israel. The DtrD stressed that Israel's beginnings must not only be sought in the patriarchs or the exodus, but particularly in the events at Horeb, now transferred to the plains of Moab, because there Israel was constituted as a community of Yahweh.

Since the first and most important commandment deals with the other gods ("You shall have no other gods before me" – Deut 5:7), the golden calf emphasised a radical break in the covenant relationship between God and Israel. According to the DtrD's narrative, the covenant was not nullified by the act of disobedience. It emphasised the faithfulness of Yahweh, who rewrote the Decalogue and allowed Moses to continue with his Moab-torah (his interpretation of the Sinai-torah), which is Deuteronomy. In the end, a covenant is mentioned (Deut 28), which is none other than the Horeb covenant narrated earlier (Deut 5:2–5). This shows that the transgression of the first commandment did not nullify the covenant and that God remained loyal.

The abovementioned existential way of remembering does not only enable us to "enter" or "feel" the past and the pain of the exiles in particular, but it also enabled the exiles themselves to find new meaning and to foster the hope of return. It was only through reliving the time of Moses that they rediscovered their own position as the people of God; it was only through remembering the horrible pre-exilic days and the re-enactment of the Sinai event in their minds that they found themselves again and regained hope for the future.

Through reliving the early history, the exiles comprehended that despite their desperate context, a new beginning was possible; that there was a new life after the unfaithfulness of the pre-exilic times; that the laws of Deuteronomy were still valid; that each generation was still standing at Horeb; and that they could still hear Moses' voice encouraging them to follow Deuteronomy. In this way the Zadokites (or the first Deuteronomistic editors of Deuteronomy) reworked the suffering of the exiles by giving the breach of the covenant a very prominent position. In this way, they comforted the exiles with hope for a new future.

Anneline du Preez



Prof Jurie le Roux, Faculty of Theology.

## Plants:

# Nature's chemical treasure chest

"Plants are the most amazing chemists in the world. They make more complex compounds every day than we can ever dream of manufacturing," says Prof Kobus Eloff, who initiated the Phytomedicine Programme at the University of Pretoria in 1995 and has been leading this unique research effort since then.

His passion for finding and harnessing the healing power of compounds in South Africa's rich diversity of plants has sustained a productive research career spanning 50 years at several universities and the Kirstenbosch Botanical Gardens. "We have about 10% of the world's plant species in South Africa – a chest of chemical treasures waiting to be discovered," Prof Eloff believes.

Prof Eloff has been called back from retirement three times, and "now on the other side of 70", he is as inspired as ever to find out more about how we can use the bioactive substances in plants to benefit people and animals, and even to improve the health and productivity of plants and food crops. Because of the potential use of medicinal plants in animal health, Prof Eloff's research group has been incorporated into the Department of Paraclinical Sciences at the Faculty of Veterinary Science, Onderstepoort. Phytomedicine and ethnoveterinary medicine are now one of the research focus areas of the faculty.

People have been using plants and parts of plants for healing purposes since ancient times. Most plants have many biologically active compounds, especially in their leaves, but getting to these substances and understanding how to use them effectively to treat diseases requires strategy, dedication, sophisticated science and also sometimes a bit of luck or serendipity.

Because the compounds responsible for antimicrobial activity are usually not soluble in water, people in rural areas usually don't have the solvents that are necessary to extract the active compounds. Consequently, bioactive compounds and potential applications are found that are not known to traditional healers. Over the past five years, Prof Eloff's research team has focused on developing a

unique database on the therapeutic potential of the complex mixtures of compounds found in the leaves of trees. PhD student Lita Pauw planned and orchestrated the collection of leaves from more than 600 indigenous tree species.

Back at the laboratory, the team prepared leaf extracts and tested each one against selected species of bacteria, mycobacteria and fungi to see whether the extracts could be used to treat infections. Some extracts have also been tested for effectiveness against viruses and animal parasites. It is useful to investigate the safety of extracts, and many extracts have been screened for their inherent cytotoxicity and mutagenicity. More tests are needed to make sure the plants will be safe to use and to get a full picture of potential risks that could result from using these extracts as therapeutic agents.

"We focused on tree leaves, because it is possible to harvest and use leaves sustainably," Prof Eloff explains. "When you debark a tree or dig up its roots, the tree is often damaged or killed, but the leaves can be harvested on an ongoing basis." Prof Eloff points out that tree leaves are frequently as active as tree bark, although, in many cases, bark is used traditionally. "There is no biochemical reason why you would find compounds in the bark that would not be found in the leaves," he adds.

All results were fed into the database that now contains comprehensive information on the bioactivity of more than half of all South Africa's indigenous tree species. They are continuing to follow up the promising leads from the tree database and identify the best candidate species for further research, in other words, the species that show most promise as an effective agent to treat or prevent disease.

They have kept dried, powdered samples of the leaves of all the trees included in the study because, as Prof Eloff points out, "all good research leads to more research".





Dr Lyndy McGaw and Prof Kobus Eloff, Faculty of Veterinary Science.

The methods that Prof Eloff and his collaborators have developed for preparing plant extracts are now in use in laboratories around the world. His research students and collaborators from other countries in Africa and Europe have played an important role in spreading this South African-grown expertise around the globe and, more importantly, have created strong collaborative ties between the Phytomedicine Programme at the University of Pretoria and other international programmes.

Prof Eloff emphasises that the research is driven by the needs of people and industry. The applications they are working on range from additives for animal feed, treating poultry diseases, combating ticks and animal parasites, producing immune boosters, and treating tuberculosis, diabetes and infections in immunocompromised patients. They even have a patent pending on using plant extracts to benefit other plants by killing the fungi that attack plant crops with a plant extract.

Prof Eloff's passion for research has inspired many students and young researchers over the years, including Dr Lyndy McGaw, a senior postdoctoral research fellow in the

Phytomedicine Programme, who is now second in command of the group. Dr McGaw is excited about the huge potential and practical relevance of phytomedicines, and especially about the role that women can play in this field. "We do our best to promote the scientific careers of young women scientists so that they can inspire current and future students."

Prof Vinny Naidoo, Director of the University of Pretoria Biomedical Research Centre, takes responsibility for all animal experiments carried out in the Phytomedicine Programme. The ability to test the *in vivo* efficacy of potential products at Onderstepoort is one of the important competitive advantages of the Phytomedicine Programme in developing plant-based therapies.

The Phytomedicine Programme is one of the most productive groups in the University of Pretoria. Since 2005, 75 peer-reviewed publications have appeared or are in press. The top ten papers of the programme have been cited 89 times, on average. The group has presented oral and poster papers at close to 140 national and international conferences and registered four patents. To date, the programme has delivered 28 MSc students (21 with distinction) and 16 PhD students. Since 2000, nearly R19 million has been invested in their research by external funders. The group has organised several workshops with delegates from all over Africa and hosted the November 2008 World Congress on Medicinal and Aromatic Plants – a high-level meeting only held once every five years. The work is completely interdisciplinary and draws on expertise in fields as diverse as biochemistry, botany, chemistry, entomology, microbiology, parasitology, pharmacy, pharmacology, physiology, plant pathology, plant production, veterinary sciences and zoology. "The strongest point of the programme is the excellent collaboration between students and the many colleagues who act as co-supervisors for students," Prof Eloff believes.

The programme aims to deliver beyond graduates and publications. The group works closely together with Bioextracts (Pty) Ltd, a small company specifically established to commercialise the products of the Phytomedicine Programme. Two products are already on the market and there are several more patents and products in development, based on information in the tree leaf database.

Looking back on his research career, Prof Eloff singles out his work with young people as the highlight. "To see a student who came from a really disadvantaged background work hard and develop to overcome obstacles and eventually obtain a PhD at an internationally respected university is simply wonderful," he says. For success in research, he emphasises the importance of having a sound strategy and staying focused, but adds that sufficient funding at the right time remains the lifeblood of research. "Without money and good facilities, it is very difficult to train researchers for the future!"

Marina Joubert

# Faculty highlights



## 6.1 Faculty of Economic and Management Sciences



Prof Carolina Koornhof, Dean

The vision of the Faculty of Economic and Management Sciences is 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 needs in Africa.

### Message from the Dean

Although the research outputs of the faculty often reflect theoretical research, the application thereof is also visible in the number of contract and applied research reports and articles completed in order to address critical research needs, both in the public and private sectors, in South Africa.

The faculty has identified the continuous improvement of both research quality and research outputs as a key priority, by:

- developing the supervision and research capacity of members of the academic staff;
- improving the quality of writing skills of staff and students;
- improving the knowledge of research methodology of staff and students;
- activating the research culture in the faculty;
- creating sufficient and effective administrative and research support to academic staff;
- increasing the number and quality of postgraduate students in the faculty; and
- increasing the number of NRF-rated researchers.

International networking with peers at renowned research institutions is of paramount importance in achieving goals and a concerted effort is being made to establish and strengthen relationships.

During 2009, 11 doctoral students and 118 master's students graduated. Three staff members of the faculty obtained their master's or doctoral degrees and numerous staff members are currently in the process of studying towards their doctoral or master's degrees. At present, four staff members are studying at international research universities to complete their doctoral degrees.

In 2009, the staff of the faculty achieved the highest research output ever, which includes 104 articles and two conference proceedings. The faculty had 12 NRF-rated researchers in 2009 and, for the first time, has the expertise of two B-rated researchers, who share their expertise and experience with the faculty as the chair and deputy chair of the research committee. The faculty research award for the department with the highest number of accredited research units in the preceding year was awarded to the School of Public Management and Administration. Faculty research awards were also made to best individual researchers. Dr Edwin Ijeoma from the School of Public Management and Administration received the award for the senior lecturer with the best research output, while Prof Rangan Gupta from the Department of Economics received the award for the best performance in the category associate professor or professor.

In 2009, the dean and heads of department conducted a management summit on research. At the summit, they shared best research practices and discussed the hurdles to the production of quality research and the strengthening of a research culture in the faculty. Several departments conducted research seminars and brown bag sessions that were attended by staff and students. The research committee also coordinated a number of workshops and training sessions for academic staff members that covered important aspects of research.

I would like to thank the members of the academic and administrative staff, postgraduate students and, in particular, the members of the faculty's research committee, postgraduate committee and research ethics committee for their contributions in making 2009 an exceptional research year. The aim of the faculty in 2010 is to continue to build its research capacity and expertise, to foster a research culture, and to improve both the research output and impact of the research of staff and graduates.

Prof Carolina Koornhof  
Dean: Economic and Management Sciences

## Accounting

### Tax knowledge of South African trainee accountants

This empirically-based, exploratory study outlines the framework of chartered accountants' tax education and training in South Africa and focuses on training officers' perceptions of the existing tax knowledge of trainee accountants when entering into a training contract after completing their university qualification. The study identified the respondents' satisfaction with the performance of "entry-level" trainee accountants of their duties. The results indicated that, although the educational background of trainee accountants was for the most part adequate, these trainee accountants were not sufficiently able to perform their duties when entering into training. The implication of this study is that the syllabus setters and educators should review the practicality of the current tax syllabus content for the education and training of aspirant chartered accountants in South Africa.

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## Auditing

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

The departments of Auditing at the University of South Africa (Unisa), University of Pretoria and the Tshwane University of Technology, in conjunction with the Bureau of Market Research (BMR) at Unisa, completed the first phase of a research project to establish the standing of and demand for internal auditing in South Africa. The project was funded by the Institute of Internal Auditors in South Africa (IIA (SA)) and KPMG. The final report was launched on 28 February 2010 at the Leadership Forum of the IIA (SA).

The study involved survey research to assess the views and perceptions of stakeholders. One questionnaire was developed for completion by the chief audit executive by means of the web, a second for completion by the chair of the audit committee by means of a personal interview, and a third for completion by the chief executive (the chief executive officer, chief financial officer or chief operating officer) by means of a personal interview. The first phase of the project focused on the private sector, sampling 30 of the top 40 companies listed on the Johannesburg Stock Exchange.

The research resulted in a number of insights about stakeholder views of the internal audit function. A perceived quality internal audit function is likely to correlate with the soundness of the organisation's corporate governance structure. Both the audit committee chairs



From left: Kato Plant (researcher, UP), Philna Coetzee (researcher, UP), Charles Nel (Technical Director, IIA (SA)) and Dr Claudelle von Eck (CEO, IIA (SA)).

and the chief executives indicated that they perceived the contributions made to the organisation by the in-house internal audit function as being greater than that made by the outsourced function. The research also revealed contradictions between how the audit committee chair, on the one hand, and the chief executive, on the other hand, perceive certain factors. For example, there were significant differences in the responses of the two parties with respect to the reporting lines of the head of internal auditing and the presence or absence of a board risk committee.

The final report was accepted with great enthusiasm by the leaders in the profession. The researchers have also submitted a research report to the IIA Research Foundation in the USA to be published as a formula research report that could be accredited by the Department of Education. The full report is available on the IIA (SA) website, as well as from the Department of Auditing at the University of Pretoria. The second phase of the research will commence shortly with a focus on the public sector.

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Economic and Management Sciences Building.

## Economics

### Evaluating the inflation-targeting regime of South Africa

A series of recent studies examined the different ways (ranging from welfare cost of inflation to the effect of inflation targeting on average levels and volatility of inflation) of evaluating the inflation-targeting regime in South Africa. The research found that welfare cost estimates, based on partial equilibrium approaches that involve estimating the area under the money-demand function, are sensitive to specifications, econometric methodologies and data aggregation. More importantly, the research indicates that the partial equilibrium approach severely underestimates the sizes of welfare cost of inflation. The welfare cost of inflation for the current target band of 3–6% is between 0.8% of gross domestic product (GDP) to around 2% of GDP, figures that are more than double when compared to the partial equilibrium approaches. Using a model of dynamic time inconsistency in monetary policy-making and the cosine-squared cepstrum, the average levels of inflation and inflation volatility respectively would have been lower if the old regime of so-called eclectic monetary policy-making had continued. The research points to two conclusions. Firstly, there are huge welfare gains from reducing the target to below the 3% level. Secondly, the poor performance of the inflation-targeting regime in terms of average levels

and volatility of inflation could be associated with the width of the target, which does not allow inflation expectations to converge to a focal point. This line of thinking is in accordance with the current theoretical literature, as well as international evidence of economies pursuing much stricter (point) targets. In sum, these cumulative research studies suggest that the best policy would be not only lowering the target, but also making it narrower.

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### Analysis of monetary policy rules in South Africa

This research investigates a number of issues concerning the modelling of monetary policy in South Africa. Recently, researchers have questioned the linear specification of monetary policy, which assumes that the response of interest rates to inflation and output is constant. Furthermore, recent economic events have drawn attention to the behaviour of asset prices (stock prices, house prices and commodity prices) and the concern of central banks about the maintenance of financial stability.

Using a variety of nonlinear parametric, nonparametric and semi-parametric regression estimation techniques, the findings of this research are that the response of the South African Reserve Bank (SARB) monetary policy to inflation is asymmetric and greater during business cycle recessions and seems to place high importance on inflationary pressures of output during boom periods. The 2007–2009 financial crisis witnesses an overall decreased reaction to inflation, output and financial conditions, amidst increased economic uncertainty, with a shift from an asymmetric response to financial conditions over recessions to a more symmetric response, irrespective of the state of the economy.

Semi-parametric models, which are data-driven and do not impose an often clumsy linear/nonlinear parametric structure on the data, consistently outperform linear and nonlinear parametric models and are best suited in forecasting the rate of interest.

The response of the SARB's policy-makers to financial conditions arguably has important policy implications, as it might shed some light on why the current downturn in South Africa and the Eurozone area (where similar practices have been reported) is less severe than in the USA where financial conditions do not feature in the Federal Reserve Bank's reaction function. Secondly, the forecasting superiority of semi-parametric models implies that there are new types of complex and subtle monetary policy responses that have hitherto been obscured by the use of restrictive parametric models.

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ECONOMIE EN  
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MANAGEMENT SCIENCES

## The impact of water scarcity on economic development initiatives

Water is a limiting factor constraining economic development, a reality that is often overlooked. South Africa's unallocated water resources (that is, water that has not been dedicated to a specific sector) have dwindled to precariously low levels. It has been estimated that the country's surplus water in 2000 (the latest available official figure) was 1.4% of its national supply. With an economy that is growing at 3% per annum, and with a population growth in excess of 2%, the surplus will soon be exhausted. The authorities acknowledge this and estimate that the country as a whole will be in a water deficit within the next 10 years. Currently, 12 of the 19 water management areas are already in a water deficit. These shortages are managed through an intricate web of interbasin water transfer schemes, but options are dwindling at an alarming rate.

At a macroeconomic and strategic level, the question therefore is how to make the best use of the country's available water resources. This research applied a macro-economic computable general equilibrium (CGE) model using an integrated database comprising South Africa's social accounting matrix (SAM) and sectoral water use balances. The research references the South African government's Accelerated and Shared Growth Initiative for South Africa (AsgiSA) and concludes that introducing the proposed programmes in a business-as-usual and water-intensive manner would strengthen the current growth in the demand for water, accelerating the time of a national water deficit.

The analysis demonstrated that a hypothetical injection into the economy of R1 billion to each of nine targeted AsgiSA industries would lead to a deficit in the available amount of water. It would, therefore, be physically impossible to stimulate the nine industries as planned, unless the necessary water supplies were reallocated from other sectors. An alternative scenario is proposed that incorporates a hypothetical water tax. This tax would decrease the total water demand sufficiently to provide for the AsgiSA initiatives and have some savings left over. If the revenues from the water tax were recycled towards the nine industries, the negative impact of the water tax would be diminished in terms of GDP and employment effects, while a large net saving of water would remain. This analysis shows that macro-economic planning and the design of economic development strategies cannot be done in isolation from consideration of natural resource constraints.

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## Health and households in South Africa

Two research projects conducted with Dr Olufunke Alaba, a postdoctoral fellow in the department, focused on health issues and their effects on households. The first project examined the timing of treatment for ill children. Using a variant of a matching estimator, the research estimated the probability that ill children received either immediate, delayed or no

treatment. Consideration was given to the impact of immediacy on the choice of facility (public or private) in which treatment was sought. The results suggest that immediate treatment (over delayed or no treatment) is less likely for children in larger households, but more likely for children with multiple symptoms. Access to insurance does not appear to affect timing. Delayed treatment (over no treatment) is more likely for children from the wealthiest households. Multiple symptoms also appear to result in immediate treatment for these households. Immediate treatment in a public facility is less likely for children covered by insurance. However, delayed treatment in a public facility is not affected by insurance coverage, although it is affected by the number of observed illness symptoms. In total, the research suggests that children without access to insurance may not be receiving immediate care, despite free public health care. This may possibly result in a greater number of symptoms that are then examined in private facilities, presumably, at a high cost to the household.

The second study postulated that mandatory contributions to a national insurance pool could have detrimental effects on the households most likely to be affected by the mandates. The analysis used matching estimators to examine differences in household budget allocations across various subgroups of the population. The analysis revealed that the mandates would impact on budget allocations in expected ways. Firstly, households would be required to allocate a greater share of their budget towards health (health insurance). Secondly, in order to offset the increase in their health budgets, households would need to make cuts in other areas. The results suggest that reallocations to the health share of the budget would most likely arise from reductions in the share of the budget allocated to food, transportation and communication. When placed in the context of policy, although the analysis cannot indicate for sure whether or not the reallocations result in social improvements, the results are strongly suggestive of negative household level welfare effects.

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## Human Resource Management

### The intercultural equivalence of the Aviation Gender Attitude Questionnaire

This study is part of a larger research project in collaboration with the University of Western Sydney (Australia) and the University of Tromsø (Norway) that focuses on gender issues in aviation. The aim of this study was to establish the differential item functioning and construct equivalence of the Aviation Gender Attitude Questionnaire (AGAQ) to determine the generalisability of the instrument across two national cultures (South African and Australian). Data was collected from a sample of South African and Australian aircraft pilots and analysed by means of various analytical procedures. To establish the intercultural equivalence of the AGAQ, multivariate methods for item analysis and the comparison of factor structures were used.

The scale-level statistics confirmed the equivalence of the AGAQ scales for both samples in the aviation contexts. It was unequivocally established that the AGAQ is a valid and culturally non-biased measure that can be used to assess South African and Australian aviators' perceptions of gender-related pilot behaviour.

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## Marketing and Communication Management

### Attitudes of young consumers towards SMS advertising

Technological advancements have provided various new mediums for advertising to consumers and have further allowed organisations to better reach consumers with regard to the frequency and impact of advertising. This study focused on determining the perceptions of young consumers towards SMS advertisements. It was found that young consumers' perceptions of the entertainment value, informativeness and credibility of SMS advertisements positively correlate with their overall attitudes towards SMS advertisements. Further, consumers' perceptions of the irritation value of SMS advertisements negatively correlated with their attitudes towards SMS advertising. Consumers' attitudes towards SMS advertisements are generally negative and this medium has to be used cautiously to reach the young consumer segment. It was concluded that the principles and practices of permission-based marketing were an important prerequisite for SMS advertising.

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### A marketing perspective on choice factors considered by South African students in selecting a higher education institution

The environment in which higher education institutions all over the world have to operate poses many management and marketing challenges to such institutions. The main objective of the study was to investigate the relative importance of the choice factors that prospective economic and management sciences students considered, as well as the sources of information used in the decision-making process of choosing a higher education institution in South Africa.

The study indicated that quality of teaching and employment prospects ranked the highest as choice factors. The word-of-mouth influence of parents, siblings and friends were the least influential factors. Campus visits and open days are the most valuable sources of information for prospective students.

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## School of Public Management and Administration

### NEPAD's role in the creation of infrastructure for trade facilitation

In this study, the research team argued that African and other developing countries cannot continue to argue about the fairness of the international trading rules, while simultaneously being further excluded and marginalised owing to their effects. It was further argued that one such effect would be the reduction in the degree of autonomy previously enjoyed by national bureaucracies. The team postulates that, through the interplay of deregulation and technology, new options for economic and political participation will become available in public administration modelling. The study also indicated that the challenges facing African states to become more involved in the global trading environment need to be investigated. Such opportunities should be investigated at both the regional and international level with the aim of modifying the present rules in order to gain new advantages. If Africa is absent from such global debate and consensus building, it can only be to the detriment of the region.

Greater access to international markets is universally accepted as the solution for many of Africa's problems. Such increased access would theoretically give African countries an opportunity to develop strong economies. Sustainable growth through trade would then replace the current common dependence on aid and enable African citizens to enjoy a fuller share of the myriad benefits of globalisation. The gradual global reduction in historic methods to protect market aspects, such as tariffs, is bringing technical requirements to the fore. These requirements often become technical barriers to trade (TBTs) between Africa and its trading partners. Simultaneously, there are continuous global demands for greater access to African markets. Such demands even occur as ever more stringent technical requirements for granting reciprocal access in developed markets are set. Such technical access requirements are insidiously becoming an increasingly important part of the African trading landscape.

Therefore, African governments increasingly need to ensure that domestic industry and agriculture have appropriate and affordable access to appropriate technical support infrastructure. The current African approaches to such generally unexpected technical challenges from elsewhere are mostly reactive donor-driven projects managed as crises. The predominant focus of NEPAD presently revolves around demonstrating appropriate

governance. Rather than continuing to be victims of globalisation, African states working cooperatively through NEPAD have an opportunity to redress their past difficulties. In the area of African standards, quality assurance, accreditation and metrology (SQAM) capacitation, NEPAD has an important leadership role to play. It could provide a foundation through which solutions in SQAM can be cooperatively sought and addressed. Aspects relating to proving compliance to the aforementioned agricultural, industrial and environmental policies need immediate attention. An African public administration-led approach to building SQAM technical capacity would then be possible.

Compliance with the various and technically challenging regulatory requirements of foreign markets cannot continue be the sole thrust of Africa's trade facilitation efforts. Implementing foreign technical solutions that make sense in a limited and different context will not deliver large-scale benefits for Africa. NEPAD-fostered partnerships based on mutually beneficial and optimal solutions are preferable. Such a proposed role for NEPAD includes the creation of sound theoretical public administration underpinning and successful operational facilitation for African public administrators working in concert on mutually beneficial technical SQAM support strategies. The many predicaments identified by this study raise the question as to whether cooperative engagement with such complexities, using a vehicle such as NEPAD, would assist African states to find appropriate and sustainable solutions.

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### Policy implementation: the role of policy learning and cognition

Two studies examined issues related to effective policy implementation. The first study was based on the premise that cross-national experiences and policy design in a specific jurisdiction should theoretically influence policy learning and eventually policy outcomes. The research explores the debate around and value of policy learning, and highlights the myths and imperatives of policy learning by determining to what extent it contributes to real policy change. One such myth is that all incidents of policy implementation should foster policy learning and therefore improved service delivery. A common definition of policy learning may be possible, but details differ in every social context. Different kinds of learning are instrumental learning, social learning and political learning. The basis for learning includes aspects such as how conscious learning is, the object of learning, who learns, and the status of learning in policy literature. Often policy change does not result from learning, although it can occur because of learning. Learning due to failure in the process of policy learning often has more long-lasting effects than learning from successes. Different kinds of policy learning and a combination of them can contribute to meaningful policy change and improved service delivery. Policy change is proof of learning. What is learned is what is remembered, but how do governments and organisations deal with policy intelligence? Policy intelligence should be valued in a culture of policy learning. Organisational and intra-organisational learning could stimulate common learning in government and institutions alike.

The second study focused on sense-making in the implementation process. What a policy means for the implementers is constituted in the interaction of their knowledge, beliefs and attitudes with the situation. The understanding of the policy message is influenced by individual cognition, situated cognition and the role of the implementing agents. The implementing agents sometimes reject or fundamentally revise national policy proposals. To take a stand against a certain policy, implementers must first know what it is that the directive is asking them to do. The understanding of directives requires cognitive skills and processes of interpretation. What implementers make of new information has much to do with prior knowledge, expertise, values, beliefs and experiences. The study delineates the contribution of cognitive frames to implementation and attempts to make additional contributions to understanding the role of cognition in the implementation process.

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### Tourism Management

#### North-south-south collaboration adds value to the tourism knowledge base in southern Africa

The North-south-south Programme is a joint project of the universities of Pretoria, Botswana, Cape Town, Moi (Kenya), Maseno (Kenya), Namibia and Oulu (Finland) that aims to advance sustainable tourism education and research at the partner universities. The programme, which is funded by the Finnish Government's Centre for International Mobility (CIMO), facilitates student and lecture exchanges, joint education programmes and collaborative research projects.

The Department of Tourism Management has not only participated in successful lecturer and postgraduate student exchange programmes, but has also played a key role in publishing a 15-chapter book on key strategic and research issues pertaining to sustainable tourism in Southern Africa. Prof Deon Wilson is co-editor of the book *Sustainable tourism in southern Africa: local communities and natural resources in transition*. Both he and Prof Ernie Heath were also contributing authors. Furthermore, three PhD graduates of the department, Dr Gerrie du Rand, Dr Dawid Mabunda and Dr Sharma Govender-van Wyk, contributed chapters in the book, based on the research findings of their PhD theses. Another key outcome of this collaborative initiative was a master's dissertation by Ms Nadine Leonard, *A comparative study of forest tourism in selected areas of Finland and South Africa*.

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## 6.2 Faculty of Education



Prof Irma Elof, Dean

need to strengthen our capacity to contribute to skills development are higher than ever. However, while it is important to acknowledge the 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 foreground in our research.

In this regard, it is noteworthy that some of the best educational researchers on the continent of Africa make the Faculty of Education at the University of Pretoria their home. Consequently, this faculty is where one will find leading studies on literacy, numeracy, mathematics and science education, doctoral education, resilience, positive psychology and student identities in South African schools. The footprint of the faculty extends beyond South African borders, with regional studies in Botswana, Zimbabwe and other African countries. A significant number of the faculty's staff members are NRF-rated, and the faculty is well known for the many national and international awards that its academics receive on a regular basis.

During 2009, the faculty was restructured to respond to the growing needs of quality teacher education in South Africa, while also expanding the knowledge creation that is pursued via research. Strategic plans were developed to strengthen all the BEd programmes by placing subject expertise central to the faculty's teacher training programmes. Research foci were realigned accordingly. At the end of 2009, the new applications for first-time students in the faculty continued to increase, as it had done the year before.

In order to contribute to social capital in South Africa, the faculty sought robust connections between research, teaching and learning, as well as community engagement. Research is

Education is a high priority in South Africa at the moment. We are at a juncture, like never 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.

### Message from the Dean

The challenges are considerable. The demands on educators, learners' alarmingly poor literacy and numeracy skills, the qualifications of educators, HIV/AIDS and the

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 sociological environments in which research is conducted.

The faculty's cadre of researchers is leading some of the largest funded research educational projects in southern Africa. They 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. The projects enjoy international acclaim. The Unit for Educational Research in AIDS (ERA) is creating partnerships in HIV research across South Africa. The Joint Centre for Science and Mathematics Education is playing a leading continental role in doctoral education in natural sciences education.

Record numbers of PhD students completed their studies in the faculty during 2009, continuing an established tradition of delivering high-quality postgraduate students annually. 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 Faculty of Education at the University of Pretoria 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 Elof  
Dean: Education

## Science, Mathematics and Technology Education

### Monitoring learner performance and providing schools with high-utility information

Over the last couple of years, monitoring and feedback of learner performance have became a major policy issue in South Africa. The cornerstone of monitoring performance is obtaining data from which inferences can be drawn. However, the way in which information is presented to schools and teachers is of the utmost importance if the information is to be used for improvement purposes. The aim of this research was to explore what information schools felt they needed, based on two monitoring systems used in this South Africa-Netherlands Programme on Alternatives in Development (SANPAD) research development project, namely the South African Secondary School Information System (SASSIS) and the South African Monitoring System in Primary Schools (SAMP). A further aim was to explore how schools used the information. The idea of data literacy emerged in terms of how schools and teachers identify the information needed for decision-making, interpret the information and use it for improvement purposes.

The research team was also given the opportunity to explore different forms of feedback, including the development of benchmarks against which academic gains could be mapped. It became clear that several data paths were possible, as well as different ways in which the data travels to key role players, depending on the culture of schools. While data utilisation can be difficult to ascertain, it became clear that the use of performance data for improvement purposes is a gradual process and that it is important to uncover obvious, as well as less obvious, forms of data use.

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### Mentorship by master Mathematics teachers

What kind of professional development would be effective for upgrading the content knowledge and professional competence of underqualified teachers in townships and rural schools? The aim of this research was to investigate the effect of a professional development approach, called mentorship, by master Mathematics teachers. Where mentorship usually focuses on the induction of beginning or student teachers, the target of the Teacher Mentorship Programme (TMP) in this case was experienced teachers who had been teaching Mathematics in township schools for years, but without appropriate qualifications. Due to no fault of their own, the mentee teachers had never previously been exposed to excellent teaching practices as learners, student teachers or practising teachers. The impact of the four-year programme (2003–2006) showed that teachers mostly needed support with subject conceptualisation, pedagogic content knowledge (how to teach challenging concepts) and portfolio assessment. In conclusion, this research offers a possible theoretical framework for designing and negotiating an individualised professional development plan.

The suggested theoretical framework departs from the zone of feasible development (ZFD), in analogy to Vygotsky's ZFD that describes the "distance" between actual performance and the idealised performance an individual can achieve with the guidance of an "expert".

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## Early Childhood Education

### To lead the child by the hand: practitioners' conceptualisation of teaching in early-learning centres in rural communities

This study forms part of a longitudinal study on the enhancement of practitioners' skills in facilitation and teaching in early-learning centres in their rural communities. The purpose of the investigation was to determine how practitioners conceptualise their facilitation and teaching practices to the very young child. In this study, researchers employed active participation from the participants. Ten practitioners were selected purposefully from the Ntataise Network in the Rammulotsi Township of Viljoenskroon. Data was collected by means of observations, video recordings of their teaching in the classroom, open-ended interviews with the teachers, drawings from the children and field notes. Four prominent categories emerged from the data: the role of lecturers from the University of Pretoria in role modelling the skills and content in teaching the children, the improvement of self-confidence when realising that they have the capacity to facilitate content for children to understand, the importance of teamwork as they learn from one another, and the acknowledgement of the parents for their teaching as the primary schools are beginning to acknowledge the abilities of the children coming from these early-learning centres and enrolling for Grade 1 at their schools. The researchers theorise that practitioners cannot be told how to facilitate learning to young children. They have to see and experience good practice (including teaching skills) role-modelled to them. In addition, they have to participate actively in the role modelling. Through these experiences, children reap the benefit of being lead "by the hand" by a competent practitioner.

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## Humanities Education

### Immigrant learner identities in South African schools

Most public schools in South Africa, in addition to opening their doors to all South African children irrespective of race, colour or creed, have also opened their doors to a number of black immigrant children. There is, however, very little research on the ways in which immigrant learner identities are

framed, challenged, asserted and negotiated within the dominant institutional cultures of schools. Accordingly, this SANPAD-funded research study asks how immigrant learners construct, negotiate and represent their identities in the South African schooling context. To what extent has the ethos of these schools been transformed towards integration in the truest sense and how do immigrant learners perceive this in practice? Are new forms of immigrant learners' self-identities beginning to emerge? Utilising the theoretical frameworks of critical race theory and figures of identification, this research study attempts to understand the constitution, negotiation and representation of immigrant identities in South African schools. Major findings that contrasted with what was found in the voluminous literature in this field were multifold in nature. Firstly, although immigrant learners' ease of assimilation into the chosen reference group was to some degree sanctioned by their phenotypic racial features, their attempt at "psychosocial passing" was politically motivated. They wanted to pass as the indigenous blacks so as to gain access to resources, etc. However, they could not come to terms with the ill discipline and poor moral conduct of South African learners and saw this as a site of contamination and shame. Secondly, immigrant learners did not readily classify themselves according to skin pigmentocracy. They initially identified themselves in terms of personality traits and subsequently in terms of ethnicity linked to culture, traditions, language and country of origin. The label of "black" was something that was ascribed to them on entry into the host country and something that they learnt to incorporate as part of their identity, given that they shared similar phenotype features as indigenous black learners. Thirdly, the majority of immigrant learners heightened their ethnic self-awareness in forming their identity. Fourthly, immigrant learners were not seen as having an identity, but rather as being "cast into a category with associated characteristics or features". The categorisation process was based on "shades of blackness" and negatively influenced many immigrant learners' formation of social identities and their sense of belonging to groups. Fifthly, immigrant learners preferred to present themselves in relation to others in terms of a "continental" perspective. There seemed to be an increasing emphasis on an "African" identity. In the sixth instance, their self-agency was twofold in nature. They not only wanted to improve their own condition as much of the literature in the field reports, but there seemed to be an inherent drive to improve the human condition of others. There was genuine concern and a form of empathy. They wanted to assist the indigenous black learners in the spirit of "brotherhood" (we are the same, we are all "Africans") to improve the moral, academic and social fibre of South African society.

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### **Learning support: perceptions and experiences of distance learners from the Basarwa and Bakgalagadi communities in Botswana**

This case study documents the perceptions and experiences that learners from the Basarwa and Bakgalagadi communities in Botswana had of studying for a secondary school-leaving certificate. It was informed by an interpretive paradigm using a mixed-methods approach. The theoretical underpinning for the study pertained to Holmbergs' theory of conversational learning (2003). Qualitative methods of data collection included semi-structured interviews, journals, document analysis and observations, while a questionnaire provided nested quantitative data.

Key findings showed that these marginalised learners exhibited strong intrinsic motivation and 72.1% of them were satisfied with the learning support provided by the host institution. This substantiates the premise that learner motivation remains a key attribute for successful distance learning in any context. Despite their geographic remoteness and adverse circumstances, positive perceptions and experiences were shared where learners had access to personalised academic and affective support from empathetic tutors. However, policy and managerial flaws frustrated and unintentionally disadvantaged them in terms of the language and culture of instruction, connectedness, feedback and future prospects. An analysis to establish learner needs, expectations and aspirations is critical for the design and development of relevant learning material, and for the delivery of quality learning support to enhance the academic experience of remote learners from marginalised communities. Implications for practice include policy reviews, open and distance learning (ODL) staff training, and the adoption of best practices specific to underdeveloped distance learning contexts.

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## Educational Psychology

### **The STAR intervention: Supportive Teachers, Assets and Resilience**

This longitudinal participatory study has been investigating psychosocial coping with vulnerability since 2003. It started as a PhD study that evolved into a broad research project – the STAR intervention (Supportive Teachers, Assets and Resilience). Teachers from four schools in three South African provinces (n=40) have been partnering as research participants, subsequently initiating school-based projects in supporting learners, their families and communities. Examples of established initiatives include vegetable gardens, soup kitchens, support centres, information centres, and referral networks with NGOs, health service providers and faith-based organisations. The research project is currently in a dissemination phase, where teachers from three schools have been trained as facilitators to extend the STAR intervention to neighbouring schools. The intervention is now being replicated in four neighbouring schools and three additional schools have been invited to join in 2010. In addition to the ongoing focus on psychosocial support and the sustainability of existing projects, the focus of the project has expanded to include the dissemination of the initial study, facilitators' experiences, recipients' experiences and the resilience of teachers. Preliminary findings indicate that the dissemination of the research has resulted in positive change in communities, with teachers initiating change by introducing school-based projects, but also by actively involving community members and mobilising available resources in communities.

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## Asset-based relationships: teachers addressing resilience and HIV/AIDS in schools

The purpose of the investigation was to determine how teachers conceptualise relationships when addressing adversity (including HIV/AIDS-related challenges) in schools from an asset-based perspective. Eight teachers from three schools were purposefully selected. Data was collected by means of phenomenographic interviews and observations. Five prominent categories of description emerged subsequent to the phenomenographic data analysis and were visually presented in a phenomenographic outcome space. Teamwork emerged as the main category. The participants experienced barriers in the asset-based intervention process, but overcame barriers in order to achieve positive changes due to relationships. The researchers theorise that teachers conceptualise teamwork at the heart of relationships when addressing HIV/AIDS-related challenges in schools. In this regard, team-based relationships are signified as caring, supportive and communicative spaces from whence teachers embark on coping with barriers linked with HIV/AIDS in schools. Although teachers experience multiple hindrances because of HIV/AIDS, among other things, they utilise relationships as a means to effect resilience in schools. This study forms part of the STAR initiative (Supportive Teachers, Assets and Resilience), a longitudinal school-based study on resilience and education.

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## The utility of the kinaesthetic family drawing to measure resilience in children of HIV-positive mothers

This study explored the utility of an instrument – the kinaesthetic family drawing (KFD) – with a child to increase an understanding of child-adaptive functioning. Many studies have indicated the need to better understand the experience of children whose parents have HIV. A challenge in studies has been the accountable use of validated measures. The study forms part of KgoloMmogo, a five-year randomised controlled trial investigating resilience in HIV-infected mothers and their young children. In KgoloMmogo, resilience is viewed from the perspective of adaptive behaviour. The researchers made use of purposefully sampled baseline assessment data of six-year-olds ( $n=11$ , three female and eight male). Data sources included KFD pictures, transcriptions of baseline interviews, as well as scores from the Vineland adaptive behaviour scale. The results of the study demonstrate that the qualitative data from children (KFD) added to information obtained from mothers (Vineland). Additional information from the KFD had interpretation value for Vineland scores and provided a child's perspective regarding adaptive functioning behaviours. Contrasting information from the KFD queried mothers' perspectives (Vineland). The absence of significant information in KFD results regarding

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## Teachers living with AIDS: underplaying the role of emotions in the implementation of HIV/AIDS policy in Zimbabwean primary schools

The study sought to illuminate the experiences of teachers living with AIDS and how their experiences affect the ways in which they understand and act on government policy. The researchers used the data collected from the teachers' stories to write narratives that gave a first-person account of the experiences of each teacher. The main findings from the study suggest that, in a context with AIDS, there are limits to what education policy can achieve if it remains out of touch with a real world in which school is attended by children and teachers whose bodies are either infected or affected by HIV. This is substantiated by the fact that while the HIV/AIDS policy is about bodies and about emotions, it is blind to the bodies and the emotions of those implementing it. The researchers contend that it is this oversight that creates the wide gap between policy intentions and outcomes. Secondly, the study highlights the uniqueness of education policy and its implementation, which powerfully brings to the fore the bodies and the emotions of the implementers. The study concludes by suggesting the reconstruction of the policy-making process to inscribe the real bodies and real emotions of the teachers into the policy, acknowledging that a significant majority of school pupils and teachers are infected or affected.

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## Development of the framework for the implementation of psychometric tests in the Ministry of Education, Botswana

In the Botswana context, use of psychometric assessments to support the school guidance and counselling programme is on the presumption that such test use will result in fair and valid decisions. The research team was invited by the Botswana Ministry of Education to develop a framework for the implementation of such psychometric tests in Botswana. Because use of data from psychometric tests to support student development in school settings is a widely recognised indicator of quality of education around the world, the team worked from the generic assumption that a priority goal in the provision of assessment services in Botswana was to support decision-making relative to the needs of the participant or client and produce data that might contribute important information regarding treatment, intervention, placement, selection or other high-stake concerns. A total of 2 099 key participants from across the country participated in this study. Participants included teachers, officers, parents and learners. The consultancy used multi-method approaches to capture both the breadth and depth of stakeholder perspectives. The researchers engaged a wide range of stakeholders to develop a framework to guide the implementation of a psychometric testing service in Botswana schools. The consultancy recommended that psychometric testing services be introduced to support the guidance and counselling programme in Botswana with public education about the services, along with resources for the successful implementation of the services.

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



Prof Roelf Sandenbergh, Dean

Increasing student numbers, especially at undergraduate level, and strong competition for human resources led to increasing demands on human resources and the loss of some established researchers. It also made the recruitment of full-time graduate students difficult, leading to a decrease in accredited publication outputs.

Significant progress was, however, made with the recruitment of staff and graduate students, and with the expansion and renewal of research facilities, supported by government, the University and industry, to place the faculty in an excellent position for future growth.

Departments were encouraged to develop and consolidate research activities and to promote the alignment of student research with that of supervisors, especially in the professional graduate programmes, to increase the quality and impact of research outputs. Staff are encouraged and guided to actively plan research careers and the significant increase in the number of NRF-rated researchers is an indication of the success already achieved in this regard. The quest is to improve both the participation of staff in research activities and the number and quality of research outputs.

The Department of Science and Technology (DST) research chairs in the faculty are functioning well and made significant contributions to building research in the faculty.

The Chair in Fluoromaterial Science and Process Integration, based in the Department of Chemical Engineering, with Prof Philip Crouse as chairholder, aims to lead and support the

The research activities of the Faculty of Engineering, Built Environment and Information Technology do not only provide a sound basis for its programmes, but also contribute to the knowledge and application in the fields and professions served by the faculty. The challenge is to balance local relevance with international competitiveness and to find the human and financial resources for research activities.

### Message from the Dean

development of South Africa's significant fluoromineral resources into bulk and speciality chemicals. An example of the positive backlinking and cooperation of the research activities of this chair was the work on the catalytic decomposition of fluorocarbon gasses using a gold surface as catalyst. Ms Ria Muller, who used the NECSA facilities at Pelindaba, received the Sastech prize for the most promising research project in chemical engineering at undergraduate level in South Africa.

The DST Chair in Artificial Intelligence, based in the Department of Computer Science, with Prof Andries Engelbrecht as chairholder, is making significant international contributions in the field of computational intelligence.

Prof Brian Rand, holder of the DST Chair in Carbon Technology and Materials, based in the Institute of Applied Materials (a joint activity with the Faculty of Natural and Agricultural Sciences), recently received an A-rating from the NRF. The research and developmental activities of this group involve the development of high-level human resources and carbon materials focused on the nuclear industry.

The National Hub for Energy Efficiency and Demand Side Management (EEDSM), sponsored by the South African National Energy Research Institute (SANERI), with Prof Xiaohua Xia as director, is functioning well and has already established significant training, monitoring and research activities. Research projects undertaken so far include industrial and residential energy optimisation, renewable energy, power systems, heat transfer, fuel efficiency, motor and transport efficiency, and energy-efficient architecture and housing.

The Polymers and Chemical Product Design Research Group in Chemical Engineering, under the leadership of Prof Walter Focke, successfully applied to the Bill and Melinda Gates Foundation for \$100 000 under the Grand Challenges Explorations Grant Scheme to support the development of an indoor spray to control malaria transmission.

Research, as an integral part of the faculty's activities, was furthered by internal research seminars and poster sessions by staff and students, increasing the research requirements of graduate programmes, focusing on research skills and achievement as part of the requirements for the appointment and promotion of academic staff, and pursuing opportunities to increase its research funding and facilities. The activities in the faculty were also made more accessible to the wider public through the publication of the *Innovate* magazine.

Departmental visitations by the faculty research committee and other interested staff members, during which the departments presented their research planning and outputs, were used to increase awareness of the research activities in the faculty and to stimulate cross-fertilisation and interdepartmental cooperation. The excellent progress that some departments made with their research also served as a stimulus to others.

Conference participation by staff members was encouraged and supported by the faculty to increase the international exposure and profile of staff members. The feedback received is indeed very encouraging and contributed significantly to the research profile of the faculty. The challenge is to convert more of the conference contributions into journal publications.

Consolidation of research activities was encouraged and several departments responded by focusing their research activities so that sustainable groups were formed with the potential to significantly contribute both locally and internationally. Typical examples of these are the research groups in energy efficiency and demand side management, process control, reactor engineering, computer and data security, teletraffic for the information society, health informatics, minerals processing, pyrometallurgy, mine safety and book publishing.

International peer review of research activities was increased by the appointment of leading researchers as external examiners for theses, encouraging peer review of staff members through the NRF rating system, and encouraging publication of research in leading international journals. The faculty is indeed encouraged by the rising number of staff that received NRF ratings, and by the recognition of Prof Xiaohua Xia of the National Hub for Energy Efficiency and Demand Side Management as an A-rated researcher and Prof Thoko Majozzi of the Department of Chemical Engineering as a P-rated researcher. Prof Majozzi made his research on process integration available to a wider audience with the recent publication by Springer of the book *Batch chemical process integration: analysis, synthesis and optimisation*.

Strong links with and support of the research in the faculty by industry were again achieved with most of the research projects receiving at least some support from industry. Typical examples are the support of Eskom for a large number of research projects through its Tertiary Education Support Programme (TESP), Arcelor-Mittal for the Industrial Metals and Minerals Research

Institute, Anglo American for the Chair in Pyrometallurgy in the Department of Materials Science and Metallurgical Engineering, which enables leading-edge education, research and industrial linkages on metals processing and finishing, the Sentech-supported Chair in Broad Band Multimedia Communications in the Department of Electrical, Electronic and Computer Engineering, the support of the Centre for Teletraffic Engineering for the Information Society by Telkom, and Sasol for Reactor Engineering, Environmental Engineering and Tribology in the Department of Chemical Engineering. Several departments are also strongly involved with the development of pebble-bed modular reactor-related (PBMR-related) technologies. A Chair in Maintenance Engineering was initiated in the Department of Mechanical and Aeronautical Engineering with support from Anglo American, Eskom, Exxaro, and Sasol.

The further development, application and commercialisation of research are priorities for the faculty. Good progress was made with the further development of silicon-based light-emitting devices, initiated in the Carl and Emily Fuchs Institute for Micro-electronics (CEFIM), through the INSiAVA initiative, that has the potential to significantly enhance the performance of electronic devices by using light for on-chip communication, with the avalanche approach to increase the efficiency of the devices, and with securing venture funding to further support the project.

The very significant progress that the faculty made with its research initiatives during 2009 is indeed encouraging. Research is now well established as a core activity in the faculty, and, although it has to be balanced with the many other demands placed on the faculty, the foundations for sustained growth into the future are being established. The support and investment of government and the University in the future growth of the faculty is encouraging and the completion of the construction of additional facilities will significantly increase its teaching and research capabilities in the near future.

**Prof Roelf Sandenbergh**  
**Dean: Engineering, Built Environment and Information Technology**

## Chemical Engineering

The department has research focus areas in process modelling and control, applied materials, environmental engineering, water utilisation, reaction engineering, biochemical engineering and sustainable process systems engineering. The chairs of Fluoromaterial Science and Process Integration and of Carbon Technology and Materials are associated with the department.

Work on the simulation of chemical engineering processes focused on the stochastic simulation of chemical engineering processes using open-source tools and the Modelica language, an open standard. The aim is to be able to simulate complex chemical engineering systems efficiently, utilising Monte Carlo simulation for stochastic estimates. Contributions were made on the identification and generation of realistic input sequences for stochastic simulation with Markov processes, which provide a simple, yet powerful, method for generating realistic input sequences. The techniques for segmenting input signals and identifying model parameters are applicable to a broad range of fields and include novel work on the employment of multi-objective optimisation to signal segmentation and estimation. The most interesting future work suggested by this research is the use of variable-length multi-objective genetic algorithms to segment signals. This framework was extended to interface with external CAPE tools using the CAPE-Open protocols for thermodynamic interfaces.

Contributions were made in Applied Materials to the development of degradable polymers as a contribution to a possible litter reduction strategy through the development of degradation-enhancing additives based on nanostructured anionic clays. The idea is to accelerate the natural sunlight-mediated degradation pathways of a littered plastic object, for example, shopping bags. The technology was patented locally and licensed to a commercial company. Commercialisation of this new nanotechnology route for controlled lifetime plastics is being investigated. Long-life polypropylene mosquito netting, incorporating up to 0.76% of pyrethroid insecticides in the fibre polymer, was developed with the support of Sasol ChemCity as a contribution to the World Health Organisation's strategy to "roll back malaria". These polymers were successfully produced on a conventional production-scale fibre spinning machine and the yarn was knitted into nets that showed good efficacy against mosquitoes. Functional polymer additives based on novel intercalation procedures invented for anionic clays are also being explored using surfactant-mediated intercalation of aliphatic carboxylic acids into a commercial layered double hydroxide (LDH).

Fluoromaterials are most useful, but are relatively difficult to manufacture. Contributions to fluoro-based processing were made in support of the development of local resources through the development of a kinetic expression for the pyrolytic decomposition of polytetrafluoroethylene. Despite the fact that the thermal decomposition of polytetrafluoroethylene has been extensively studied over the past six decades, some inconsistencies regarding the kinetic parameters, for example, the order of the reaction, remain. A rate law was developed that is applicable to the reaction of granules and can be used for geometries of arbitrary shape.

Research in environmental engineering contributed to the characterisation of photocatalytical processes for the destruction of troublesome pollutants in water. The required exposure time for complete degradation of single-ring aromatic compounds was reduced to less than two minutes under aerated conditions in a photocatalytic reactor. When applied to the taste odour-causing compounds commonly found in drinking water sources – geosmin and 2-methylisoborneol (MIS) that are produced by blue-green algae (cyanobacteria) – complete degradation was achieved in less than eight minutes. 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. The use of the cheaper energy source – solar energy – in the treatment of water using photo-oxidation is expected to improve the economic viability of the technology and contribute further in reducing the energy required. Contributions were also made on the use of tubular reverse osmosis for the treatment of solid waste leachate, the development of a defluoridation plant for rural areas, the use microbial interventions for toxic waste minimisation, and in situ bioremediation for the treatment of U(VI) and Cr(VI) from the nuclear and mining industries.

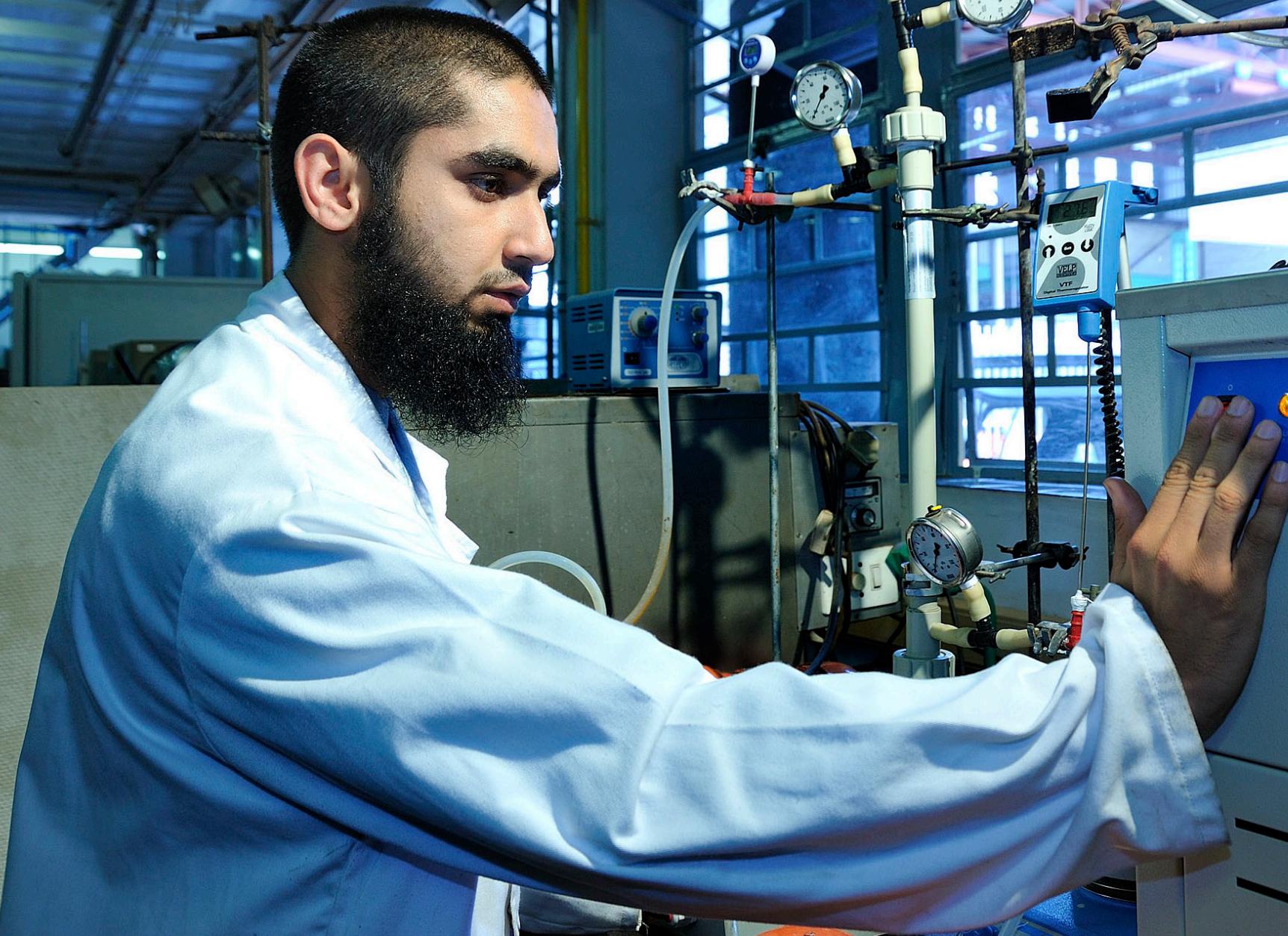
Further contributions to the development of trickle-bed reactors were made by the reaction engineering group regarding the influence of shape on entrainment behaviour and of hydrodynamic multiplicity on axial dispersion. Sustainable process systems engineering contributions were made on water reuse in multicontaminant batch plants, the use of heat, and inherent storage to minimise energy usage in batch plants.

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## Civil Engineering

The research foci in the Department of Civil Engineering are geotechnical engineering, water resources engineering, structural engineering and transportation engineering. The Chair in Railway Engineering is associated with the department. Contributions were made by investigating the effects of principle stress rotation on permanent deformation in rail track foundations, the use of particle-image velocimetry track deflection measurements, the use of bubble plume-induced destratification to reduce evaporation from open impoundments, the use of mathematics vs pattern recognition in water resource studies, the potential application of nanotechnology in pavement engineering and the use of strontium aluminate/polymer composites as pavement material by establishing its luminescent properties and durability.

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## Electrical, Electronic and Computer Engineering

The Department of Electrical, Electronic and Computer Engineering has research focus areas in advanced computing and embedded systems, bioengineering, control systems, distributed sensor networks, electromagnetism, electronics and microelectronics, energy systems, industrial electronics and electric drives, optics and photonics, power systems, broadband wireless multimedia communication, signals and digital communications, as well as the work of the Intelligent Systems Group. The Carl and Emily Fuchs Institute for Microelectronics, the Advanced Computing Centre, the Centre for Telecommunications Engineering in an Information Society, the Centre of New Energy Systems, the National Hub for Energy Efficiency and Demand Side Management, the Centre for Radio and Digital Communication, the Centre for Electromagnetism and the Sentech Chair In Broadband Wireless Multimedia Communications are associated with the department.

The Bioengineering Group made contributions related to cochlear implants, such as the estimation of stimulus attenuation in cochlear implants, the reduction of crosstalk in surface electromyography (EMG) recordings using spatial filtering, the modelled temperature-dependent excitability behaviour of a single ranvier node for a human peripheral sensory nerve fibre, as well as on sentence recognition in noise. The Control Systems Group continued their work on HIV by characterising the effect of robust multirate model predictive control-based (MPC-based) treatment schedules on HIV dynamics. Projects related to the minerals industry included a survey of control and economic concerns in grinding mill circuits and an economic performance assessment of two ROM ore milling circuit controllers. A modelling methodology for natural dam-river network systems was also developed.

The Distributed Sensor Networks (DSN) Group followed its contributions on energy management in DSN with further work on the efficient management of clock drift in preamble sampling Mac protocols for wireless sensor networks and a comparison of two routing metrics in optimised link state routing (OLSR) on a grid-based mesh network. The applications, challenges and design principles of industrial wireless sensor networks were evaluated. The contributions from the Electromagnetism Group included an analysis of retro-directive cross-eye jamming, an alternative formulation and application aspects of the generalised projection method for array antenna synthesis, gaussian process modelling of coplanar waveguide (CPW) forward error correction (FEC) slot antennas, the design of a linear non-uniform CPW-fed slot array with reduced sidelobe levels, the fast and efficient calculation of mutual admittance between CPW-fed slots on electrically thin substrates, as well as the extended reciprocity-based computation of mutual admittance between CPW-fed slots on conductor-backed two-layer substrates, the frequency-independent performance of elliptic profile transverse electromagnetic (TEM) horns, an improved diffraction model and numerical validation for horn antenna gain calculations, a log periodic bandstop filter, and a double dipole antenna for dual-band wireless local area network (WLAN) applications.

The Electronics and Microelectronics Group further developed light-emitting silicon devices through the INSiAVA initiative with the support of the University and the South African

Intellectual Property Fund, with the aim of developing integrated silicon photonic circuits. Nanoporous silicon explosive devices were evaluated. Contributions on integrated circuit (IC) design included the development of a design approach to complementary metal-oxide semiconductor-based (CMOS-based) class-e and class-f power amplifiers, and the mathematical modelling of the LC-ladder and capacitive shunt-shunt feedback low-noise amplifier (LNA) topology. The Energy Systems Group developed an optimal control model for load shifting with application in the energy management of a colliery. The Broadband Wireless Multimedia Communication Group reported the modelling of a spatially correlated multiple-input, multiple-output (MIMO) wireless channel.

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## Industrial and Systems Engineering

The Department of Industrial and Systems Engineering has research focus areas in resource optimisation, industry and functional area application, business engineering and enterprise architecture. Ms Jacomine Grobler, an MEng student, made an exceptional contribution with her work on the metaheuristics for the multi-objective Flexible Job Shop Scheduling Problem (FJSP) with sequence-dependent setup times, auxiliary resources and machine down time, which was done in collaboration with the Department of Computer Science, for which she received the prestigious  $S_2A_3$  medal. Cooperation with the University of Delhi continued with a contribution on the use of stochastic differential equation-based flexible software for a reliability growth model. A contribution to optimising the treatment of HIV was made with the development of a stochastic model of the dynamics of HIV under a combination of therapeutic interventions. Another major contribution was evaluating the risk in continuous-review inventory systems and three-unit reliability systems with preparation time.

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## Materials Science and Metallurgical Engineering

Research in the Department of Materials Science and Metallurgical Engineering is focused on physical metallurgy, welding and corrosion, minerals processing and hydrometallurgy, and pyrometallurgy and refractory materials. The Industrial Metals and Minerals Research Institute (IMMRI) and the Anglo Chair in Pyrometallurgy are housed in the department.

Contributions in physical metallurgy included the characterisation of martensite as a function of the Ms temperature of the steel being developed for use as armour plating, establishing



Prof Madeleine du Toit, Materials Science and Metallurgical Engineering.

the influence of temper condition on the microstructure and the mechanical properties of semi-solid metal processed on an Al-Si-Mg A356 alloy, and the characterisation of the age hardening of an EN 4017 aluminium alloy. Researchers were also involved in the development of nuclear fuel particles intended for the pebble-bed modular reactor with contributions on the evaluation of the phase composition, crystallinity and trace isotope variation of silicon carbide (SiC) in experimental Tri-isotropic (TRISO)-coated particles, and the innovative evaluation of the fracture strength of TRISO-coated particles by compression testing.

The Welding and Corrosion Group made contributions on the influence of interstitial diffusion across the fusion line on the heat-affected zone (HAZ) microstructure and properties in 12% chromium type 1.4003 steels, the development of high-strength ductile braze repairs for stationary gas turbine components, and the development of austenitic stainless steel tube samples for the controlled chloride cracking.

Methods for the recovery of metals from eWaste were developed with contributions on the liberation characteristics of printed circuit board comminution fines, and the evaluation of froth flotation, smelting and electrochemical leaching for the recovery of metals from eWaste.

The beneficiation of iron ore was supported by the characterisation of reducibility using packed beds of iron ore and carbon with one-dimensional heating, and the characterisation of the disintegration of Northern Cape iron ore under reducing conditions. The use of sintering in silica-rich clay was investigated to stabilise the Cr(VI) in stainless steel plant dust as a method to release it into the environment. Plant operational practice was supported by the development of operator guidance tables for the control of the open-slag bath furnaces at Highveld Steel and Vanadium.

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Prof Josua Meyer, Mechanical and Aeronautical Engineering.

## Mechanical and Aeronautical Engineering

The research foci in the Department of Mechanical and Aeronautical Engineering are organised in the Dynamic Systems Group, with thrusts in vibration monitoring and diagnostics, vibration measurement and analysis, structural dynamic design and analysis, vehicle dynamics and computational solid mechanics, the Thermofluids Research Group, with thrusts in enhanced heat transfer, electronics cooling, microchannel condensation, optimisation with constructal theory, and the Design and Manufacturing Group, with thrusts in mine health and safety, biomechanics, and the lubricity of diesel. The Chair in Maintenance Engineering is associated with the department.

The Dynamic Systems Group contributed to the methodologies of the numerical durability assessment of heavy vehicle structures, the use of Vold-Kalman filter-order tracking in the vibration monitoring of electrical machines, the monitoring of tool wear and the setting of optimum cutting conditions considering progressive tool wear effects and input uncertainties, the use of neural networks to assess the residual life of machines and components, the online condition monitoring of axial-flow turbomachinery blades using rotor-axial Eulerian laser Doppler vibrometry, the monitoring of the condition of rock bolts using ultrasonic guided waves, the development of a tailless gull-wing aircraft by investigating its pitch-handling characteristics, the handling properties of off-road vehicles through the development of an interconnected air-spring model, and the development and optimisation of a gradient-based approximation method for the optimisation of a vehicle suspension system.

The Thermofluids Research Group made contributions through the investigation of heat transfer enhancement using helical inserts in smooth tubes, the evaluation of constructal ducts with wrinkled entrances, the development of an improved flow pattern map for the accurate prediction of the heat transfer coefficients during condensation of R-134a working fluid in smooth horizontal tubes in the low-mass flux range, and by conducting an experimental

study of heat transfer augmentation near the entrance to a film-cooling hole in a turbine-blade cooling passage. Enhanced heat transfer from electronic devices through embedded heat-spreading layers in rectangular heat-generating electronic modules, and the development of a non-numerical calculation method for heat removal from power electronics using embedded solid-state cooling layers were also examined.

The Design and Manufacturing Group made significant contributions to improving mine health and safety with the development of a quiet, self-propelled rock drill, a dynamic roof support system for tabular stopes, a roof support system for rockfall mines, a universal load-indicating device to be used in conjunction with various support systems, and an alternative to onboard scrubbers for continuous miners to decrease dust levels and increase the amount of ventilation in the panel. The group also contributed to solving the problems experienced with diesel engines by investigating the role that diesel lubricity and cleanliness play in the premature failure of these engines.

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## Mining Engineering

The research foci of the Department of Mining Engineering are hard-rock mining mechanisation, rock breaking, mine design, safety and health, environmental engineering, surface mining and financial mine evaluation. Contributions were made through the investigation of the factors that influence the determination of discount rate in the economic evaluation of mineral development projects, a review of the management discipline and management competencies in the South African mining industry, the application of numerical modelling to pillar design in South African mines, the development of a blast-hole stemming performance evaluation model using a purpose-built testing facility, and enhancing mine environmental engineering practice by contributing to the updating of the industry handbook with contributions on chilled-water reticulation, mine ventilation economics and water management.

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## Architecture

The research foci of the Department of Architecture are on environmental potential, housing and urban environments, and heritage and cultural studies. Contributions were made to an overview of architecture in a democratic South Africa, intangible heritage and community identity in post-apartheid South Africa, teaching architecture and building science, the use

of photographic interviews to explore living space in the urban environment, the ex situ experience of landscape (architecture) in texts, a critical appraisal of legislation and the South African Standard, Part S, Design 100: *The pedagogic structure of and syllabus for the generic studio*. Housing and urban environments in South Africa were explored in terms of practice and education, educating for flexibility, and informality as legitimate energy in the city.

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## Construction Economics

The Department of Construction Economics does research in the following broad areas: procurement methods, social housing, land rights, facilities management, quantity surveying practice, property finance models, real estate market models, real estate curricula, property maintenance management, construction contracts, information classification and specification processes in construction, project management in construction, and building cost analysis.

Contributions were made on the development of an outsourcing scorecard for the United Nations and similar public-sector organisations, an evaluation of the outsourcing of United Nations' peacekeeping roles and support functions, an analysis of the South African perspective of residential property development and financial ratio analysis, transformation in property education, the valuation of broiler units, requirements for utilising adjudication in the South African construction industry, standard methods of measurement for underground developments, planning for profit and reimbursable expenses in the South African architectural profession, the influence of city-planning policies on property development, entrepreneurial ability in broad-based black economic empowerment (B-BBEE) in the South African property sector, the future of standard-form contracts in the South African construction industry, property developers' perceptions of green buildings in South Africa, a partnership model to address poor service delivery in South Africa, and the acceleration of costs on construction projects.

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## Town and Regional Planning

The research foci of the Department of Town and Regional Planning are strategic development planning, sustainable settlement planning, design and maintenance, the creation of safe, responsive and enabling urban spaces, and planning methods and techniques. Contributions were made on the use of spatial analysis to support a more nuanced reading of the South African space economy, the national significance of opportunities offered and challenges faced

by South Africa's city regions, city improvement districts in South Africa, and post-apartheid perceptions of the residential quality of the Schubart Park housing complex. At the same time, the department produced technical reports on topics such as long-term planning by all three spheres of government for the Sekhukhune District Municipality, the regulatory framework for land-use management in South Africa, township regeneration in the City of Johannesburg, mainstreaming youth development in municipal development planning, and the harmonisation and alignment of planning, budgeting and implementation by all three spheres of government in the Metswideng and Sedibeng district municipalities.

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## Computer Science

The Department of Computer Science has several research groups, each with its own research foci. The Computational Intelligence Research Group (CIRG) is studying computational intelligence, and its research fields include artificial neural networks, swarm intelligence, evolutionary computation, artificial immune systems, data and text mining, multi-agent systems, image analysis, and game-playing systems. Computer and Information Security, with specific reference to distributed systems, security and privacy (ICSA), is studying computer and information security, and its research fields include digital forensics, distributed trust and security issues in pervasive computing, privacy, vulnerability scanning, intrusion detection, and database and workflow security. Distributed Systems and Languages (Polelo) is studying computer science and geographic information systems, and its research fields include geographic information systems, distributed systems, and programming languages. Theoretical and Applied Computer Science Research (FASTAR) is studying theoretical and applied computer science research, and its research fields include finite state systems, finite automata, regular expressions, pattern matchers, parsers, transducers, algorithms and data structures, and formal concept lattices. Software Engineering Principles and Practices (Espresso) is studying software engineering principles and practices, and its research fields include methods and processes, such as agile methods and open-source development, tools and environments, such as software configuration management (SCM) and refactoring, human aspects. Software Science and Formal Methods (SSFM) is studying software science and formal methods, and its research fields include formal specifications of systems, model-driven engineering, theoretical and methodological foundations of software engineering, and tools for computer-aided/automated software engineering. The department also maintains the CILib resource, a framework for developing computational intelligence software in swarm intelligence, evolutionary computing, neural networks, artificial immune systems and fuzzy logic.

Contributions were made on optimisation methods to locate multiple optima and to track optima in changing environments, swarm-based algorithms for solving dynamic multi-objective optimisation problems, bare bones differential evolution, fuzzy hybrid-simulated annealing

algorithms for the topology design of switched local area networks, a fraud management system architecture for next-generation networks, adapting usage control as a deterrent to address the inadequacies of access control, metadata context in database forensics, regular expression hashing to reduce FA size, developing an incremental algorithm to construct a lattice of set intersections, developing a virtual machine framework for constructing domain-specific languages, and sensitivity analysis of Voronoi-based sensor deployment and reconfiguration networks.

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## Informatics

The research foci in the Department of Informatics are information science and organisations, information science and education and information and communication technology (ICT) for sustainable development. Each focus area is associated with one or more workgroups of the International Federation of Information Processing (IFIP) and incorporates the following focus areas: theoretical aspects of informatics, the socio-economic impact and implications of information systems and information technology, information technology in the service of the organisation and society, and knowledge discovery from data to enhance organisational decision-making.

Contributions were made on chronism theory, culture and system delay: a longitudinal study of post-apartheid South Africa, ethical considerations during human-centred overt and covert research, selective exclusions resulting from the digital divide in the context of indigenous knowledge systems in South Africa, an assessment of knowledge management growth from a South African perspective, and the use of action research to link practice and theory in information systems strategy development.

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## Information Science

The research foci in the Department of Information Science are knowledge management, information processes, the meta-context of information, and book and publishing studies. Contributions were made with research on corruption, libraries and building a new South Africa, knowledge management in law firms in Botswana, the information behaviour of consulting engineers in South Africa, the role of emotion in the information behaviour of health care professionals, the demands, challenges and excitement of scholarly information work, the

development of a framework, the use of social networking tools for innovative service delivery at the University of Pretoria library, digital libraries and archiving knowledge, implementing a common library system for the Lesotho consortium, perspectives from systems librarians on the implementation and performance of the Innopac library consortium, the impact of policy changes in the education sector on the development of the book publishing industry in Kenya, and the quantification of the publishing history of South African children's literature in English. The department was also responsible for the International Federation of Library Associations (IFLA)/Free Access to Information and Freedom of Expression (FAIFE) world report on access to information and freedom of expression. The report was designed as an interactive, customisable electronic publication. A system to enable this was developed for the IFLA.

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## Engineering and Technology Management

Research in the Graduate School of Technology Management is focused on technology and innovation management, project management, maintenance and physical asset management and systems engineering, and lifecycle management.

The development of an industrial framework for the civil aviation industry in South Africa was investigated by researching the comparative industrial technology capabilities and business competitiveness of both emerging and developed economies. Critical success factors were identified for small and medium-sized enterprise (SME) electrical contractors in the construction industry in South Africa, and reasons for the lack of skilled artisans in South Africa were investigated from an artisan perspective. The mixed performance of science parks was researched in terms of the bright and dark sides of interorganisational knowledge transfer relationships. A contribution was also made to resiliency management in a globally integrated economic network.

Prof Leon Pretorius delivered a paper on technology forecasting: the case of computational fluid dynamics at the 4<sup>th</sup> International Conference on the Management of Innovation and Technology held in Bangkok, and was awarded the Outstanding Paper Award. Innovation in the automotive component sector is being investigated as part of a larger international project. The picture that emerged from this survey is one of an industry that lies in the global automotive value chain, but competes as a high-quality provider, rather than an innovator. Much development and upgrading will be required to transform this industry from one consisting of dependent subcontractors to one that consists of knowledge creators.

The Department of Engineering and Technology Management is the hub of higher education in project management and contributed to research in this field with contributions on project governance for large capital projects, the need for a specific management strategy for a

clean development mechanism (CDM) and the risk management potential of a stage/phase-gate project management approach. A maintenance strategy model was developed for static equipment, based on inspection methodologies and a risk management analysis.

The Lifecycle Management Group made contributions by assessing the social sustainability performance of the petroleum industry in the Niger delta of Nigeria, assessing the viability of the South African biofuels industrial strategy, systems analyses and the sustainable transfer of renewable energy technologies with a focus on remote areas of Africa, determining the most important factors and the use of the focus group technique for the selection of sustainable energy technology, and developing microsimulation as a tool for the estimation of the carbon emissions balance for South Africa.

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## Institute for Technological Innovation

The Institute for Technological Innovation utilises scientometrics to establish a quantitative basis for policy development and providing advice on technology and innovation. The institute was invited to make presentations at the national workshop of the National Bioethics Advisory Commission (NBAC) on the impact of the policy environment on biotechnology in South Africa over the next five years and the Indicators Reference Group (IRG) expert workshop on measuring and monitoring innovation in South Africa by the National Advisory Council on Innovation (NACI). A scientometric assessment was made of the state of science and technology in Africa for the period 2000 to 2004, and more specifically of South Africa's inventive outputs, by analysing international patents, and also to establish the influence of patenting on the performance of South African university researchers. The human resource needs in the nuclear industry were investigated in support of better planning for the anticipated nuclear-build programme for South Africa. The development of local resources in fluorine was supported by a comparative mapping and assessment of South Africa with four benchmarking countries.

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## 6.4 Gordon Institute of Business Science



Prof Nick Binedell, Director

the distinct political economies that constitute future emerging markets. The growth and development of economies that were previously considered to be underdeveloped will require a dedicated research focus in order to develop appropriate theory and practice relevant to the particular economies in which companies operate. This is particularly true in the case of South Africa.

The purpose of GIBS's teaching and research is to have a direct impact on management practice. To this end, every effort is made to ensure that academic research is framed and disseminated through a number of channels to make it accessible to a wider audience.

It is pleasing to report that the volume of research has steadily increased over the past years. During 2009, the faculty published ten peer-reviewed journal articles (eight in local journals and two in international journals).

It is an academic requirement of the MBA degree that each student produce an original piece of research. Some 778 research papers have been produced since the school's inception. This prodigious output is supervised by faculty members and a number of these research projects find their way into academic journals.

Towards the end of 2009, GIBS launched the Centre for Business Analysis and Research (CBAR), which is devoted to coordinating the increasing number of research-related initiatives underway at GIBS. Some of the larger initiatives operating under the umbrella of the CBAR are an EU-funded project on the globalisation of innovation, a multinational

The growth in the number of published research outputs reflects the increasingly important role that research plays at the Gordon Institute of Business Science (GIBS). As it is a postgraduate and post-experience institution, the majority of students who study at the business school are executives at large South African companies.

### Message from the Director

collaborative research project between South Africa and the Swedish government that is focused on economic growth and innovation, and a Kellogg-supported project on the base-of-the-pyramid concept.

The school is fortunate to have two NRF-rated academics on its staff and the deepening of research capacity in the faculty continues to be supported in a number of ways, including the attendance of local and international conferences, the presentation of papers, and research retreats and regular faculty colloquia, as well as visits by and collaboration with accomplished international researchers.

Prof Nick Binedell  
Director: Gordon Institute of Business Science



GORDON INSTITUTE  
OF BUSINESS SCIENCE

University of Pretoria



## Market timing on the JSE using exchange rate fluctuations

Asset managers are either “passive” (that is, they invest in portfolios for the long term) or “active”. Active managers have two basic approaches to outperforming passive buy-and-hold strategies: asset selection (that is, they buy shares that are underrated by the market and will outperform) or market timing.

Market timing is often defined as the process of shifting the weights in portfolio constituents in accordance with expected market conditions. For example, during bull phases of the market, market-timers will increase the weighting of equities versus cash, and vice versa for bear phases. Many researchers have shown that, while the potential returns of such a strategy are attractive, the success of the market timer is dependent on his forecasting ability. Generally speaking, high levels of prediction are necessary to outperform a buy-and-hold strategy.

This research investigates a market timing strategy on the JSE related to exchange rate fluctuations in the rand. Various researchers have identified shares that react positively or negatively to exchange rate fluctuations affecting the rand. By increasing the weight of so-called “rand-hedge” shares when the rand is expected to weaken or increasing the weight of “rand-play” shares when the currency is expected to strengthen, a market-timer can enhance his returns – subject to the accuracy of his currency predictions.

Using three independent sets of currency-sensitive shares, this research examines the risk and return outcomes on the JSE that would have been experienced by market-timers for different levels of predictive accuracy over the period October 1998 to October 2008.

The results show that exceptional returns, in excess of 35% per annum above the benchmark, can be obtained, depending on forecasting ability. To be certain of outperforming the benchmark, a forecasting accuracy for the rand of around 70% is required, which is difficult to obtain. Even with considerably lower forecasting ability, it is possible to outperform a benchmark following this strategy.

These findings indicate that while similar levels of forecasting accuracy are required, bigger potential returns are possible for market-timing strategies relating to currency fluctuations when compared to conventional asset-switching strategies.

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## Management of intellectual property rights

The enforcement of intellectual property (IP) rights is contested in developing countries. Firms in less developed countries lack the experience of effective patent regimes – or indeed

patents – that will allow them to benefit from a structured IP regime, and they are also expected to pay for acquiring the technologies that would allow them to become globally competitive.

It is increasingly becoming necessary to navigate the complex process of codifying and managing IP in order to compete globally. Helena Barnard, a senior lecturer at GIBS, and Tracy Bromfield, a GIBS MBA alumna and Manager of Applied Research at Sasol, jointly conducted a series of studies to investigate how Sasol has learnt the value and process of patenting and other forms of IP.

They point out that the capability to create IP is not the same as the capability to manage it. Sasol had patents long before the firm understood how to extract the full value from those patents. Barnard and Bromfield document how Sasol’s current IP management strategy evolved through trial-and-error learning.

The evidence from their work suggests that patents are very seldom used simplistically to protect a given technology. Rather, IP is often used as a “bargaining chip” to gain access to the knowledge of others, whether formally, for example, through cross-licensing, or informally, for example, by gaining invitations to relevant conferences on the basis of a reputation for competence. This very social (rather than technical) use of patents is complicated by the fact that competitors are the most likely to have helpful technologies. Managing the tension between cooperation and competition is at the heart of managing IP. In addition, there is a local/global tension, because many of Sasol’s closest collaborators are located abroad rather than locally.

They conclude that firms need to understand what they want to achieve with their IP – that is, develop a clear IP strategy – in order to make effective decisions about whether, when and how to formalise their IP, ideally even before they start to patent their inventions.

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## Methods of reducing the referral of frivolous cases to the CCMA

With over 125 000 cases referred to the Commission for Conciliation, Mediation and Arbitration (CCMA) annually, and a recent judicial statement, it is clear that too many of the cases referred are without merit and are often referred as an attempt by a party to gain an unwarranted payout at the conclusion of an employment contract. This situation increases the administrative burden and potentially increases the cost of doing business in South Africa.

Propositions based on international experience from three other labour dispute resolution systems and recommendations in the literature were tested with the aid of the Delphi



Dr Helena Barnard, Gordon Institute of Business Science.

technique. Three rounds were conducted with experts in the field. The findings show that there are a number of interventions that, if implemented, would prevent the referral of frivolous cases to the CCMA. In implementing the interventions, the underlying principle needs to be that rights of access and use should be enhanced and not narrowed. Therefore, the interventions focusing on enhancing systems are deemed preferable to those that use exclusionary criteria.

The most prominent interventions from literature and international experience include charging referral fees, awarding costs against parties who refer frivolous cases, allowing for greater legal representation and introducing qualification criteria for referrals.

The research findings indicate that the measure most likely to achieve success in preventing frivolous cases is the implementation and management of stricter screening processes. These stricter screening processes should not only evaluate the jurisdiction of the matter, as is currently the case, but should also closely examine the merits of the cases being referred.

A second intervention likely to see a significant reduction in the referral of frivolous cases is the more frequent use of cost awards. Although cost awards should be limited to frivolous cases, they should be used more often and should be more strictly enforced.



Prof Albert Wocke, Gordon Institute of Business Science.

The third measure identified as being likely to have a significant impact on the prevention of frivolous cases was increasing the powers of commissioners to dismiss cases at conciliation instead of simply issuing a certificate.

A number of other initiatives were identified as having the potential to reduce the referral of frivolous cases, but were rejected, as they were viewed as limiting or reducing rights.

The research also indicates that any proposed intervention should not be viewed in isolation and that a holistic view should always be taken. The necessity for the broad-based education of all CCMA users should underpin any intervention. The education needs to cover the roles and responsibilities of all parties, including the penalties imposed for frivolous referrals.

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## 6.5 Faculty of Health Sciences



Prof James Ker, Dean

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 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 in their focus, but also vary between laboratory-based, cutting-edge science and finding solutions to 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 Forensic Anthropology Research Centre (FARC), which is not only involved in South African research, but also in international collaborations. The Applied Morphology Research Centre (AMRC) published an article in the journal *Homo*, which was the third most accessed article in that journal. The Clinical Anatomy Focus Group was also active in research.

Research in immunology and all its related research focus areas, such as inflammation, HIV/AIDS and pneumococcal disease, had a large research output. Pharmacogenetics and stem cell research have started. Physiology research in sudden, unexpected death has led to a number of publications and collaborations with the Department of Forensic Medicine. Osteoporosis research is ongoing, as is research in insulin resistance and basic cancer research.

The School of Health Systems and Public Health has an ongoing focus on alcohol use in women and the prevention of foetal alcohol syndrome in collaboration with the MRC and other South African universities, notably the University of Cape Town. In the School of Dentistry, research in the departments of Oral Pathology and Oral Biology has focused on the impact of HIV on the oral cavity. Human papilloma virus oral pathology and its consequences are also being actively researched. Overall, the faculty has had the best research output since its establishment in 2001.

Prof James Ker  
Acting Dean: Health Sciences

### Forensic Anthropology Research Centre

A number of projects relating to the visit of Dr Maryna Steyn to a skeletal collection in Crete were completed. A paper has been accepted on the presence and frequency of antemortem trauma in several modern populations, which also compares prevalence. Another paper was published that questions the necessity of applying population-specific data when using measurements of the pelvis to determine sex.

Projects involving the assessment of accuracy when determining ancestry, including an MSc project, indicated that traditional morphological characteristics were shown to demonstrate high amounts of within-group variation and should not be used in forensic anthropological assessments of unknown remains.

Another MSc project dealt with the histological and chemical differences between various species of animal and human bones. The chemical composition differed very little, but the morphology showed considerable variability between species.

A project relating to human skeletal remains found at Chloorkop was completed. The remains probably belonged to migrant labourers, and some interesting pathology was found.

Other master's research included a study on tissue depths of South African black females for use in facial reconstruction. In addition, reconstructions were done using the newly developed tissue thicknesses for South Africans, as well as other published tissue thicknesses for non-South African populations. The effect of this was then tested in an identification parade. Another study examined the mandibular and maxillary canines, specifically dealing with their use in determining sex and ancestry.

PhD research was conducted on the use of the bones of the human hand in forensic applications. Formulae for the determination of sex and stature were developed in addition to detailed techniques to identify the various smaller bones of the hand.

Pilot projects were conducted on the fracture patterns of dry vs wet bone (in collaboration with Prof Jules Kieser from Otago, New Zealand), while projects stemming from previous research



Prof Maryna Steyn, Forensic Anthropology Research Centre.

on the human remains from Gladstone, Kimberley, were conducted in collaboration with Ms Alie Emily van der Merwe and Prof GJR Maat from Leiden University. These included an assessment of dentition and origin of the migrant labourers.

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## Applied Morphology Research Centre (AMRC)

An article by Dr Anna Oettlé, Prof Etheseria Pretorius and Prof Maryna Steyn on the geometric morphometric analysis of the use of mandibular gonial eversion in sex determination was published in the journal *Homo*. It was cited as the third most accessed article in the journal. *Slideworld* cited an article by Prof Resia Pretorius on the role of alternative and complementary treatments of asthma, as well as an article on acupuncture and electrotherapeutics research. An article by two postgraduate students, Nanette Oberholzer and Eureke Smit, was cited by *Leads Discovery* in England. A review of immunomodulators with a focus on the homeopathic product Canova® was published in *Homeopathy*.

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Prof Sonja Boy, Oral Pathology, School of Dentistry.

## Clinical Anatomy

### Neonatal and adult anatomy is what differentiates the stages

Research by Mr Albert van Schoor highlighted the differences between neonatal and adult anatomy. It emphasised that neonates cannot be regarded as small adults, particularly where invasive procedures, such as administration of regional anaesthesia, are concerned. Rectal anatomy underlying surgical procedures was revisited by Dr Anna Oettlé in order to reduce complications during proctoscopy, sigmoidoscopy and resection for rectal cancer.

Correlation studies between imaging and normal anatomy were conducted by Mrs Nanette Briers. The study on anatomical structures in the transverse sinus indicated that the presence of septae, trabeculae and arachnoid granulations may be responsible for venographic filling defects in as many as 53% of patients. It also showed that the right transverse sinus is at the highest risk for demonstrating potential venographic filling defects that could eventually result in a raise in intracranial dural venous pressure.

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## Immunology

### The immunopathogenesis and therapy of acute and chronic inflammatory diseases of non-infective origin

The major research programmes of the Department of Immunology progressed extremely well in 2009. These are infectious diseases research and research focused on the immunopathogenesis and therapy of acute and chronic inflammatory diseases of non-infective origin.

Tuberculosis, HIV/AIDS and severe pneumococcal disease are the major research focus areas in infectious diseases research. Tuberculosis research is focused on the potassium (K<sup>+</sup>) transporters of mycobacterium tuberculosis (MTB), especially their role in bacterial virulence, and potential to serve as novel targets for drugs and vaccines. The primary objective of HIV/AIDS research is to establish the effects of HIV infection on regional T-lymphocyte colonisation and macrophage activation in the gastrointestinal tract, as well as the effects of antiretroviral therapy on the reconstitution of various subpopulations of T-lymphocytes, macrophage activation status and privileged viral reservoirs, especially in relation to anatomical site and drug resistance. Novel insights into HIV immunopathogenesis of this type are essential for discerning approaches to drug and vaccine design. Pneumococcal diseases research continues to focus on pneumolysin, the major protein virulence factor of this microbial pathogen, by using strategies that target the production and/or cytotoxic and pro-inflammatory activities of the toxin.

In the case of acute or chronic inflammatory diseases of non-infective origin, the department's efforts are targeted primarily at identifying the mechanisms that initiate mobilisation of calcium during receptor-mediated activation of inflammatory cells, particularly the neutrophil, as well as those that restore Ca<sup>2+</sup> homeostasis to the cells. This research has identified several novel Ca<sup>2+</sup>-handling-based targets for anti-inflammatory therapy. The second component in this research programme involves the identification of the mechanisms by which heavy metals of environmental or industrial significance (cobalt, manganese, palladium and platinum) trigger and/or potentiate harmful inflammatory responses.

For the past few years, the Pharmacogenetics Group has focused on the ability to predict patients' responses to the medications they take through the assessment of activity of the cytochrome P450 drug-metabolising system. Its particular interest is to relate this ability, as determined by measuring the metabolism of a test drug (phenotype), to the genetic make-up (genotype) of the patient, a so-called genotype-phenotype correlation. Researchers have discovered several very interesting variations in the African population, which may assist in understanding why different groups of individuals respond differently to the medications they receive. This will lead to the emergence of personalised medicine, which will assist the clinician to optimise the choice and dosage of medications prescribed in order to avoid non-response or serious adverse effects.

The Stem Cell Research Group has an interest in three areas in the stem cell field. First, the creation of a public cord blood stem cell bank, which is a much-needed resource on the subcontinent,

aimed at providing genetically-compatible stem cells for bone marrow transplantation (BMT). BMT is used to treat a wide spectrum of blood cancers and other disorders. This form of treatment is currently denied to the majority of the population due to the lack of genetically compatible stem cells. Its second interest lies in the generation of haematopoietic (blood-forming) stem cells that are resistant to HIV. The objective is to be able to use these stem cells to treat an HIV-infected individual. Finally, the group has an interest in inherited disorders of the muscle, namely muscular dystrophy. Its objective is to be able to treat this disorder using muscle stem cells.

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## Physiology

### Research into the pathogenesis of osteoporosis and cardiovascular disease

The Department of Physiology is actively involved in research relating to the pathogenesis of osteoporosis and cardiovascular disease, with special reference to cardiomyopathy. The physiological effects of stress, in particular autonomic dysfunction, the in vitro effects of polyunsaturated fatty acids on bone biology and the modulation of insulin sensitivity in visceral fat tissue that is important in the treatment of Type 2 diabetes mellitus are also being investigated. Various aspects of sport physiology and neuroscience, as well as the in silico design, synthesis and analysis of estradiol analogues for tubulin and kinesin motor protein and carbonic anhydrase isoforms with potential anticancer activity in vitro, are being researched.

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### The hyperparathyroid heart mimicking acute myocardial infarction

The focus of research is on variants of papillary muscles and the various electrocardiographical effects of these variants, and the possibility that such variants may be an underrecognised cause of sudden cardiac death. Furthermore, a new variant of hypertrophic cardiomyopathy, which is caused by subaortic muscular tendons, has been described and published. This was seen due to the focus on alterations of endoventricular structures. Ultimately, the work focuses on the possibility of a new cause of sudden death that may be due to dysrhythmias caused by papillary muscle anomalies and other endoventricular structural alterations. Left ventricular false tendons are a common echocardiographic finding and consist of thin fibrous or fibromuscular structures traversing the left ventricular cavity. They have no connection to any valvular cusps and may be single or multiple. Histologic examination has shown that they can be composed of any

combination of cardiac muscle, fibrous tissue, blood vessels and Purkinje cells. At present, the clinical significance of these false tendons is uncertain, with some studies showing a possible causal role for ventricular arrhythmias. These tendons have been divided into five categories, based on the site of implantation. In this study, a sixth category of left ventricular false tendon is identified, with implantation into the ventricular septum in a subaortic position. These subaortic false tendons are associated with localised subaortic hypertrophy and it is suggested that they play a causal role in the genesis of localised subaortic hypertrophy with a possible new variant of hypertrophic cardiomyopathy – false tendon-induced subaortic hypertrophy.

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### The effects of polyunsaturated fatty acids on osteoblastic cells

Osteoblasts in culture can differentiate into mature mineralising osteoblasts when stimulated with osteogenic agents. Clinical trials and *in vivo* animal studies suggest that specific polyunsaturated fatty acids (PUFAs) may benefit bone health. The aim of this study was to investigate whether arachidonic acid (AA) and docosahexaenoic acid (DHA) affect osteogenesis in osteoblasts and the transdifferentiation into adipocytes. Results from this study show that long-term exposure to AA inhibited alkaline phosphatase (ALP) activity in these cells, which might be prostaglandin E2 (PGE2)-mediated. DHA exposure also inhibited ALP activity, which was evident after both short- and long-term exposure. The mechanism whereby DHA inhibits ALP activity is not clear and needs to be investigated. Although long-term exposure to PUFAs inhibited ALP activity, the mineralising properties of these cells were not compromised. Furthermore, PUFA exposure did not induce adipocyte-like features in these cells, as evidenced by the lack of cytoplasmic triacylglycerol accumulation.

Pro-inflammatory cytokines such as IL-1, IL-6 and TNF- $\alpha$  are known to be active in the pathogenesis of osteoporosis. Results from clinical trials and *in vivo* animal studies suggest that specific long-chain polyunsaturated fatty acids (LC-PUFAs), especially those of the n-3 PUFA family, might be beneficial to bone health. In order to elucidate possible cellular mechanisms, the effects of some LC-PUFAs, representative of the n-3 and n-6 families, were investigated on osteoblastic secretion of various inflammatory cytokines.

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### Wellness strategies desired for a complete employee programme

Organisational wellness is about assisting employees and their families to make voluntary behavioural changes that reduce their health risks and enhance their individual productivity and well-being. To have an effect on health outcomes at the worksite, wellness strategies

need to enable healthy lifestyles for all, including the whole range of staff members – those at risk of chronic disease (such as heart disease, cancer and diabetes), as well as those with a lower risk for chronic disease and those who are already convinced that they need to make healthy lifestyle choices. Wellness programmes should be a part of the overall company strategy for a healthy workplace. The most effective workplace wellness promotion is comprehensive and aims at improving all of the elements involved.

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### Mechanistic insights into the short-term fatty acid effects on a dipocyte glucose uptake

The modulation of insulin sensitivity in visceral fat tissue could be important in the treatment of Type 2 diabetes mellitus. Selected fatty acids may impact on insulin-stimulated and basal glucose uptake in adipocytes, thus isolated rat epididymal adipocytes or murine 3T3-L1 adipocyte cultures were exposed to 100  $\mu$ M oleic, arachidonic (AA), eicosapentaenoic (EPA), docosahexaenoic or stearic acids and insulin (15 nM) or vehicle for 30 minutes. Glucose uptake was quantified by measuring uptake of 3H-deoxyglucose/mg adipocyte protein/min. All fatty acids tested, except for stearic acid, depressed insulin-stimulated glucose uptake by an average of  $33 \pm 4.2\%$ . In cultures, however, AA and EPA stimulated insulin-dependent glucose uptake with 58 and 47%, respectively. On the other hand, all fatty acids tested, except stearic and arachidonic acids, stimulated basal glucose uptake with an average of  $34 \pm 8.1\%$ . In cultures, EPA, but not AA, could stimulate basal glucose uptake. Inhibitor studies in fresh adipocytes showed the involvement of prostaglandins, lipoxins, protein kinase C and tyrosine kinase in these processes. The results gained from 3T3-I1 cultures suggest a positive role for polyunsaturated fatty acids in the treatment of Type 2 diabetes mellitus.

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### Influence of 2-methoxyestradiol on MCF-7 cells

Since several anticancer drugs of clinical importance specifically target tubulin and thereby interfere with microtubule dynamics, the microtubule cytoskeleton represents one of the most highly validated cancer targets identified to date. Thus, the *in silico* design, synthesis and investigation of estradiol analogues as potential anticancer agents are being investigated *in vitro*. Novel estradiol analogues for tubulin and kinesin motor protein and carbonic anhydrase (CA) (CA II, IX, XII) binding affinity were designed by means of *in silico* analysis and subsequently synthesised. *In vitro* cellular and molecular studies are currently being conducted to elucidate each compound's signal transduction mechanism and to verify their potential anticancer activity to contribute to the design/improvement of compounds with therapeutic potential.

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## Developing a protocol to examine the physiological effects of stress

The Department of Physiology has embarked on developing a protocol that examines the physiological effects of stress, in particular autonomic dysfunction. A pilot study will be conducted on final-year medical students using a fenometer to measure baroreceptor sensitivity and heart rate variability as markers. Subsequently, autonomic dysfunction in patients with psychiatric diseases will be addressed. The involvement of the department in the Neuroscience Research Group will lead to multidisciplinary projects. The possibility of new treatment modalities in ADHD is envisaged.

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## Oral Pathology and Oral Biology

### An investigation into the role of oral epithelial cells and Langerhans cells as possible HIV viral reservoirs

Two of the research focus areas of the Department of Oral Pathology and Oral Biology are oral cancer and HIV, as well as the combination of these two diseases. Recently, the department established an Oral HIV Clinic at the Tshwane District Hospital to provide comprehensive oral health care to HIV-infected individuals in the public sector. Oral lesions may be indicative of a decrease in the current immune function. Furthermore, treatment of oral infection eliminates foci of possible systemic infections in these frail individuals.

The presence of HIV-1 in oral epithelial cells is a controversial subject, and, although it had previously been reported by a few authors, it remains an uncertain entity with more questions than answers. A molecular study was therefore performed to determine the presence of HIV-1 in the oral epithelial cells, as well as in the dendritic cells of oral immunity, called the Langerhans cells of HIV-1 positive patients. The study also evaluated the possible use of a non-invasive brush biopsy technique for future *in vivo* HIV research.

Although 10 of the 35 patients in this study had HIV-1 DNA in one or more of the sampled anatomical locations during PCR analysis of the whole brush samples, no HIV-1 DNA could be demonstrated in any of the purified epithelial or Langerhans cell specimens after cell sorting and cell microdissection were performed. This study showed the use of non-invasive oral brush biopsies as an experimental model for future *in vivo* oral HIV research to be

very possible and will be investigated further. The work was accepted for publication in the official international journal of oral pathology.

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### Human papilloma virus

Another HIV-related project that was completed recently and published early in 2009 was to compare the human papilloma virus (HPV) strains found in the oral mucosa with that found in the cervical mucosa of HIV-1 infected women. This has never been done in South Africa and is therefore a crucial study if one considers the strong association of HPV with cervical as well as certain forms of head and neck cancers. Individuals with HIV-related immunodeficiency are at an increased risk for oral HPV infection and the prevalence of this infection is higher in HIV-positive than in HIV-negative patients. What is even more important in this regard is the fact that highly active antiretroviral therapy (HAART) does not decrease the oral persistence of this virus and the implications for transmission to sexual partners are far-reaching. The possibility of cancer after sexual transmission of HPV is therefore a strong research focus on which work is also currently being done in the Department of Oral Pathology.

Lymphoma is classified as a Group 1 lesion, which means that it is strongly associated with HIV infection. Oral plasmablastic lymphoma (PBL) was originally described in 1997 as an AIDS-associated tumour and fewer than 200 cases of the oral mucosa have since been reported in the literature. Once more, due to the high number of people living with HIV in South Africa, a substantial sample of cases diagnosed as PBL is available in oral pathology laboratories, which include the Department of Oral Pathology.

Firstly, it is virtually impossible to distinguish PBLs from plasma cell neoplasms with plasmablastic differentiation. Contradiction with regard to the true nature of these neoplasms exists. It was decided to do a study on cases diagnosed as PBL in the Department of Oral Pathology at the University of Pretoria, as well as cases in the Department of Oral Pathology from the University of Limpopo, in order to describe the molecular profile of these neoplasms, which will make it possible to find better management strategies for patients with this aggressive form of lymphoma.

The aim of the first aspect of the study was to describe the immunohistochemical profile of PBL affecting the oral mucosa, to determine tumour clonality through examination of cytoplasmic immunoglobulin light chain restriction and to evaluate the role of Epstein Barr (EBV) and Human Herpes 8 Virus (HHV-8) in this South African population sample. The study represents the largest series of plasmablastic lymphomas (PBL) affecting the oral cavity published to date and some of the results and conclusions are the first to be described in the literature. Forty-five cases of PBL in the oral cavities were retrieved from the files. PBL is currently microscopically classified into two groups due to certain morpho-

logic criteria described in the literature, namely PBL of the oral mucosa type and PBL with plasmacytic differentiation. In this large cohort of cases, it was shown that this morphologic classification has no diagnostic or clinical advantages and its use should be reconsidered and even discarded. What is even more important is the fact that 21 of 45 cases (47%) showed clear light chain restriction by immunohistochemical examination. It is proposed that all cases of PBL with clear light chain restriction should be reclassified as plasmablastic extramedullary plasmacytomas.

The second aspect of the study was done in collaboration with the Somatic Cell Genetics Unit Department of Haematology and Molecular Medicine at the University of the Witwatersrand and the National Health Laboratory Services (NHLs). Only a single case report on the cytogenetic features of these neoplasms has been described in the literature.

Due to the findings of the first aspect of the study, it was decided to evaluate the possible presence of a break in the immunoglobulin heavy chain (IGH) and C-MYC genes and then to evaluate cases positive for the break-apart probes for possible translocation partners through further FISH analysis. All cases will also be evaluated for the presence of deletion of the long arm of chromosome 13, as this represents an abnormality commonly described in multiple myelomas and plasmacytomas. This work has never been done before and will be published as soon as all the results are available.

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## School of Health Systems and Public Health

### Prevention of fetal alcohol syndrome

Fetal alcohol syndrome (FAS) is the most severe of the conditions that make up the fetal alcohol spectrum disorders (FASDs). South Africa has the dubious reputation of having the highest detected rates of FAS in high-risk communities in the world. The main disabilities experienced by people with FAS are low intellect, limited physical growth and poor social skills. These, in combination, have serious effects on a person's ability to learn, live and work independently, and predispose a person to risky health-related behaviour. On a community level, people with FAS are a burden to the educational and social services, as well as to their own families. However, reducing the rates of FASDs, especially in communities where alcohol use by women is the norm, is very difficult and requires a comprehensive approach.

The research project is a collaborative intervention project between the School of Health Systems and Public Health of the University of Pretoria, the Department of Public Health and Family Medicine of the University of Cape Town, and the Alcohol and Drug Abuse Research Unit of the Medical Research Council.

A large research grant was awarded to this consortium in 2005 by the Centers for Disease Control and Prevention (Atlanta, USA) for the development of a comprehensive model to prevent FAS in rural and urban areas of South Africa (2005–2009). Two research sites are being used, Tshwane Municipality in Gauteng and the West Coast in the Western Cape. A formative phase provided both quantitative and qualitative data on the context and behaviours that predispose a woman to an alcohol-exposed pregnancy in these sites. The intervention phase included working with communities to raise awareness of how to prevent FAS, training service providers to better identify and support women at risk, and to identify possible cases of FAS, and a randomised controlled trial to test the effectiveness of motivational interviewing and life skills training in reducing high-risk behaviour in women before pregnancy, in both sites.

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### Research on HIV, TB and alcohol use by women

In terms of HIV and TB, a chapter on quality of life and financial measures in HIV/AIDS in southern Africa was published in *Handbook of disease burdens and quality of life measures* by M Bachmann, Goedele Louwagie and L Fairall. In addition, Goedele Louwagie, in collaboration with researchers from the University of Pretoria, the Medical Research Council and the Foundation for Professional Development, obtained a R500 000 grant from the National Department of Health to execute a study on TB and HIV collaborative activities.

One of the MSc Epidemiology students, Dr Simbarashe Takuva, under the supervision of Goedele Louwagie, is busy with a retrospective cohort analysis of antiretroviral treatment modifications at the referral HIV clinic in Mbabane, Swaziland.

With regard to women and alcohol use, the *South African Medical Journal* accepted an article on factors associated with female high-risk drinking in a rural and urban South African site for publication in the form of a scientific letter.

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## 6.6 Faculty of Humanities



Prof Sandra Klopper, Dean

The humanities and social sciences are unified by a common interest in the concept of the human. As such, these disciplines contribute significantly to research focused on different modes of communication, be it in the arts and in various literary genres, or through political and other forms of discourse.

### Message from the Dean

This concern with communication is evident in many of the research projects undertaken in the Faculty of Humanities at the University of Pretoria during the course of 2009, ranging from work done in Ancient Languages and Philosophy to various activities in Communication Pathology.

Some of the other recent research activities in the faculty demonstrate that however diverse the disciplines of the humanities and social science might be, they all grapple with a number of interrelated issues, in particular the complex terrains of cognition, the construction of cultural and other identities, and the changing realities of social and political relations, whether in historical or contemporary settings. Often it is the shifting relations between these variables that raise key questions for researchers working on topics in cognate disciplines such as history, sociology, and political sciences.

Increasingly, the problems facing researchers in humanities and the social sciences also raise important questions regarding the ever-changing landscape of interpersonal relations, including relations of power, and the victimisation of vulnerable individuals and communities. These relations are reflected in, for example, the work currently being done in the faculty on the gendered experiences of different groups of people and the often pressing social and political challenges confronting today's youth.

The University of Pretoria has the largest humanities faculty in the country. It comprises 18 academic departments, two teaching units and a number of specialised research centres. Students can choose from a wide range of opportunities in fine arts, languages, basic social sciences and applied social sciences at undergraduate and postgraduate level. The faculty is committed to sustaining critical intellectual enquiry.

The past year was one of transition for the faculty. The appointment of a new dean on 1 October 2008 paved the way for a comprehensive survey and status quo report of the faculty by a project team appointed by the executive. As an outcome of this report, academic departments have been retained and the three schools (Social Sciences, Languages and Arts) have been abolished. The faculty has embarked on a number of new initiatives, including some aimed at strengthening research. This includes a project that will contribute to an international collaborative research programme on alternative economic paradigm. The faculty has a particular interest in fostering dialogue on such issues between researchers from countries in the global south. The faculty is currently engaging potential donors with a view to establishing an international centre for mediation and conciliation.

In keeping with the range of disciplines offered in the faculty, its research thrust is both complex and diverse. Focus areas lie in the three core clusters: the arts, languages and social sciences. The faculty's research output has increased in both quality and quantity. In 2009, faculty members published 145 articles in accredited journals and contributed to 34 books as authors, co-authors or by making other contributions. Numerous papers were delivered at local and international conferences. The faculty boasts 26 researchers with NRF-ratings. Its researchers are active on various other levels. They serve on the editorial boards of accredited journals and act as referees of research articles. They also invest in postgraduate students and publish extensively in highly rated journals.

During the period under review, Prof Andries Wessels of the Department of English published the first international article on the poetry of the Jewish-Afrikaans poet, Olga Kirsch, in the influential *American Journal of Jewish Literary Studies*. While Jewish South African writers like Dan Jacobson and Nobel Prize-winner Nadine Gordimer are internationally known, Kirsch's work has remained unknown outside South Africa. Prof Wessels proposes that Kirsch's voice, which articulates her unstable position between being an outsider in terms

of Calvinist Christian belief and the mainstream political sensibilities of the community, yet an insider in terms of language, sympathy and understanding, approaches what Homi Bhabha called the third space of enunciation where two cultures intersect, and where identity is fluid, constructed and reconstructed.

Prof Lize Kriel of the Department of Historical and Heritage Studies concluded her research of the past decade on colonial writings about the BanaNwana of present-day Limpopo with the publication of The 'Malaboch' Books: Kgalusi in the 'Civilization of the written word.' The study looks into the making of historical knowledge through written texts and publications. Reviewers have described the book as "important as a case study of how to apply the insights historians have derived from the 'literary turn' in their discipline", as "an incisive and masterful historical and literary analysis", and as "an interesting and fresh excursion into intellectual history".

Prof Maxi Schoeman, Prof Janis Grobbelaar and Dr Charles Puttergill of the Department of Political Sciences and Sociology conducted a joint survey on the voting behaviour of the youth. This formed part of a long-term pilot project to chart the voting behaviour and political preferences of the youth at the University during an election year. The research findings appear to confirm that the perceptions of the youth on matters of voting mirror general trends evident in the broader society.

Prof Sandra Klopper  
Dean: Humanities

## Ancient Languages

### The production, transmission and interpretation of books in the Ancient World

Three members of the department participated in the Fifth Annual Conference of the Asia-Pacific Early Christian Studies Society, which was hosted by the Tohoku Gakuin University in Sendai, Japan in September 2009. The theme of the conference was *Letters in Early Christianity*, and colleagues Hennie Stander (who investigated the Greek Church Father Chrysostom's views on and uses of letters), Koos Kritzinger (who did the same with the Latin Church Father Jerome) and Phil Botha (who explored the Syrian Church Father Ephrem's fictitious use of the epistolary form in his writings) read papers that will be published in *Scrinium*, the mouthpiece of the *Société des études Byzantines et slaves*. Letter-writing was a characteristic feature of early Christianity. This began with the letters of the Apostle Paul, but he had already made use of a long tradition in the Ancient World of employing letters as a form of political, philosophical and polemical communication. This tradition was continued in the Early Church in the form of personal and spiritual communications, but also as a way of informing believers about the authoritative decrees of synods and bishops. Such correspondence proves to be a valuable source for understanding the

social, historical, theological, literary, political, cultural, philosophical and psychological dimensions of Early Christianity. The research that was conducted proved to be very interesting and enlightening.

An Australian research associate of the department, Prof Pauline Allen, published a book on a particular early Christian author, namely Sophronius, who lived in Jerusalem during the seventh century of the Common Era. Other aspects of Early Christianity also received attention. Hennie Stander and Koos Kritzinger participated in a joint project with Australian colleagues on poverty in the Early Church and they published articles in accredited journals on economical perspectives in Chrysologus's sermons on the lost son and theft and robbery in Chrysostom's time.

Yet another focus area of the department was the production and interpretation of texts in the Hebrew Bible. Phil Botha investigated the use of rhetorical devices in Psalms 24 and 26, while Gert Prinsloo and a Dutch research associate, Dr Raymond de Hoop, together contributed three chapters to a book on textual, literary and delimitation criticism. Their work focused on the segmentation of texts in Early Hebrew and Greek manuscripts, and the implication of such delimitations of units for the exegesis of biblical books.

Another research highlight that should perhaps be mentioned is that members of the department contributed a total of six entries in two prestigious international lexicons. Articles on Dichtung/Dichten/Dichter, Glaube, Psalmen and Verheissung/Erfüllung appeared in the *Lexikon der Bibelhermeneutik* published by De Gruyter of Berlin, and articles on Constantius I Chlorus (ca. 250–306) and Constantius II (Flavius Julius Constantius) appeared in the *Encyclopaedic Prosopographical Lexicon of Byzantine History and Civilization*, which was published by Brepols of Belgium.

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## Communication Pathology

### Phonemic paraphasia in bilingual speakers with aphasia

The phonological planning ability of bilingual speakers presenting with phonemic paraphasia after acquired brain damage needs to be considered in clinical practice by speech-language pathologists. A first and additional languages may impact on this ability differently. Also, a study of this phenomenon may reveal aspects of the underlying control processes of phonological planning during language encoding in the brain. The purpose of this study was to compare the nature and number of phonemic paraphasias in the first (L1) and second (L2) language of three early bilingual speakers with conduction aphasia. Phonemic paraphasias in L1 and L2 (Afrikaans and English) were compared in two picture



Prof De Wet Swanepoel, Communication Pathology.

description tasks and two word-naming tasks. The one picture represented everyday activities and the other a number of more unusual scenes that may require more complex language encoding. Both were described in L1 and L2. The naming tasks in L1 and L2 contained 20 high-frequency words and 20 low-frequency words, all with equal numbers of one-, two- and three-syllable words. Word meaning was similar in L1 and L2. More error words occurred in L2, but the nature of the paraphasias did not differ. Little difference was found between the number and nature of errors in high- and low-frequency words. More errors occurred during picture description than during naming. More single phoneme errors than syllable errors occurred. Language of production and active linguistic-symbolic planning, but not word-frequency, increased the load on phonological planning. The results implicate increased processing demands of L2 on phonological planning. The results do not support syllabic encoding of words in either L1 or L2.

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### Hearing health care through telemedicine: opening doors to the underserved

Hearing loss is the most prevalent chronic disability globally. Unfortunately, professional services are limited and unavailable throughout the majority of the world and especially across Africa. The use of new technologies in telemedicine in hearing assessment and intervention is making remote testing a reality. The first trans-Atlantic hearing test was recently conducted through an Internet connection by a professional in Dallas, Texas, on a patient in South Africa. Subsequent studies to validate the reliability and accuracy of these tele-audiology procedures are demonstrating that this technology may be able to provide equivalent degrees of accuracy in evaluating patients remotely. In a study conducting tele-audiology hearing assessments at a distance exceeding 14 000 km,



Prof Benda Hofmeyr, Philosophy.

from Dallas to Pretoria, no clinically significant differences between results obtained by remote intercontinental testing and conventional face-to-face testing were observed. Furthermore, automated hearing testing has been evaluated and has demonstrated equivalent results to manual audiometric testing in patients with and without hearing loss. The combination of telemedicine technology and automation offers significant promise for addressing the global shortage of hearing health care personnel, particularly in underserved regions such as Africa. With the widespread coverage of cellphone networks across Africa, tele-audiology services may be provided in remote and isolated areas of Africa and the globe.

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### Vuvuzela noise exposure: measurements of intensity and effects on hearing

The vuvuzela is a proud symbol of South African soccer, having evolved over the past 15 years into a symbol of hope and unity for many people in the country. Today, soccer stadiums in South Africa are invariably filled with loud and raucous sounds from the vuvuzela that reverberate with energy to the exhilaration of supporters. The intensity of the vuvuzela at the 2009 Confederation Cup caught the attention of the global soccer community. Despite complaints by international commentators, players and audiences, FIFA approved the vuvuzela as part of the signature South African 2010 World Cup. The international soccer community will probably be caught by surprise at the loudness of the vuvuzela and its non-stop chorus throughout the length of a soccer match. Studies by Prof De Wet Swanepoel and his colleagues have highlighted the dangerous sound intensities of the vuvuzela and the risk of noise-induced hearing loss. A follow-up study determined the actual noise levels that spectators were exposed to at a typical soccer match and measured the effect

on the hearing of a group of spectators. Exposure levels exceeded limits of permissible average and peak sound levels. Significant changes in post-match hearing thresholds and cochlear responsiveness highlighted the possible risk of noise-induced hearing loss. Public awareness and personal hearing protection should be prioritised as preventative measures at recreational events where the vuvuzela is used.

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### A description of the stuttering intervention programmes and approaches of practising speech-language therapists in South Africa

The study aimed at describing the approaches and programmes used by speech-language therapists (SLTs) in South Africa. An explorative, descriptive research design was selected and 41 SLTs currently in private practice participated. Participants who do not offer stuttering therapy were excluded from this project. Most participants used a diverse selection of approaches and programmes to address stuttering intervention. A need for further undergraduate research and continuous professional development was recognised. The implication is that more research should be conducted to provide evidence-based treatment programmes.

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## Drama

### Storying the self: exploring identity through performative inquiry

This research investigated the ways in which the use of performative inquiry can shift notions of knowledge as situated to knowledge as experiential, embodied and an *in situ* encounter in the domain of performance studies. This research focused specifically on understandings of knowledge around the articulation and construction of identity with specific reference to the production *Shiftings* (2007). *Shiftings* was conceptualised as an extension of an undergraduate theoretical module that explores the ways in which contemporary theatre practices can position the performer as site upon which hegemonic constructions of identity are played out, subverted or questioned.

The production and working process towards the production were prompted by students' perceived lack of identification with and understanding of the learning content. Stressing multiple "I's" allowed students to acknowledge and speak as multiple selves, yet integrating these selves in the moment of doing, and uttering and framing that as a simultaneously reflective experience in the frame of the performance. The performative inquiry thus allowed students to embody multiple reflective stances. The multiple overlaps in modes of engagement with the process

of the performative inquiry allowed performers to self-reflexively problematise identity and their subject positions, recognise the performative aspects of identity, and make visible the mechanisms of identity construction. The performative inquiry positioned students as witnesses to the ways in which they became active agents in generating knowledge.

The researcher's reinterpretation of performative inquiry offered her an appropriate methodological approach to teaching and learning that served the students' learning preferences and the demands of the module. It made use of narrative as a central force in performance and identity constructs to offer a personalised, experiential, embodied engagement with knowledge. It demonstrated how conceptual and academic thinking translates into performance practice. Performative inquiry not only made it possible for students to come to terms with the course content, but also encouraged them to reposition, reiterate and reimagine themselves in their wor(l)ds. An article on this research was accepted for publication in the *South African Theatre Journal*.

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### Come All Ye Faithful: gender and identity in the religious vitalisation of South African cinema

This research was presented at the 2009 South African Visual Arts Historians Conference. It aims at investigating gender identity in the films *Faith like Potatoes* (2006) and *Hansie* (2008), focusing on how these films place these notions in redemption narratives. The researcher sees both films as forming part of the religious vitalisation of South African cinema, which takes redemption narratives and infuses them with a clear affirmation of so-called "traditional" Christian Afrikaner constructions of identity – reminiscent of *De Voortrekkers* (Shaw, 1916), overtly locating individual salvation and redemption in organised religion, while reaffirming problematic gender roles in the post-apartheid South African cinescape.

The films' male protagonists' redemption serves to maintain a discourse of submission, first before God and then before man. The male protagonist is aligned with the Father, while he carries gendered authority himself in his relationship with his wife (and with other secondary characters) and "fathers" (literally and metaphorically) others. *Faith like Potatoes* (Van den Berg, 2006) and *Hansie* (Van den Berg, 2008) not only manage to present female characters that are interchangeable between the films (there is nothing that sets Jill and Bertha apart, except maybe that Jill is more of a "mother"), but also female and black characters, whose presence in the plot remain epiphenomenal.

The study represents a variety of associated ideas that problematise the content and language of both film texts, each (but mainly *Faith like Potatoes*) presenting a religious grand narrative that legitimises white normativity and male dominance, while constructing contentious religion-based notions of gender as associated with prescribed binary ideas about masculinity and

femininity. The films' moments of confirming and affirming masculinity are placed in a safe, non-subversive, classical Hollywood narrative form, which present a clear resolution at the end of the film. Although the classical Hollywood narrative is still seen as the dominant way of making films and telling their stories, the use of this dominant narrative model reinforces the idea that what is seen on screen is "natural" and "acceptable". There is no attempt in any of the two films to subvert or even question the ideology of patriarchy or to destabilise the visual language (camera shots, angles, editing techniques, framing devices) of the classical Hollywood narrative that helps to maintain dominant ideas of power relationships.

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### Space and Involvement: theatre in a South African prison

This research investigates the idea of applied theatre's ability to create a space of freedom within a system of formalised power, in this instance the South African prison system. Applied theatre, which often places a spotlight on social issues and concerns, may not yet be able to provide answers to the specific community, but it can articulate challenges and questions that can be utilised to engage a specific community, and encourage them to voice and express their own solutions. Ideally, this voicing and expression will aid in the shift of the individual and community from a position of being oppressed to one of freedom. The complexity of the change from oppression to freedom underlines the importance of the analyses of the drama or theatre work itself as potentially the prime "object" of study for this field of research.

The basics of Theatre in Prison may stay constant, but it is possible, through engaging with other disciplines (in this case, the departments of Social Work and Criminology, and Psychology) to explore new ways of packaging the application of theory (applied theatre). With reference to the interdisciplinary research done by the departments of Drama, Social Work and Criminology, and Psychology, this research will trace and interrogate the development, performance and outcomes of at least six different performances in the male juvenile pre-trial section of the C-Max prison in Pretoria. Indeed, a small space or fissure exists between the practised smile and the panoptic eye of the criminal, where applied theatre may be able to forge a little bit of freedom and challenge authority.

Focusing on the idea of theatre for/with/by the oppressed, it is of the utmost importance that drama and theatre in prison find new ways to transcend new kinds of repression, oppression, exploitation and injustice. The complicity and interrelationship of various issues that constitute a spider's web of HIV/AIDS, rape, domestic violence, physical abuse and others social concerns is addressed and illustrated by various performances.

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### Teaching the classics to a new generation

The aim of this research was to demonstrate how innovation in lateral approaches to teaching drama texts can result in enhanced learning for the students. Speaking at the 2009 Higher Education Learning and Teaching Association of Southern Africa (HELTASA) Conference, the researcher referred to her personal experience of teaching Greek plays to second-year students in Drama and Film Studies. In previous years, these classes tended to be viewed as tedious and uninspiring to the modern-day youth. The course was lecturer-driven and students had to prepare for class by reading plays and other prescribed reading material (which they very seldom did). The academic demands of the course were high and students had little interest in ingesting factual information or in exploring a variety of arguments and viewpoints related to the learning material.

Her decision to use drama to teach drama is based on Dorothy Heathcote's teaching methodology and philosophy that stress the importance of child/student-centred learning. She mentions the importance of allowing the students to take important decisions during a lesson in order for them to feel that they are shareholders in the learning process and that they are not empty vessels to be filled. Every student has prior knowledge and experience that can be harnessed and integrated into the learning content. Knowledge and understanding are collectively generated, not transmitted to students. When students feel that the learning content is relevant to their personal contexts, they are more likely to engage with the learning material in a meaningful manner. Using drama to teach students about drama implied that students would not only read the plays, but perform them in ways that would demonstrate their theoretical understanding of the plays, while revealing the contemporary relevance.

In addition, detailed and timely feedback after each performance by means of class discussions helped motivate the students to reflect and consolidate aspects of the course content, redirect thinking, identify problem areas and provide a profile of student learning up to the point of assessment. This method of teaching has proved to be successful since 2001. Class attendance figures soared to full attendance in the majority of classes. Furthermore, students are now actively involved and participate in class discussions in a more informed manner than before.

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## English

### The outsider as insider: the Jewish Afrikaans poetry of Olga Kirsch

The first international article on the poetry of the Jewish-Afrikaans poet, Olga Kirsch, was published in the influential *American Journal of Jewish Literary Studies*. While Jewish South African writers like Dan Jacobson and the Nobel Prize-winner Nadine Gordimer are internationally known, Kirsch's work has remained unknown outside South Africa because she wrote in the language of her Free State childhood. With reference to the work of Gilroy and Van Lennep, it is suggested that Kirsch occupies a position of liminality in Afrikaans literature. She is recognised as an important poet in the tradition, yet an outsider in terms of Calvinist Christian belief and the mainstream political sensibilities of the community.

The researcher proposes that Kirsch's voice, articulating her unstable position between being an outsider in these terms, yet an insider in terms of language, sympathy and understanding, approaches what Homi Bhabha called the "third space of enunciation", where two cultures intersect, and where identity is fluid, constructed and reconstructed. The researcher finds that this instability is a crucial sublimation and springboard in Kirsch's art: in the "lush land" (of her poetry) within the desert (of existence), her verse becomes a necessary place of fulfilment, completion and reconciliation in her otherwise divided life.

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## Historical and Heritage Studies

### The Banaanwa

The research of the past decade on the colonial writings about the Banaanwa of present-day Limpopo was concluded with the publication of the book *The 'Malaboch' Books: Kgalusi in the 'Civilization of the written word'*. This study looks into the making of historical knowledge through written texts and publications. The focus is on the colonial subjugation of the Banaanwa of Kgalusi Mmaleboho in a war against the Boers in 1894. In the course of the 20<sup>th</sup> century, two diaries – one by an Anglican priest (Colin Rae) and one by a German missionary (Christoph Sonntag) – came to play an extraordinary role in the way Malaboch and his people would be represented in what Roland Barthes referred to as the "civilisation of the written word."

Attention is paid to the diary as a source for historical research, and the extent to which – especially in published form – its aspirations, also as a literary genre, affect its possible meanings for successive generations of readers. Reviewers describe the book as "important

as a case study of how to apply the insights historians have derived from the 'literary turn' in their discipline", as "an incisive and masterful historical and literary analysis" and "an interesting and fresh excursion into intellectual history."

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### Becoming Zimbabwe

A research project that has been jointly coordinated over the past three years in conjunction with Prof Brian Raftopoulos, Director of Research and Advocacy at the Solidarity Peace Trust in Cape Town, has resulted in the publication of the book *Becoming Zimbabwe*. It is aimed at reinterpreting Zimbabwe's historical past and reevaluating the country's historiography. The study interrogates the idea of national belonging and citizenship and the nature of the state in Zimbabwe in historical perspective in the context of the country's evolving political economy and geopolitical and regional contexts. The study challenges the notion that a singular political party or social group has the right to dictate the terms for understanding and narrating the past to the exclusion of the other social groupings in society and to challenge the contrived exclusive versions of the country's past in what has sometimes been referred to as "patriotic history". It seeks to demonstrate the plural nature of understandings of the past, mainly because this has a fundamental bearing on the politics of the present. This collaborative research and writing undertaking harnessed the efforts of several leading Zimbabwean historians and was supported by the Ford Foundation and the Institute for Justice and Reconciliation in Cape Town. *Becoming Zimbabwe* not only makes an important contribution to Zimbabwean historiography, but also speaks to the complexity and controversies that characterise that country's experiences.

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## Music

### References to music in Afrikaans literature

The researcher has previously written about aspects of the oeuvres of the Afrikaans authors Hennie Aucamp, Karel Schoeman and Lina Spies. In 2009, he was the first person to complete an MA in Creative Writing at the University of Pretoria. For this degree, he offered a volume of short stories and a dissertation on the references to music found in Marlene van Niekerk's acclaimed Afrikaans novel *Agaat* (2004). This novel won the foremost literary prizes for Afrikaans literature and has been translated into Dutch and English. Two articles emanated from the analysis of *Agaat*.

References to music and music activities are often found in the novel. Van Niekerk's views on the inclusion of music references are discussed in the first article. In an interview and in written responses to questions, Van Niekerk supplied explanations about her ideas on the power and value of music, the use of references in general, and the specific use of music references. Van Niekerk often listens to music while writing. The music becomes a provocation, a type of stimulus to find the right frame of mind. Music also functions as a controlling agent to prevent her from writing too "easily". Although Van Niekerk declares that she uses music to colour her characters, she is of the opinion that no connection should be drawn between herself and the characters in *Agaat*. She nevertheless confirms that music plays a major role in her life, as well as in the lives of the characters in the novel. Singing is often described as a creative activity in *Agaat*. Van Niekerk explains that singing and the image of a singer are important matters to her. Van Niekerk's views contained in this article form an important text concerning her *ars poetica*.

The second article investigates the references to classical music in *Agaat*. Van Niekerk possesses a sound knowledge of music and of the repertoire. She can, therefore, make a variety of references to musical terminology, musical instruments, music making, South African culture in which music plays a decisive role, Afrikaans folk songs and songs from the FAK song book, psalms and hymns, popular songs, and compositions from the repertoire of classical music. Concealed, translated quotations of lines from German poems set to music as art songs are also included in *Agaat*. In these cases (poems set to music by Brahms, Mahler, Schubert and Schumann), the word text is incorporated in a complex manner. Her craft in the inconspicuous inclusion into the text of changed and/or adapted lines from poems is possibly the highlight of her art of allusion and reference.

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## Philosophy

### Ethics in small and medium-sized enterprises (SMEs)

In the field of business ethics, a lot of research has been done on ethics management and corporate social responsibility in large firms. The same cannot be said of small and medium-sized enterprises (SMEs). This is the case despite the fact that SMEs are the largest providers of employment and the key to poverty alleviation globally. In this project, it was decided to gather research papers on ethics in SMEs from various parts of the world (Africa, Europe, India, Latin America, New Zealand and Australia and the USA). This proved to be no easy task, as most SMEs do not describe their ethical activities in terms of corporate social responsibility (CSR) or ethics management. In fact, the research indicated that, in SMEs, ethical considerations seem to be dealt with without the use of any of these labels. In SMEs, ethics presents itself as a much

more integrated part of business activity. It was found that in SMEs a strong sense of normativity emerges out of everyday business interactions with a variety of stakeholders. The kind of stakeholder interactions that large businesses spend a great deal of time analysing, nurturing and monitoring, happens as a matter of course in SMEs. In fact, creating reputational value, building networks and nurturing community interactions are very much part of securing their bread and butter. The research further found that the main threats to ethics in SMEs are corruption in the environments in which they function, a lack of peer networks and government support, and prohibitive policies, procedures and structures that were designed with large companies in mind. Besides co-authoring (with Kris Dobie) an article entitled *Ethics and sustainability in SMEs in sub-Saharan Africa: enabling, constraining and contaminating relationships*, the researcher also co-edited a special edition of the *African Journal of Business Ethics* with Dr Laura Spence (UK), in which perspectives on the ethics of SMEs from various parts of the world were published.

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### Nietzsche and the Anglo-Saxon tradition

This study aimed at filling a hitherto unattended gap in Nietzsche studies, namely his relationship with the English-speaking world. While he gladly acknowledged the French roots of his thought and his use of his own German tradition – both literary and philosophical – very little has been said about the English giants whose influences abound in his work. Shakespeare, for example, is mentioned over a hundred times in the Nietzschean oeuvre, and makes his first appearance even before Goethe does. The English world was as important to Nietzsche as were the French and German traditions, particularly if one takes into account that no other country embodied the vices of modernity against which Nietzsche railed quite to the extent that imperial Britain did. No other country had so much at its disposal to aid them in turning their values into the values of the world. The grand narrative of British philosophy, with its persistent theme of "progress", constitutes a case of undiluted modernism. The research project examines Nietzsche's engagement with this tradition, what he loved and loathed about it, and how it helped to form the philosopher that we today know as Nietzsche. The study was published in the book *Nietzsche and the Anglo-Saxon tradition* as part of Continuum Publications' Studies in Continental Philosophy series. The book follows a negative to positive trajectory, beginning with the thinkers that Nietzsche evaluated negatively, such as Bacon, Hobbes and Darwin, and concludes with those whom he deemed worthy thinkers, such as Shakespeare, Emerson and the great Romantics.

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## Radical passivity: Ethical problem or solution?

The French philosopher Emmanuel Levinas's ethical metaphysics is essentially a meditation on what makes ethical agency possible – that which enables us to put the well-being of another before our own. This line of questioning found its inception in and drew its inspiration from the mass atrocities that occurred during the Second World War. The Holocaust, like the Cambodian genocide, or those in Rwanda and Srebrenica, exemplifies what have come to be known as the "never again" situations. Yet, atrocity crimes are still rampant. In our present-day world, hate crimes motivated by racial, sexual or other prejudice, and mass hate, such as genocide and terror, are on the rise. Within this context, this project sought to critically reflect upon Levinas's notion of a radically passive ethical agent as opposed to the commonplace notion of an active autonomous agent with the freedom to act independently without an inherent imperative steering its actions. Levinas claims that taking responsibility for others in need follows from neither sympathy and compassion nor a free, rational weighing of options. Rather, ethical action is made possible by a primordial responsibility that is preconsciously felt. We are passively obligated before we can actively choose to help. Levinas therefore argues that the "needy other" incapacitates our customary egocentric ways, and that this "radical passivity" enables us to recognise our inherent responsibility to others in need. This project resulted in book entitled *Radical passivity: rethinking ethical agency in Levinas*, edited by Dr Benda Hofmeyr, which brought together a number of internationally renowned Levinas scholars. The book was published in the prestigious Springer book series, *Library of Ethics and Applied Philosophy*.

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## Political Sciences and Sociology

### Voting behaviour of the youth

Psephology is a growing field of interest in the post-apartheid South African context. Demographically speaking, with regard to the age and gender structure of the population, South Africa is in a transition. In spite of occupying this intermediary position, a sizeable proportion of the electorate is young. Slightly more than a quarter of all voters on the Electoral Commission's registration and voters' role for 2009 was younger than 30 years of age. Within this age category, university students are of particular interest, as they constitute, to a large extent (albeit not exclusively), the future leaders in the social, political and economic spheres of society.

This study forms part of a long-term pilot project that charts the voting behaviour and political preferences of the youth at university during an election year. A great degree of speculation preceded the run-up to the April 2009 election with regard to the way the youth would vote. Key trends observed in society are reflected in the outcome of the survey.

A comparison drawing on data recorded in surveys following the May 2006 local government election and April 2009 national election revealed that a considerably larger proportion of students sampled indicated that they were registered for the April 2009 election. While the registration gap between male and female had shrunk, reported registration of females still lagged slightly behind that of males in 2009.

Although almost two-thirds of all students sampled indicated that they had voted in the April 2009 elections, this constituted almost nine out of ten registered students. This result indicates that political parties were successful in mobilising the youth to vote. National elections generally yield higher rates of participation, and are deemed more important. However, an overwhelming majority surveyed expressed their intention to vote in the 2011 local government elections.

Only a minority of students reported political party membership. Proportionately more males belonged to a political party, worked (volunteered) for one and indicated that they had an interest in politics. These reported differences in behaviour between the genders are statistically significant. There was no statistically significant gender difference in the attendance of political rallies or meetings or in the belief that voting can make a difference.

Slightly more than half the white students indicated that they had an interest in politics, compared to almost three-quarters of the black students. Proportionately speaking, considerably more black students than white students indicated that they attended rallies or meetings during the election campaign. Only slightly more black than white students volunteered during the election campaign. However, slightly more than four-fifths of the white students indicated they supported a political party, while only slightly more than two-thirds of the black students did so. Three-quarters of the white students were supportive of the idea that smaller parties should collaborate to form a stronger opposition, while less than half the black students supported such an idea. All these differences were statistically significant. There was no statistically significant difference between the racial categories in political party membership or the importance attributed to voting. For both categories, party membership was low, while voting was recognised as being important.

It was noteworthy that slightly more than half the students chose to describe the outcome of the election as a victory for Jacob Zuma rather than a victory for the African National Congress (ANC). Although slightly more men opted for describing it as an ANC victory, the difference in the response of the genders is not statistically significant. An overwhelming majority of white students chose to describe the outcome of the election as a victory for Jacob Zuma rather than an ANC victory. In contrast, slightly more than two-fifths of the black students described the election in this way. This difference between the racial categories is statistically significant.

In conclusion, slightly more than a quarter of the sample indicated that they preferred the ANC "most". Almost an equal proportion indicated they liked it "least". In contrast, almost a third of the sample indicated that they preferred the Democratic Alliance (DA) "most", while slightly less than

one-tenth disliked it "most". In contrast the Freedom Front (VF+) attracted slightly more than a quarter that liked it the "least". Nelson Mandela is recognised in both surveys as an admired leader. While Jacob Zuma hardly figured in the 2006 survey, he was more prominently mentioned in the 2009 survey. In contrast, the popularity of Thabo Mbeki decreased considerably in the 2009 survey. Helen Zille received more support in the 2009 survey than Tony Leon had garnered in the 2006 survey. Overall, these research findings appear to confirm that the perceptions of the youth on matters of voting mirror general trends evident in the broader society.

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## The experiences of South African female peacekeepers

In 2009, South Africa celebrated ten years of participation in international peacekeeping operations. Its first, and long-standing, involvement was in Burundi, but since then the country has contributed to peacekeeping operations in several countries, mainly in Africa, including the Democratic Republic of Congo (DRC) and Sudan. Currently, South Africa is the 13<sup>th</sup> biggest troop contributing country (TCC) to peace missions, with the largest women contingent deployed in peace support operations (PSOs). South Africa is also one of only a handful of countries incorporating women into combat positions in its military and has committed itself to gender mainstreaming in the South African National Defence Force (SANDF), in line with Security Council Resolution 1325 (2000) – the so-called women/gender, peace and security resolution, which calls, among others, for the full inclusion of women in all aspects of peace-related activities, including peacekeeping.

The research project explored the experiences of these women soldiers during their deployment, focusing on specific challenges related to debriefing and the harvesting of knowledge and experience for the improvement of future PSOs. Data was gathered by means of questionnaires (male and female participants) and focus group discussions, as well as a series of unstructured interviews with senior SANDF decision-makers and consultants involved in gender mainstreaming training for PSOs. A second phase of the project, funded by the High Commission of Canada, has commenced in cooperation with Prof Elrena van der Spuy, Vice-dean, Faculty of Law, University of Cape Town.

The findings include the following: Women soldiers still suffer from stereotyping of the roles men and women are supposed to play in society. Women soldiers are often perceived as being "weak" and "in need of protection" by their male colleagues, and considered not to be "mentally strong enough" to handle the often difficult and dangerous situations they face. Women soldiers, on the other hand, overwhelmingly believe that they handle such situations professionally and

much evidence for this was provided by the participants. Nevertheless, women soldiers are often confined to support positions in the military base "for their own protection".

Women soldiers believe that, in addition to their responsibilities as soldiers, they also contribute to community-building in the areas to which they are deployed. They tend to organise various events, become involved in education campaigns and, interestingly, believe that their mere presence as women in uniform serve as an incentive and symbol of hope for female victims of civil war and violence, showing these women that a better life is possible and that "women can do it".

Despite these differences, male and female peacekeepers have a lot in common. They suffer from boredom during their deployment, they worry about their families back home, they often return home to face marital problems due to their long absences and they all believe that there is too little opportunity for debriefing once they are back home.

Several challenges need to be addressed by the SANDF (and the defence forces of all TCCs). The most important are the following: More attention needs to be paid to gender mainstreaming and gender-awareness training in pre-deployment training. A concerted effort should be made to recruit more women peacekeepers and more women to the SANDF. More senior women officers should be included in PSOs. A media campaign should be launched to make South Africans aware of the sterling contribution that peacekeepers make to improve security on the continent. A debriefing model should be instituted that would allow not only for stress relief, but would also capture invaluable experience and insight for the planning of future PSOs. More research should be conducted on the topic of women peacekeepers and regular interaction should take place between researchers and senior SANDF personnel.

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## Social Work and Criminology

### The sexual assault and rape of male offenders and awaiting-trial detainees

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, 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 awaiting-trial detainees. 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 occur in the correctional centre. The reasons offered for the occurrence of rape in the correctional centre included that an agreement had not been reached between inmates and because of that rape will take place, corruption by correctional officials, the involvement of prison gangs and the use of 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 were awaiting trial for aggressive offences (armed robbery) and one for a sexual offence (rape). The perpetrators force their victims to engage in oral sex, interfemoral sex and anal sex.

From the feedback of the participants and the literature review, the researcher developed an Offender Sexual Protocol. The Department of Correctional Services can use this protocol to reduce and manage sexual assault and rape in male correctional facilities.

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## Continuous Professional Board

The aim of the research was to evaluate the appropriateness and feasibility of the Draft Continuous Professional Development Policy of 2004 that enables social workers and social auxiliary workers to participate in continuous professional development (CPD) and that will ensure a skilled, empowered and professional cadre of workers and accordingly make amendments to pave the way for the compulsory implementation of CPD. In 2001, the South African Council for Social Service Professions (SACSSP) decided, in principle, to implement a CPD system for all professionals registered with the Council. The 8<sup>th</sup> Draft CPD Policy was implemented in a pilot project during January 2004 with social workers and auxiliary workers. A quantitative study was done in the two pilot provinces, Gauteng (urban) and 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 outstanding purposes of CPD were indicated as education and development, improved and quality service delivery, self-development, building confidence, support and networking, CPD activities, availability, workload and the accessibility of suitable CPD administration. 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 research findings indicated that the employer has a role to play in CPD. 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 earned per hour (as opposed to the range according to the level of participation of the attendee), the number of points carried forward to the following year and allowing CPD activities on an

annual basis. The need for effective communication media to inform the constituency on the availability of opportunities was emphasised. In summary, the qualitative study confirmed that the commitment of the social work profession to the recognition of CPD has been established. Social workers indicated that they were reluctant to attend activities if they were not linked to CPD. 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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## Baseline survey on the needs and perceptions of the youth

Contemporary human rights practice encourages full participation by those social categories that are marginalised in society. The youth constitutes a vulnerable category that is often excluded from decision-making processes in communities. The Convention on the Rights of the Child, adopted by the United Nations General Assembly, celebrated its 20<sup>th</sup> anniversary in 2009. This Charter Convention urges policy-makers to engage with and involve the youth in matters of concern to them. When the development of policy is based on such inclusion, it promises to prepare the youth for an active and well-adjusted adulthood. In order to collect baseline information on the youth in Tshwane South, a survey was conducted in four schools. These schools were purposively selected to ensure variation with regard to language of instruction, educational programmes offered and residential setting.

The survey asked participants to provide information on their background, recreational activities and school experiences. They also commented on social and political issues, security and plans for the future. A successful youth policy requires comprehensive knowledge about young people. This research provided baseline data on the well-being of young people in Tshwane South and the needs they express. It paid attention to their perception of their ability to influence the youth policy and participate in the development of the broader society and local community. It is envisaged that the findings of this baseline survey will be compared in 2010 with a similar study conducted in Karlskrona in Sweden, with a view to sharing ideas, methods, strategies and best practices to improve youth policies that will give the youth the skills, knowledge and information to deal with issues that influence their daily lives. Partners in the broader comparative project are the Gauteng Department of Education (Tshwane South) in South Africa and the Blekinge Institute of Technology, in partnership with the municipality of Karlskrona, in Sweden.

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## Visual Arts

### Placing visual culture on the agenda

Two recent publications, *Taking a hard look: gender and visual culture* and *Gendered bodies and new technologies: rethinking embodiment in a cyber-era*, firmly place the new field of visual culture in the spotlight. Both books, the first an edited volume and the other a monograph, deal with the specific role played by gendered representations in visual culture. *Taking a hard look: gender and visual culture* showcases a collection of papers that were delivered at an international conference that was hosted by the Institute for Gender and Women's Studies in June 2007.

Gender and visual culture traverse in quite unique and often fascinating ways. On the one hand, gender functions as an interdisciplinary approach and critical tool to analyse and investigate several subject fields. As such, gender contributes to establishing a much-needed theoretical and functional platform spanning many fields of enquiry from where gender practices can effectively be critiqued and ideally changed. On the other hand, the growing popularity and ubiquity of visual culture in a global context create an increasing need to reflect on and interrogate this phenomenon in an academic manner. Although Visual Culture Studies is an established subject at many northern institutions, it is fairly new and relatively undertheorised in the south. In response to the growing need to investigate issues dealing with gender and visual culture, and particularly how they creatively intersect, the selected chapters are collected in this volume in the hope of making a purposeful contribution to the burgeoning discourse.

The monograph, *Gendered bodies and new technologies: rethinking embodiment in a cyber-era*, explores the contemporary era of ubiquitous information flow, heightened mobility and limitless consumer convenience, during which human interaction with new technologies has become increasingly seamless. In the process, the human body is effectively and steadily reduced to just another interface or a "second life".

What is easily forgotten during this translucent transaction is that being human necessarily implies being embodied. In other words, to constitute a body in its non-negotiable physicality is still what it entails to be human (among other things). To live daily in and through the complicated and dynamic intersection between "mind" and "body", psychology and physiology — also known as embodiment — is what makes us human.

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## Centre for Augmentative and Alternative Communication

### Teachers' perceptions of inclusion of two types of learners: learners with little or no functional speech and learners with attention deficit and hyperactivity disorder

The radical reforms in the education system in South Africa over the past few years have aimed to redress past inequalities and to move from a system of segregation to one of inclusion. The success of including learners with disabilities and other barriers to learning in mainstream classrooms depends heavily on teachers' perceptions about this process.

The Centre for Augmentative and Alternative Communication (CAAC) surveyed 119 Grade 1–3 mainstream teachers to determine their perceptions about the inclusion of learners who have little or no functional speech (LNFS) versus learners with attention deficit and hyperactivity disorder (ADHD). Teachers were randomly assigned to two groups. A crossover design was used: Group 1 first read case study A, followed by case study B, and Group 2 did the reverse. Teachers were then asked to complete a questionnaire tapping their perceptions about the inclusion of these learners.

Preliminary analysis of results indicate that teachers overall seem to have a slightly more positive perception about the inclusion of a learner with ADHD, although learners with LNFS were not perceived more negatively per se. Teachers are probably more familiar with learners with ADHD, who are often already accommodated in mainstream schools. This might have prompted an overall more positive attitude.

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### Determining vocabulary items for reporting crime or abuse in the South African context

Crime against people with developmental and other disabilities is similar in scope to that against women, children and the elderly. Individuals with disabilities who have little or no functional speech are particularly vulnerable when it comes to crime, abuse and neglect. One contributing factor might be that, due to their communication disability, they are seen as being unable to tell about their victimisation, or that they might appear to be unreliable witnesses.

Alternative ways of communication, such as communication boards or speech-generating devices are often used to help people with little or no functional speech (LNFS) to communicate. Persons who are unable to spell have to rely on preprogrammed vocabulary



to express themselves. In order for such persons to report a crime or abuse, the appropriate vocabulary needs to be available for them to do so. The current study thus aimed at identifying the appropriate words that should be incorporated into an augmentative and alternative communication system. To date, three focus groups have been held with professionals working with people with disabilities – each group coming from a different language background (English, Afrikaans and Northern Sotho). Fifty words that were thought to be crucial for reporting crime or abuse were identified by each group.

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### **The study of family activity settings that typically developing three- to five-year old children participate in in a low-income African context**

Family-centered practice in early childhood intervention calls for culturally appropriate and sensitive intervention methods. If practitioners and interventionists understand the everyday experiences and events (also known as activity settings) that families engage in, it could help them formulate intervention goals that are congruent with rather than disruptive of family practices and functioning.

There is a lack of research aimed at understanding the family contexts of young South African children of low-income urban families. A two-phase research project was undertaken under the auspices of the Centre for Augmentative and Alternative Communication (CAAC) to identify the activity settings that children aged three to five years from lower socio-economic urban settings typically engage in. The first phase entailed the development and piloting of an extensive questionnaire, which was then used to gather data in a setting in the greater Johannesburg area. The second phase entailed a replication in a setting in the greater Tshwane area.

The study employed a descriptive design using face-to-face structured interviews. Some 112 caregivers were interviewed, using a structured interview schedule previously developed in consultation with the caregivers from Soweto, using focus groups.

The results indicated similarities and differences between the two contexts regarding the types of activities that children participate in, the frequency of participation, the partners involved, and the purpose of the activities.

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## **Unit for Academic Literacy**

### **A socio-affective approach to improving students' reading comprehension abilities**

Developing students' academic reading abilities – as a component that would contribute towards attaining a level of academic literacy that would enable students to successfully complete a tertiary qualification – is one of the focal points of the interventions offered by the Unit for Academic Literacy. Research on academic reading is therefore undertaken by several members of this unit. Different approaches aimed at enhancing students' academic reading abilities have been employed by various institutions, with varying degrees of success. The researcher is investigating a socio-affective approach to the development of reading competencies, attitudes and values. This approach, which is still relatively unexplored, yielded exceptionally favourable results in interventions facilitated by a group of researchers and academics from the University of Maryland (USA). As their interventions involved subjects (participants and respondents) at primary-school and high-school levels, the researcher adapted the approach to the multilingual, tertiary context at the University of Pretoria. Her research among first-year students has shown that most second-language speakers of English have a poor reading background, low motivation and a negative attitude towards reading. These students employ inappropriate reading strategies, do not engage in critical reading, and, generally, do not read anything but the scheduled class texts. As her research revealed various social and affective factors that influence the above reading behaviour, beliefs and attitudes, her intervention was designed in such a way that it would remedy as many of the issues that influence these students' reading behaviour as possible, and improve their reading abilities. The research has subsequently led her into consequential areas in a quest to further refine this intervention, which, for the very first time, uses a socio-affective approach for enhancing tertiary-level students' academic reading abilities.

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## 6.7 Faculty of Law



Prof Christof Heyns, Dean

members published in prestigious journals such as the *American Journal of International Law*.

Research conducted in the different departments of the faculty covered virtually all areas of law and dealt with issues such as the protection of the official languages under the Constitution, the involuntary detention of patients with tuberculosis, government responsibility for potholes in public roads, reckless credit provision, wrongful arrest, the protection of journalists' sources, class actions and breach of contract, anti-dumping and transformative constitutionalism.

The Centre for Human Rights conducted research for the United Nations on international human rights protection in South-east Asia, and assisted the Southern African Development Community (SADC), as well as the East African Community (EAC), with legislative drafting. It also published a major study assessing the work done by the New Partnership for Africa's Development (NEPAD).

The Centre for Child Law conducted research and made submissions on the revision of the Maintenance Act and the Child Justice Act, and assisted the Department of Social Development with developing its adoption policy.

A full-time or structured doctoral programme was introduced and the first four students were admitted. This programme runs parallel to the ordinary doctoral programme and primarily attracts international students.

The Faculty of Law sees itself as a research faculty, which means that, in addition to its undergraduate programme, it also has a strong focus on postgraduate programmes and research. During the year under review, the faculty made significant progress towards its goal of reducing its undergraduate students, while growing its postgraduate numbers.

### Message from the Dean

The faculty has continued its efforts to expand its research focus to include not only South African national law, but also comparative law and international law. Faculty

Publications such as *Constitutional Law of South Africa* were updated and the faculty served as the African hub for the Oxford University online publication, *International law in domestic courts law reports*.

The regular faculty publications *De Jure*, the *African Human Rights Law Journal*, the *African Human Rights Law Reports* and the *Pretoria Student Law Review* all saw new editions. A new publication, *Constitutional Court Review*, was launched at a meeting at the court. The process of turning *De Jure* into an online publication was started.

The system of regular departmental research meetings, often also involving extraordinary professors and other outside experts, was expanded.

A World Bank grant allowed the expansion of the Law of Africa Collection in the Oliver R Tambo Law Library, as well as the publication of eleven new titles by the Pretoria University Law Press (PULP).

Three staff members were granted fellowships to conduct research at the Stellenbosch Institute for Advanced Studies and a number of staff members conducted research overseas, for example, at Birkbeck College.

Prof Christof Heyns  
Dean: Law



## Public Law

### The governance of Kosovo: Security Council Resolution 1244 and the establishment and functioning of EULEX

This research analyses the evolution of the mandate for civil administration in Kosovo, provided in United Nations Security Council Resolution 1244 (1999). It illustrates the difficulties that arise in the face of an open-ended mandate for civil administration under Chapter VII of the charter, as a result of which any formal amendment necessitated by realities on the ground requires a subsequent Chapter VII resolution. It concludes that although the Security Council's endorsement of the mandate of civil administration by the European Union Rule of Law Mission (EULEX) in Kosovo under overall United Nations control in November 2008 provided an ex-post facto legal basis for the mandate, its long-term legality is uncertain, due to political realities in Kosovo itself.

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### The role of European courts in the development of a hierarchy of norms within international law: evidence of constitutionalisation?

The article exposes the deficient human rights protection currently provided in international law itself to individuals directly affected by United Nations Security Council resolutions. It does so by analysing the Kadi decisions of the Court of First Instance of the European Communities in 2005, as well as the subsequent appeals decision by the European Court of Justice (ECJ) in 2008. It concludes that the ECJ's decision weakened the notion of a universal value system to which the United Nations Security Council is also subjected.

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### The regulatory framework of the South African health system

This research explored the nature of the South African health system in the context of the regulatory legal framework. It was found that the system consists of both the public and private health sectors. Although the private health sector works well, the public health system is inadequate and fragmented in principle and does not meet the imperatives of the constitutional right to health, mainly because of a lack of resources and other economic concerns.

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### Observations on the use of official languages for the recording of court proceedings

The research discusses the constitutional provisions that relate to the interpretation and application of the use of the official languages for the purpose of the official recording of judicial proceedings in South African courts. This is followed by a critique of the most prominent judgments in which the question was dealt with. The discussion shows that the argumentation in some of these judgments reveals a dreadful trend of the judicial flouting of clear constitutional provisions, on the skimpiest of grounds, thus reneging on the very responsibility of these courts as the guardians of the supreme constitution.

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### The role of a modern central bank in managing consumer bankruptcies and corporate failures: A South African public-law angle of incidence

Most people in South Africa, including many lawyers and legal practitioners, are unaware of the important public law role that a central bank plays in most constitutional democracies and in particular financial environments. Recent global and regional events have highlighted the lack of insight in the role of a modern central bank on the one hand, and its impact in securing stability in local economies and facilitating economic growth and fiscal stability on the other. This particular research was thus aimed at emphasising, explaining and comparing the various statutory (national laws and the Constitution) provisions relating to the South African Reserve (Central) Bank (SARB). Not only were the various powers and functions of the SARB investigated, but many of the important advantages of such an institution were explained, especially in the managing of consumer bankruptcies and corporate failures. The research furthermore covered aspects of the historical development of the SARB, statutory foundations, including powers and functions, and a brief comparative section with other major central banks in the world. It is finally submitted that the research is of value for both lawyers and economic advisors, and should act as a stimulus for further academic research and debate on this sometimes neglected field of public law. In the final analysis, the research confirmed that the public law principles of Rule of Law, legality and good governance also apply in the sphere of national monetary and fiscal policy.

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## The status of acts of sexual violence in international criminal law

Acts of sexual violence have long been trivialised in international law. The rape camps during World War II, during the Bosnia-Herzegovina conflict and the Rwandan genocide shocked the international community into focusing on the status of sexual violence as an international crime. The ad hoc tribunals of the former Yugoslavia and Rwanda established presidential authority during the last decades in recognising and prosecuting acts of sexual violence as genocide, crimes against humanity and war crimes. The contribution examines international instruments and important judgments that illustrate the circumstances in which acts of sexual violence may constitute international crimes. The conclusion reached is that the time has come to recognise the fact that acts of sexual violence can constitute the crimes of genocide, crimes against humanity and war crimes.

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## Mercantile Law

### Can a class action be instituted for breach of contract?

The institution of a general class action via an act of Parliament would allow the protection of consumers who find it hard to pay for products and even harder to reach the price of justice. Arbitration clauses prohibiting the use of a class action should be handled with care, as bargaining inequity could leave the consumer helpless during a dispute where consensus between the parties to an arbitration clause could bereave the consumer of his right to institute a class action. The success and efficiency of the law depends on the legal principles applicable in a certain context of the law. The South African Law Commission has completed research on the class action. A bill on class and public interest actions awaits enactment. It is therefore regrettable that, at present, no general class action for breach of contract in terms of the South African common law is recognised by our courts, despite the delay in the enactment of the bill and the court's constitutional power to broaden the option of applicants by allowing a general class action beyond the scope of the Constitution as a matter of urgency.

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## Revisiting the public disclosure of private facts in cyberworld

Traditional jurisprudence holds that a person who posts private information onto a social networking website does not have a legitimate expectation of privacy. However, online social

networking has revolutionised the way people communicate and share information with one another. This article considers ways in which a person could have a legitimate expectation of privacy on the internet by attempting to answer questions such as whether privacy can exist where there is no physical space or inherently private subject matter, secrecy or seclusion and – more pertinently – whether the established jurisprudence can be applied within the phenomenon of social networking sites. South African law readily protects the privacy of telephone calls or e-mails sent between parties communicating with each other, and it found a way to apply traditional privacy jurisprudence to these modes of communication. Therefore, just as telephone technology challenged the notions of privacy in the USA in 1928, online social networking websites and the internet are challenging our notions of privacy now. To rise to this challenge, South African jurisprudence will have to firstly, determine whether or not there is room for the recognition of the internet as an integral part of interpersonal relationships, in the same way that foreign jurisprudence has. Once the law has recognised the internet as integral to modern society's interpersonal relationships, along with the possibility that the boni mores is taking on a different hue, the second determination will have to be: When exactly does an internet user have a legitimate expectation of privacy in cyberspace? To assist in this determination, it would be useful to take note of the theories surrounding public and private spaces on the internet, and the fact that it is possible to demonstrate a will to keep the information private, such as when a profile is set as private.

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## Centre for Human Rights

### The impact of the Protocol on the Rights of Women in Africa on violence against women

The research, undertaken by the Gender Unit at the Centre for Human Rights, focused specifically on the provisions of the protocol dealing with violence against women in six SADC countries (Lesotho, Malawi, Namibia, South Africa, Tanzania and Zambia). In the process, a picture emerges of the laws and policies that states have adopted to bring their legal systems in line with the Women's Protocol. It has been found that, although many states have become party to the protocol and formally accepted the treaty, there is still much to be done in the way of giving effect to the treaty in national law and practice. A report on the research was published by the Pretoria University Law Press to serve as an advocacy tool.

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Prof Karin van Marle, Legal History, Comparative Law and Legal Philosophy.

## Private Law

### Wrongful arrest: a brief survey of the full impact of the Constitution in recent case law

In Wrongful arrest: a brief survey of the full impact of the Constitution in recent case law (2009, *Obiter*, 533–546), the effect of several recent court judgments on the scope of section 40(1) of the Criminal Procedure Act, 1977, is scrutinised. This subsection authorises a peace officer (including a police officer) to arrest someone without a warrant. For many years, since *Tsose v Minister of Justice* 1951 3 SA 10 (A), it was simply undisputed that such lawful arrest could be made if the peace officer intended to bring the arrestee before a court of law. The officer's bad motive was regarded as irrelevant. In several judgments since 2004, it has been held that strict application of the Tsose-rule could fly in the face of, *inter alia*, section 12 of the Constitution, 1996, which guarantees the fundamental right of freedom and security of the person. The research shows that where there are alternative ways of bringing someone before court, an arrest on the strength of the Tsose-rule alone will undoubtedly be wrongful, resulting in a civil claim against the arrestor and, in most cases, against the Minister of Safety and Security.

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## Procedural Law

### Western Cape v Killian 2008 5 BCLR 496 (SCA)

The court had to decide whether a criminal trial was unfair, to the extent of being vitiated, because the person who acted as prosecutor also interrogated the accused in an earlier



Prof Frans Viljoen, Centre for Human Rights.

statutory inquiry. The court held that it was an ad hoc issue of fact and did not compel a universal conclusion of procedural law. The researcher *inter alia* discussed the test to be applied where it is alleged that the state gained derivative non-evidentiary advantages at the trial due to an earlier inquiry. Central to this discussion is the right against self-incrimination. The researcher warned that the importance of getting at the truth in any proceedings must remain subservient to the protection of fundamental rights, otherwise our justice system is on the slippery slope towards the creation of a police state.

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### The protection of journalists' sources in South Africa

This research addresses two potential obstacles to the recognition of a journalist-confidential source privilege in South Africa. In the first instance, it evaluates concerns that source protection would amount to "press exceptionalism" (the notion that the media should receive legal protection superior to that permitted to the individual). Secondly, it considers the difficulties posed by the establishment of criteria for distinguishing a "journalist" from any other citizen. The research suggests that neither of these are insurmountable obstacles to the protection of journalists' sources and that the underlying values served by source protection should be carefully scrutinised. Such an approach would ensure that media sources are only protected to the extent that the protection amplifies those values serving democracy.

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## Comparative notes on the operation of some avoidance provisions in a cross-border context

In administering a bankrupt estate, the insolvency representative will examine possible voidable transactions in which the debtor was involved before the onset of bankruptcy to ascertain whether any of the debtor's property or assets that should be available for distribution among all creditors were disposed of improperly. In the case of a cross-border bankruptcy case, the application of national laws regulating these may differ in many respects. Therefore, they also pose difficult questions in such an instance. This research thus provides a general comparison of the law that regulates transactions entered into prior to bankruptcy in a number of jurisdictions and makes some proposals with a view to dealing with these issues.

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## The interaction between the debt relief measures in the National Credit Act 34 of 2005 and aspects of Insolvency Law

This research considers the impact of the debt relief remedies in the National Credit Act of 2005 (the NCA) on Insolvency Law in view of a recent judgement in *Ex parte Ford* [2009] JOL 23412 (WCC) where the court refused an application for voluntary surrender in view of the fact that the debtor did not first apply for debt review in terms of the NCA. It attempts to provide possible answers to the question of to what extent courts should, in insolvency proceedings, consider the concepts of over-indebtedness and reckless credit and related debt relief remedies when considering applications for voluntary surrender or compulsory sequestration.

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## Indigenous legal systems and sentencing: *S v Maluleke* 2008 1 SACR 49 (T)

In *S v Maluleke* 2008 1 SACR 49 (T), it was proposed that South Africa should consider indigenous law for alternative sentencing options, particularly where there is a need to involve the community in the healing of the victims' hurts, in the rehabilitation of offenders and in the reconciliation with those they wronged and with society at large. The court highlighted success with a similar approach in Australia. This research investigates the nature of African indigenous law, the role of an apology during criminal cases, the symbioses between indigenous law and restorative justice, and finally, the desirability of the court's proposal

regarding the revival of indigenous sentencing options. The researchers found that, instead of indigenous law, per se, it is rather the values of smaller, traditional communities that Australian courts (successfully) implement. It goes hand in hand with respect for the wisdom of "elders". It is recommended that, after proper assessment of the applicability of these values in a particular case, a similar approach be followed.

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## Legal History, Comparative Law and Legal Philosophy

### Insurance in Rome: *Martialis Epigrammaton III 52*

This research shows that the legal concepts on which insurance is based were part of Roman law. Since the scope of the stipulatio-contract was virtually unlimited, insurance transactions could be implemented by way of this contract. This hypothesis is validated by literary sources, justifying the conclusion that, in spite of the fact that the insurance contract did not form part of the Roman contracts, insurance as such was part of Roman commercial life.

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### Rights of scholars to wear religious and cultural symbols to school

The Pillay case should have ended the debate on the extent to which schools must accommodate the religious and cultural beliefs of learners. As a Constitutional Court decision, this case should have given clarity. However, it raises more questions than answers and introduces the concept of "reasonable accommodation" into the discourse. Consequently, learners have protected rights and schools must review their policy documents in order to avoid the infringement of learners' constitutional rights to express their beliefs by wearing symbols to school.

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## 6.8 Faculty of Natural and Agricultural Sciences



Prof Anton Stroh, Dean

During 2009, the Faculty of Natural and Agricultural Sciences contributed significantly to the production of high-quality, internationally recognised research publications. The more than 280 Department of Higher Education and Training units recorded constitute approximately 25% of the total publication output of the University of Pretoria. It is noteworthy that, through the faculty's research endeavours for 2009, 124 MSc and 44 PhD students graduated.

### Message from the Dean

In addition to this, the faculty experienced a significant growth in the number of researchers who are recognised internationally for their contributions. The faculty has 109 scientists who have been rated by the NRF, which is an increase of more than 20% from the previous year. Prof Nigel Bennett and Prof Brian Rand were both awarded A-ratings by the NRF in the most recent round of evaluations.

Although it is not possible to mention all the special awards of recognition received by scientists in the faculty, it is appropriate to note the following outstanding achievements: Prof John Taylor of the Department of Food Science received the University of Pretoria's Chancellor's Award for Research. He specialises in the indigenous African cereals, sorghum and millets. Two of the faculty's scientists were honoured by highly prestigious awards from the African Union (AU). Prof Pat Eriksson was the winner of the AU Continental Scientist Awards, 2009. He is an A-rated scientist and was personally congratulated by President Jacob Zuma at the prestigious award ceremony. Prof Brenda Wingfield was honoured with an AU Woman Scientist Regional Award, which recognises her great scientific achievements and contribution through science to the socio-economic development of Africa. In addition, Prof Wingfield was appointed in one of the two newly established deputy dean positions in the faculty, where her portfolio focuses on research and postgraduate studies.

Being people-centred, the faculty continuously seeks opportunities to recruit and appoint highly recognised researchers to either strengthen its existing research teams or to introduce new and relevant research foci in the faculty.

In 2009, the faculty was successful in recruiting Prof Mathieu Rouget, a young researcher, to the Department of Plant Science. Prof Rouget specialises in biodiversity conservation and climate change, and currently has an h-index of 22, which implies that at least 22 of his publications have been cited more than 22 times. The multidisciplinary nature of his work will combine ecology, geography and economics, and will address important issues such as land use and biodiversity planning, climate change and ecosystem services.

Prof Wlady Altermann was recruited as the first incumbent of the newly established Kumba Exxaro Chair in Geodynamics at UP from 1 July 2009. Prof Altermann received a B1-rating from the NRF in recognition of his stature as one of the world's leading precambrian geologists and specialists on archaean geodynamics.

In September 2009, Prof Paxie Chirwa joined UP as the incumbent of the newly established SAFCOL Chair in Forestry. Discussions are underway with the New Partnership for Africa's Development (NEPAD) and the African Network for Agriculture, Agroforestry and Natural Resources Education (ANAFE) to establish a human capital development programme for postgraduate studies on the African continent. UP will be a leading partner in this initiative.

Prof Subhabrata Chakraborti from the Department of Information Systems, Statistics and Management Science, University of Alabama, USA, was offered a position as research professor in the Department of Statistics. This position forms part of the South African Research Chairs Initiative (SARCHI) of the NRF. Prof Chakraborti has established a strong

and very productive relationship with the Department of Statistics since his first visit in 2003 under the Fulbright Scholarship Program. His research interests are mainly in the field of parametric and nonparametric statistical process control. It is envisaged that Prof Chakraborti will take up this position during 2010.

In terms of buildings and research facilities, the faculty was successful (with major support from UP's executive) in obtaining significant funds from the Department of Higher Education and Training for the construction of a new R100 million building that will form a hub for Plant Sciences at UP. This project started early in 2010 and the building will be located to the north of the existing Forestry and Agricultural Biotechnology Institute (FABI). The new facilities will not only increase the potential for further growth, but will also enhance research collaboration in the various research focus areas of plant science in a modern building with research laboratories that are dedicated to conducting innovative work in fields such as ecology, medicinal plant science, plant biotechnology and taxonomy. For example, South Africa's indigenous plants have many strategies to survive harsh environmental conditions and pathogens. Some even produce compounds to outcompete other plant species for survival. The vision of the plant scientists is to potentially transfer some of the mechanisms or genes that control these processes safely to the crops that feed us and thus increase the yields of these crops. In addition, plant scientists are studying indigenous plants with the aim of finding medicines to cure some of the serious infectious diseases that are a threat to the health of South Africans.

The new Plant Science Building will have a seminar hall to seat about 100 people and two large undergraduate laboratories, a microscopy laboratory that will seat 160 students and a biotechnology laboratory to seat 120 students. The basement will make provision for the parking of 100 vehicles and the roof will be used to accommodate a glass-covered greenhouse, where plants will be cultivated for experimental purposes.

This initiative will bring expertise from various departments together in the biological, agricultural and food sciences (Plant Science, Plant Production and Soil Science, Microbiology and Plant Pathology, Genetics, Biochemistry, and Bioinformatics) in order to work on relevant multidisciplinary projects. It is noteworthy to mention that UP is ranked 54th in the world (out of 887 institutions) by the Institute for Scientific Information (ISI) in the category Plant and Animal Science, based on the number of accredited publications, and 122nd in the world based on the number of citations. The University of Pretoria has also produced a quarter of the publications nationally in this field over the past ten years.

In addition to the new Plant Science Building, the faculty received additional funding from the Department of Higher Education and Training, which was supplemented by UP to upgrade existing research and teaching facilities. The funding will be utilised to upgrade laboratories in Chemistry (R11.6 million) and Zoology and Entomology (R15 million). An additional R15.4 million will be allocated to new equipment in physical sciences, food science and bioinformatics.

The Faculty of Natural and Agricultural Sciences at UP is one of the most diverse science faculties in South Africa. This can be attested by the broad scope of research findings that are reported in the section that follows.

Prof Anton Ströh  
Dean: Natural and Agricultural Sciences

## Biochemistry

### Institute for Cellular and Molecular Medicine

A new initiative was launched in 2009 with the establishment of the Institute for Cellular and Molecular Medicine (ICMM) at the University of Pretoria with Prof Michael Pepper as the director. It aims to establish biotechnology start-up companies from marketable research ideas in the medical and veterinary science domains arising from the three faculties of Natural and Agricultural Sciences, Health Sciences and Veterinary Science. In his inaugural lecture on 10 February 2009, entitled *An oily start towards a medical biotechnology institute*, the head of the Department of Biochemistry, Prof Jan Verschoor, announced how the institute intends to engage with this exciting new venture. The Biochemistry Department focuses on human and animal health, in particular HIV/AIDS, malaria, tuberculosis (TB) and tick-related diseases. Vaccines, diagnostics and drugs for treatment are developed using modern bioinformatics and chemical screening technologies. Plants and the relevant pathogens and host responses are investigated for clues to find improved means to manage these diseases. The department produced 13 published research papers in 2009 that addressed these topics, each testifying to extensive interdepartmental, interfaculty, interinstitutional and international networks of collaboration.

That the "early" start of the ICMM could also be dubbed "oily", derives from the nature of the first substance that is destined to be developed into marketable products in the near future. Mycolic acids are the waxy oils that envelop the mycobacteria that cause TB. The dogma that these oils merely provide a physical and chemical barrier to protect the pathogen against host biochemical onslaughts was abandoned when the UP team demonstrated (and patented) several unique biological properties of the mycolic acids from 1994 to 1999. Since 2000, in collaboration with Prof Johan Grootenhuis from the University of Gent, it has been demonstrated that the mycolic acids induce specific innate immunity, cured experimental asthma in mice, and expressed potential as a unique adjuvant for vaccines.

A major breakthrough was the discovery that mycolic acids could be used as antigen for a novel new TB diagnostic that is much more rapid than existing technologies and is not affected by co-infection with HIV. These two aspects of a TB diagnostic are essential to tame the current panic in southern Africa where HIV infection drives the TB epidemic to the world's worst. After filing in 2005, the University was granted the European patent rights for its invention of the so-called MARTI TB test in 2008. The application in the USA is pending. In 2009, a follow-up article by the

UP team and its collaborators in *Methods of Enzymology* describes how the MARTI TB test was invented as a laser-based biosensor and optimised for validation in TB reference laboratories. Another 2009 paper by the team in *Chemical Communications* was selected as a "hot article" and describes how the MARTI test can be configured for high sample-throughput using an electrochemical biosensor.

It is envisaged that UP will establish an ICMM-based start-up company in 2010 to commercialise products derived from mycolic acids research. Papers will appear on the application of chemically synthetic mycolic acids in the diagnosis of TB, stemming from a productive collaboration with Prof Mark Baird of the School of Chemistry, University of Bangor, UK. That university, together with the University of Gent and UP, has already embarked on a Wellcome Trust-supported research project to test synthetic mycolic acids-based vaccine adjuvants at the Faculty of Veterinary Science at Onderstepoort under the supervision of Dr Jannie Crafford.

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The mycolic acids research team (from left): Mr Gerrie Mostert (UP's research commercialisation expert), Prof Johan Grooten (University of Gent), Dr Jannie Crafford (Faculty of Veterinary Science) and Prof Jan Verschoor (Department of Biochemistry, Faculty of Natural and Agricultural Sciences).

## Plant Science

### Using South Africa's plant diversity to fight cancer

In a collaborative study between scientists from Japan, Egypt and UP, a novel chlorophenol, 4-chloro-2-(hepta-1,3,5-trien-1-yl)-phenol was isolated as the major phenolic compound from a cell culture of *Helichrysum aureonitens*. This plant is commonly known as one of the everlasting and is used extensively in traditional medicine to treat several diseases. The new chlorophenol is produced in low quantities by the plant under natural conditions, but the authors managed to increase its production significantly by creating tissue cultures and growing it under artificial conditions. The chlorophenol has a similar anticancer activity to some of the most potent anticancer drugs that are unfortunately very expensive. The cost of production of the novel chlorophenol in cell culture suspensions will be significantly less. The discovery of the chlorophenol also contributed to basic biosynthetic knowledge, as it proved to be the missing link in the biosynthetic pathway of other chlorinated acetylenic compounds in plants.

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### Plant hormone protects millet from disease

Pearl millet is an important staple crop in the semi-arid tropics of Africa and Asia. Its tolerance to heat and drought stress makes it an attractive alternative to other cereals that are unable to withstand climate change due to global warming. An economically important pearl millet disease is rust, which is caused by the fungus *Puccinia substriata*. Rust on the leaf surface decreases the plant's photosynthetic capacity and ultimately the crop yield. An exciting discovery made by PhD student Bridget Crampton in the Department of Plant Science was that salicylic acid, a well-known plant hormone treatment of pearl millet plants, protected these plants against subsequent attacks by the rust fungus. Microarray expression profiling, using the microarray facility of the African Centre for Gene Technologies (ACGT) at the University of Pretoria, identified candidate genes that might contribute to this resistance. Dr Crampton was awarded the bronze medal of the Southern African Association of Botanists, which is an award for the best PhD thesis in a given year. The results of this study have a practical application for farmers. Treatment of pearl millet plants with salicylic acid, or its commercial derivative Bion®, could provide a solution for farmers to improve their pearl millet yields under rust disease pressure.

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## Genetics

### Fig wasps show the way to resolve family feuds

The reading of a will can tear the most serene family apart. Families usually stand together and come up for one another, but when a will is under discussion, the strongest competition comes from one's closest relatives. Animals and plants have evolved mechanisms to reduce or even avoid direct competition with relatives, dispersal being the most important, but sometimes conflict is inevitable. Fig wasps are a fascinating exception. These inconspicuous wasps, barely 2 mm long, are famous for pollinating fig trees. They take the expression "keeping it in the family" to the extreme. A single mother lays all her eggs in one fig and her offspring mate exclusively with one another. Clearly, this incestuous lifestyle creates some problems. Most people would assume that the dangers of inbreeding would eliminate the species. However, Prof Jaco Greeff and his research team found that the wasps show very limited detrimental effects from inbreeding. Far more startling is how the competition pans out. The biggest competition is between the adult wasp's sons, because they compete with each other to mate with their sisters. The mother alleviates some of this competition by producing very few sons (10%) – just enough to fertilize all the sisters. In species where mothers fail to control competition and produce too many males (> 20%), evolution has shaped the sons' behaviour instead. In some species, some males will expose themselves to great risks (being dragged off by ants 100 times their own size) to search for females "abroad". In some species, males have evolved formidable fighting machinery and massive jaws to eliminate their toughest competitors – their brothers.

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### African horse sickness virus genes exchanged

Dr Vida van Staden's research group has generated a set of novel "reassortant" strains of African horse sickness virus (AHSV), which could help clarify the contribution of specific virus proteins to disease symptoms. This virus is endemic to southern Africa, and is a serious threat to the horse industry, as regular outbreaks occur despite the availability of a vaccine. The symptoms of African horse sickness can range from a mild fever to severe breathing problems and death, depending on the virulence of the virus. Because the viral genes occur on discrete segments of nucleic acid, one can infect cells with two different parent strains of the virus, and obtain progeny viruses with a random mixture of the parental genes. Using this approach, the group generated a panel of reassortant progeny viruses, and assayed them for their effect on infected cells. This enabled them to identify specific genes, and the proteins they encode, which play a role in virus release, membrane permeability and the cytopathic effect of the virus on the host cell.

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## Microbiology and Plant Pathology

### Phytobacteriology

Over the past five years, the Department of Microbiology and Plant Pathology has established a research group that focuses on the bacterial pathogens of plants. This includes pathogens of importance to both the agricultural and forestry sectors in South Africa. The pathogen that has received the most attention so far is *Pantoea ananatis*. It is not only a pathogen that is found on a wide range of plants, but has also been implicated in opportunistic human infections. It is frequently isolated from different environmental sources, such as the plant environment and insects and has an extraordinary ability to survive in a multitude of environmental niches, under a variety of conditions, and to cause cross-kingdom infections. The research has primarily centred on developing reliable methods of identifying *Pantoea* species and attempting to understand their ability to infect the host and survive in its absence.

In order to distinguish between the *Pantoea* species, two approaches were developed: fluorescent amplified fragment length polymorphisms (f-AFLPs) and multilocus sequence analysis (MLSA). These techniques have allowed the researchers to move species incorrectly placed in the genus *Pantoea* and *Pectobacterium* to *Tatumella* and *Pantoea* respectively. They have also described one new *Tatumella* species, as well as 11 *Pantoea* species. Most of these species are plant-associated, although clinical strains were also identified.

In 2006, Inqaba Biotech, using 454 technology, sequenced the genome of a virulent strain of *P. ananatis* isolated from Eucalyptus. This was the first plant pathogen to be sequenced in Africa. The genome has now been assembled and annotated, and compared to the genomes of closely related species. The pathogen shares various virulence and survival factors that are associated only with either plant pathogens, bacteria associated with insect hosts or human and animal pathogens. The genome sequence of *P. ananatis* thus gives an indication of an organism that is well adapted to survival in a wide range of environments and that is capable of causing disease symptoms in a number of hosts.

In the Potato Pathology Programme, Dr Jacquie van der Waals has been investigating the etiology, spread and virulence of *Pectobacterium* and *Dickeya* species in potatoes in South Africa. One of the most important findings is the first report of *Pectobacterium carotovorum* ssp. *Brasiliensis*, which causes blackleg in potatoes in South Africa. This pathogen appears to be the most important causal agent of blackleg in the country. The disease poses a major potential threat to the South African potato industry, especially in terms of seed exports, tuber quality and yield.

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Prof Louis Nel, Microbiology and Plant Pathology.

## Pine disease spreads to the Eastern Cape

The first report of pitch canker on mature pines in South Africa was from the Tokai plantations in the Western Cape. More recently, this devastating pathogen has been observed in the Eastern Cape. Until recently, the pathogen that causes this disease, *Fusarium circinatum*, has been restricted to pine seedling nurseries. The occurrence of *F. circinatum* on mature pine trees is of great concern. It has thus become more crucial for all forestry companies to prioritise the screening and selection of trees that are tolerant or resistant to infection by this pathogen. This will be the only sure means of avoiding dramatic losses in the longer term.

The importance of this disease has also necessitated more research into the pathogen *F. circinatum*. In a recent initiative, the genome of this pathogen has been sequenced and researchers in the departments of Microbiology, Plant Pathology and Genetics are actively characterising this genome.

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## Lyssavirus laboratory

This virology group in the Department of Microbiology and Plant Pathology has gained wide national and international recognition. Among others, the laboratory has a longstanding collaboration with the Centres for Disease Control and Prevention (CDC) in Atlanta, USA. One interesting example of this collaboration is found in field research in Kenya, primarily aimed at rabies and rabies-related virus discovery in bat species (collectively

known as lyssaviruses). This research is crucial to the elucidation of the evolution and epidemiology of these important viruses in Africa and has led to several new isolations of known lyssaviruses, a filovirus isolate (Ebola family) and the identification of several other emerging viruses from bats in Kenya.

In 2009, Dr Wanda Markotter was a member of the field research team that discovered a novel lyssavirus in Kenya, named the Shimoni bat virus (SHIBV). The new virus, clearly a new species, based on subsequent genetic characterisation, was the first virus to be isolated from a Commerson's leaf-nosed bat. This is the first new lyssavirus species in Africa that was described since the isolation of Duvenhage virus in 1970. The demonstration of unique African lyssavirus cycles has far-reaching implications for research into vaccines, diagnostic procedures, viral evolution, epidemiology and host/viral ecology.

In 2009, Prof Louis Nel was a member of the World Health Organisation Expert Advisory Panel on rabies and related zoonoses (Switzerland and France, 2009). He was a scientific advisor to the African Rabies Expert Bureau (Senegal 2009) and a scientific assessor of the European Union programme, RABMEDCONTROL (Tunisia and Spain, 2009). Over the past three years, he has championed the cause of South Africa as a potential demonstration site for the elimination of rabies – with specific focus on KwaZulu-Natal, where dog rabies is endemic. The proposal was largely based on the extensive research data this UP laboratory and its collaborators have produced in recent years. In 2009, this proposal was chosen together with two other global proposals for rabies eradication and collectively awarded \$10 million from the Bill and Melinda Gates Foundation.

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## Zoology and Entomology

### Beetle research at the edge

Prof Clarke Scholtz and two members of his research group, Adrian Davis and Ute Kryger, published a definitive work on dung beetle evolution and conservation, evolutionary biology and conservation of dung beetles in the past year. This was a synthesis of the authors' combined total of about 80 years of research experience on dung beetles, and was based largely on the 200-odd papers they have jointly published on dung beetles, or those published with other leading international collaborators.

One of the exciting research projects that this research group is currently tackling is a study of the Cape high mountain stag beetles of the genus *Colophon*. These beetles are perceived to be very rare, but their presence on only the highest peaks of the Cape fold mountains under favourable climatic conditions for only the mid-summer months has contributed to this perception. As a result of their perceived rarity, they are highly prized by beetle collectors worldwide, changing hands for up to R100 000 each, which is, gram for gram, much more expensive than rhino horn or ivory. Conservation authorities have consequently listed them on the listed species database of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), which places them in conservation categories similar to that of elephant and rhino, and, consequently, all collection of and trade in these beetles are illegal. The UP researchers have special permits to undertake research on these beetles. This takes them, mostly on foot, to the highest peaks in the mountains with some of the most rugged and inhospitable, but spectacularly beautiful terrain imaginable. The results so far have been mixed, with limited success on some mountains and none on many others, but beetle researchers remain optimistic that the next time the results will be better.

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### Mole rats benefit from being social

In 2009, Prof Nigel Bennett, Dr Marna Costanzo and Dr Heike Lutermann set out to investigate spatial learning and memory in two species of subterranean African mole rats that occupy extensive underground burrow systems. The Cape mole rat is a solitary species that generally has a simple burrow system with a geometric configuration considerably less complex than that of the Damaraland mole rat. The latter is a highly social species and occurs in colonies of up to 40 individuals.

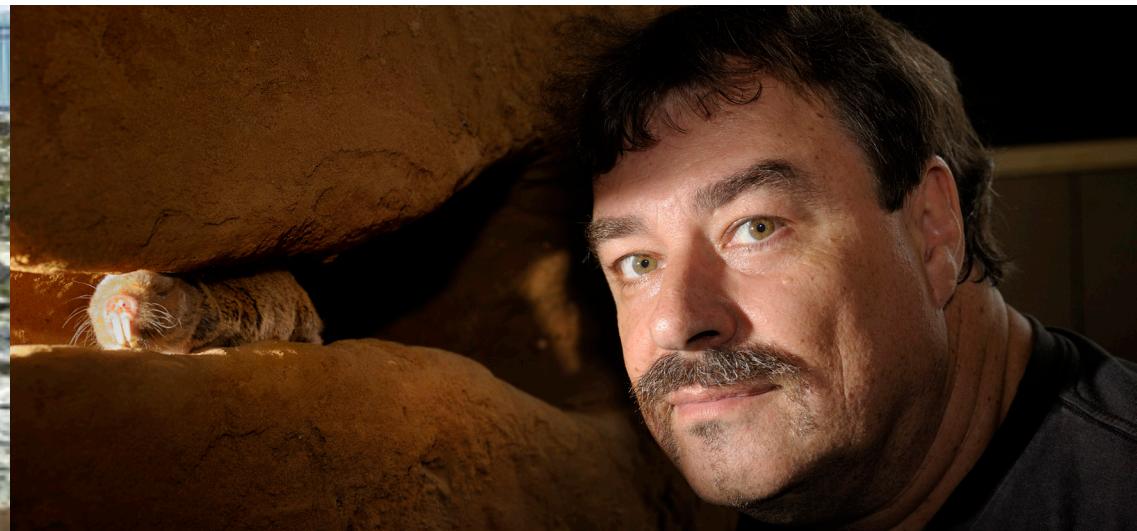
In subterranean rodents, the complexity of the geometry of the burrow system varies both with the degree of sociality and – interestingly – with the sex of the animal. The researchers set out to determine if social species have superior abilities in spatial learning and memory compared to their solitary counterparts when navigating a complex maze. They further set out to investigate if there was a sex bias in spatial learning and memory.

Using an artificially designed maze system with a food reward at the end, the researchers demonstrated that there was no marked difference in learning and memory retention with respect to sex. In accordance with their hypothesis, marked differences between the species were apparent during both learning and memory trials, with the members of the social species performing better. These findings suggest that individuals of social species may possess an enlarged hippocampus that facilitate the learning ability and the memory of the extensive labyrinth of tunnels that these animals call home.

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Below left: Prof Clarke Scholtz and colleagues.

Below: Prof Nigel Bennett, Zoology and Entomology.



## Mammal Research Institute

### The value of friendship

In many species, females form strong social bonds with other females. In the case of female horses, such relationships have adaptive value: mares that form close social bonds with other mares have improved pregnancy, foal birth and foal survival rates, according to a study published in the Proceedings of the National Academy of Sciences by Prof Elissa Cameron. Their enhanced reproductive success appears to be linked primarily to mutual protection from harassment by stallions.

Studies in humans have shown that women with stronger friendships are healthier and have healthier babies. Similarly, previous studies on baboons have shown that strong social bonds enhance reproductive success. However, the value of close social bonds has previously only been shown between close relatives, but unlike most other mammal groups, mares form these tight bonds between unrelated females. In these horses, which live wild in the Kaimanawa mountains on the North Island of New Zealand, mares with the weakest social bonds had about half as many foals as those with stronger social bonds. Since these mares are not related, the value of friendship transcends the value of social relationships with relatives, suggesting that friendship is an evolutionary strategy.

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## Mathematics and Applied Mathematics

### Interlacing zeros of linear combinations of orthogonal polynomials

Special functions play a significant role in mathematical physics, especially in boundary value problems. Usually a function is called "special" when, like the logarithm, the exponential and trigonometric functions, it belongs to the toolbox of the applied mathematician, the physicist or the engineer. The function usually has a particular notation and a number of properties of the function are known.

Certain special functions have interesting properties where they vanish or become zero. One well-known property of the zeros of orthogonal polynomials is that in between any two zeros of the one polynomial there is exactly one zero of the next polynomial in the sequence. This is known as the interlacing of the zeros and is useful in many contexts, most notably numerical quadrature.

Collaborative research with Prof Kathy Driver of the University of Cape Town and Dr Norbert Mbuyi has examined conditions under which the zeros of combinations of the simplest and most useful orthogonal polynomials retain this interlacing property.

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### Pricing of exotic energy derivatives based on arithmetic spot models

This work provides valuation formulae of financial instruments called derivatives traded in large volumes in the energy markets. The class of spread contracts (spread between two refined energy products) is huge, including important examples like the spark and dark spread. The spark spread is the difference between spot electricity and gas, whereas "dark" refers to the difference between electricity and coal. This research analyses the pricing of options for a class of arithmetic spot price models.

The price dynamics in typical energy markets possesses several specific features that must be accounted for in modelling, and which complicate the valuation of financial derivatives. Prices may show a strong seasonal influence, for instance, because of a high demand for electricity or gas for heating in the winter. The prices are mean-reverting, but with significant spikes occurring, possibly seasonally. These spikes could occur in electricity markets due to a sudden drop in temperature not matched by sufficient production volume, or an unexpected failure of a power plant. To get reliable prices on derivatives, one needs to have accessible spot price models that incorporate these features of energy prices.

The researchers considered an arithmetic model for the spot price dynamics of an energy, which was proposed by Prof Fred Benth, Prof Jan Kallsen and Dr Thilo Meyer-Brandis in 2007, and which includes seasonality of prices, mean-reversion at different speeds and seasonal spikes. These researchers derived analytical prices for energy forwards, along with expressions for the price of call, and put options on these forwards.

The analysis done by the researchers was generalised in this research project to cover average-type options and spread contracts of various kinds. It turns out that this spot price model is very flexible, and easily computable expressions come out for these derivatives. This is a direct consequence of the arithmetic nature of the underlying spot price process that was chosen.

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## Geology

### An indivisible trio: geology, biology and atmosphere

In a paper published in 2009, Prof Eriksson and his co-authors (including Prof Hannes Rautenbach, head of the Department of Geography, Geoinformatics and Meteorology) were able to demonstrate that physically formed features in the Transvaal sedimentary succession challenge assertions about the Great Oxidation based on geochemical data, and suggest that this event might rather reflect unusual conditions in the formation and breakup of Precambrian supercontinents (containing a set of cratons, such as Kaapvaal), rather than aberrations in palaeo-atmospheric compositions.

Further research with Prof Wlandy Altermann focused on the interpretation of microbial remains in 2.5 to 2.6 billion-year-old carbonate rocks of the Transvaal succession, in a joint project between UP and the Polish Academy of Sciences in Warsaw. A recent publication on mass production of carbonate rocks by cyanobacteria has received much international attention.

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## Aon Benfield Natural Hazard Centre, Africa

### Seismotectonic models for South Africa

In a recent paper of fundamental importance for hazard management, a first systematic attempt was made to build a seismogenic model of South African seismic zones. In general, knowledge of a seismotectonic model is crucial for understanding the origins of seismicity and for constructing reliable seismic hazard maps. To date, no such study has been done for South Africa. This work forms part of a critical step to bring together digitally several datasets in a common geographic information system (GIS) platform (geology, geophysics, stress, seismicity, neotectonics, topography, crustal and mantle structure and anisotropy), to understand the significance of datasets for seismotectonic zonation and the limitations of these datasets, and to obtain a reasonable regional model for use in seismic hazard assessments. Knowledge of these seismic zones is important for understanding the origins of seismicity in South Africa and for building more accurate seismic hazard maps.

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## Chemistry

### Rapid detection of amphetamines

Amphetamine and related derivatives are widely abused central nervous system stimulants. It is not enough to detect certain derivatives, such as methcathinone ("Cat") in the urine of suspected abusers by commonly available preliminary immunoassay testing. The use of legal over-the-counter medication is well known to be a cause of false positive preliminary drug testing results. Multi-analyte confirmations for amphetamine derivatives are therefore required. However, traditional analytical methods necessitate lengthy procedures with prolonged sample turnaround times. A short turnaround time is of prime importance in the case of persons held in custody and for other clinical and forensic toxicology applications, like workplace drug testing.

A validated rapid GC-MS assay for urinary confirmation of nine of the most commonly used amphetamine derivatives, including methamphetamine ("Tik") and methcathinone, has been reported by Dr Johannes Laurens and Mr Adriaan Marais of the Department of Chemistry. The method entailed *in situ* derivatisation of urine samples by extractive acylation, followed by a rapid chromatographic separation and mass spectrometric detection. All nine amphetamine derivatives were separated in less than three minutes and quantified simultaneously by selected-ion monitoring using stable isotope substituted internal standards. The total instrument cycle time is six minutes per sample, allowing 200 confirmatory analyses per day on one instrument. The limits of detection, precision and accuracy are acceptable for forensic court evidence. This method has been employed successfully since 2008 for the amphetamine derivative confirmations in urine in the Forensic Toxicology Laboratory of the Department of Chemistry.

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### School leavers' abilities to master first-year Chemistry

At the start of 2009, the first group of students who were taught exclusively according to outcomes-based education and the new curricula for science and mathematics in public schools entered tertiary education. Over the past seven years, Prof Marietjie Potgieter conducted a research project to monitor the proficiencies of first-year Chemistry students upon entry to tertiary education. This project enabled the Department of Chemistry to do a rigorous assessment of the shifts that occurred in the preparedness of students following the extensive revision of secondary education. The mismatch between the Grade 12 performance rating scales used in the former dispensation and those used in the current National Senior Certificate was quantified. The study showed that while content topics explicitly taught and assessed in Grade 12 were mastered to a similar extent as before,

students were significantly less well prepared in terms of the development of skills such as mathematical competency and logical reasoning. A number of basic concepts such as acids and bases and the mole concept were also poorly mastered. These results were widely communicated to chemistry lecturers at South African universities, as well as to the Department of Higher Education and Training, so that deficiencies could be addressed in a constructive manner.

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## Physics

### Theoretical studies of carbon-based materials

Carbon exhibits a variety of interesting structural and electronic systems because of its propensity to form both sp<sub>2</sub> and sp<sub>3</sub> bonds. This gives rise to a range of interesting magnetic, transportation and physical properties for carbon and carbon-based materials – especially nanoscaled materials – with a wide range of both established and potentially new applications involving a multitude of structural systems such as nanotubes, graphite, buckyballs and, lately, graphene.

Prof Nithaya Chetty of the Department of Physics is engaged in a research programme involving the theoretical and computational studies of carbon and carbon-based materials. His research expertise is in the field of the theoretical and computational studies of solid-state systems within the framework of density functional theory, which is a quantum mechanical method to study the electronic properties of solids. Today, with the advent of modern, faster computers with larger memories, and also with the development of faster computational algorithms to solve the relevant equations more efficiently, calculations can be performed locally and cheaply, rather than having to rely on massive supercomputers, which was the case a decade ago. This, together with faster networking and the availability of open source and freeware software, has made the field of computational studies of materials a fast-developing research activity in South Africa, and a burgeoning field at the University of Pretoria.

The advent of graphene in 2004 has excited much interest in these unique two-dimensional systems because of the enormous potential that graphene has for novel applications. These systems also give theoreticians an opportunity to explore novel methods for modelling them because of their ideal two-dimensional nature. Graphene, which may be considered to be a single layer of graphite, is a semi-metal with a unique electronic structure. The low-energy electronic excitations are massless, which results in ballistic electronic transport. A great effort recently has been centred on altering the electronic structure of graphene using various dopants. This research, together with the work of master's student Edwin Mapasha,

involves studies of lithium on graphene. The attachment of lithium on this material holds promise for lithium energy storage devices. Lithium on graphene has been studied by several previous authors, and the researcher is extending this study to newer configurations to give more detailed structural and electronic results that have not previously been considered. He is also testing the results against different approximations to the exchange-correlation potential, which is an essential construct in his computations.

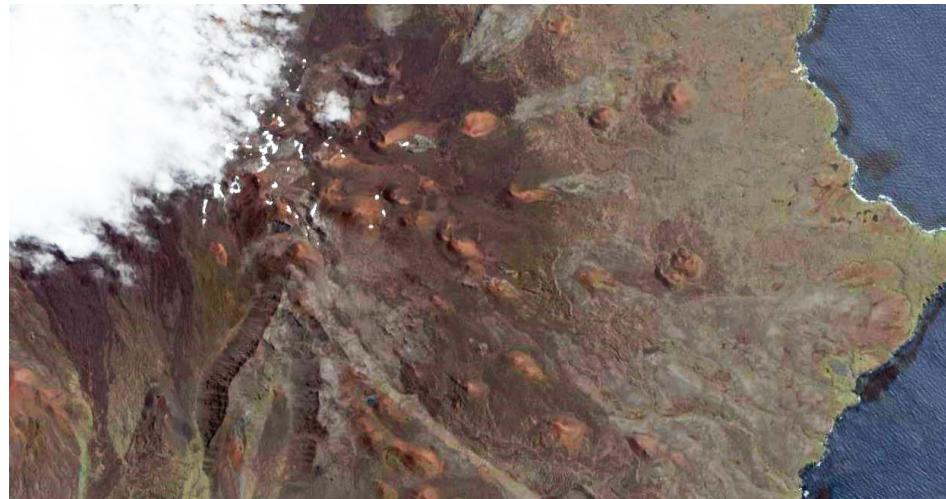
Together with PhD student Richard Andrew and Prof Max Braun of the Faculty of Education, he is exploring the elastic properties of alloys of carbon with silicon. Alloys of these elements only appear to exist at 1:1 mixing, low concentrations of impurities of C in Si, or low concentrations of Si in C. It appears that higher levels of doping are not possible, or have not yet been realised in the laboratory. This research project entails exploring the crystalline stability and physical and electronic properties of alloys involving C with Si that cover the entire range of alloy mixing, and focuses on predicting the properties of these systems. The great advantage of being able to do computational “experiments” is that one is able to consider material systems that have not been realised experimentally before, and, in doing so, one has the technology to predict the properties of systems that are yet to be discovered.

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### The volcanic rocks on Marion Island: a model for hematite formation on Mars?

Sub-Antarctic Marion Island is located in the Southern Indian Ocean, approximately halfway between South Africa and Antarctica. The island was first discovered in 1663 and was annexed by South Africa in 1947. Since then, South Africa has been maintaining a permanent weather and research station on the island. Recently scientists from the Department of Physics analysed the volcanic rocks on Marion Island using Raman spectroscopy. Hematite (red iron oxide) was identified as the colouring agent responsible for the red colour of the scoriae cones that can be seen from space. Hematite was also identified as a thin layer that covers glassy phases in the volcanic rock. This hematite appears grey and supports studies proposing volcanic activity as an alternative mechanism for grey hematite formation on Mars.

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Google-Earth picture of Marion Island showing the many red scoriae cones.

## Ergodic theory of quantum dynamical systems

A collaborative research programme between the Department of Physics and the Department of Mathematics and Applied Mathematics focuses on the mathematical structure of quantum dynamical systems. In particular, the long-term behaviour (so-called ergodic theory) of such systems is studied by means of mathematical objects known as "operator algebras", and more generally by the techniques of functional analysis. The basic physical motivation is quantum statistical mechanics. The goal of the work is to identify general structures that are present in wide classes of quantum dynamical systems, and that can be used to analyse these systems mathematically. In the most recent and ongoing work, the focus is especially on how a given system's properties can be classified by considering subsystems of it, as well as by investigating in which ways the system can be combined with other systems to give larger systems (roughly put, by viewing the given system as a subsystem of larger systems). Subsequently, this work has been used in a substantial paper of a recent Fields Medallist, Prof Terrance Tao, and his co-workers at the University of California, Los Angeles.

The idea is to extend classical multiple ergodic theories to quantum dynamical systems with the aim of understanding the recurrence properties of such systems. Classical recurrence theorems were used by Tao and Green to prove the famous Green-Tao theorem in number theory, which states that the set of prime numbers contains arbitrarily long arithmetic progressions.

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## Agricultural Economics, Extension and Rural Development

### Institutional economics perspectives on Africa's agricultural development

The new institutional economics (NIE), as an important and growing school of thought in Economics, questions the basic assumptions of neoclassical and mainstream economics. The specific focus and contribution of NIE arise from its recognition, firstly, that economic actors face a particular problem as a result of imperfect information about the behaviour of other actors in transactions and, secondly, that institutions play an important role in addressing these problems. This recognition demands explicit attention to the ways in which actors and societies address problems arising from imperfect information in transactions. This school of thought of the economics discipline provides a useful framework for studying the problems of agricultural development in Africa.

It is in this context that Prof Johann Kirsten recently completed a book on the applications of new institutional economics in agricultural development. The book, *Institutional economics perspectives on Africa's agricultural development*, represents an effort to consolidate lessons learnt from applying an "institutional lens" to the agricultural development challenges of Africa. It presents a framework for thinking about the institutional challenges facing African agriculture, as well as the tools of economics analysis that can be used to address them. The combination of theoretical chapters on core themes, supported by case studies from a wide range of countries, makes an important contribution to existing literature, with an accessible synthesis of new institutional economics theory and research around the theme of understanding and improving African agriculture.

The focus throughout is on sub-Saharan Africa (especially eastern and southern Africa), and on policies and institutions affecting smallholder agriculture, which reflect their predominance. The book's focus on institutional issues is not at the expense of related and essential complements to institutional change, such as infrastructural development or technical change. Explicit attention to institutions is warranted, however, for two reasons. Firstly, there has been too little analysis of institutional processes and constraints in agricultural development in the past. Secondly, institutional change is often a prerequisite for effective investment in infrastructural and technical change.

The book addresses a number of policy issues that are highly relevant to African agriculture. The current juxtaposition of market challenges in smallholder African food systems and in global commodity and financial systems demands more nuanced understanding of the functioning of markets for different commodities and services in different political, cultural and economic situations. The material in this volume provides essential skills for development practitioners, policy makers and graduate students working, or intending to work, in these fields.

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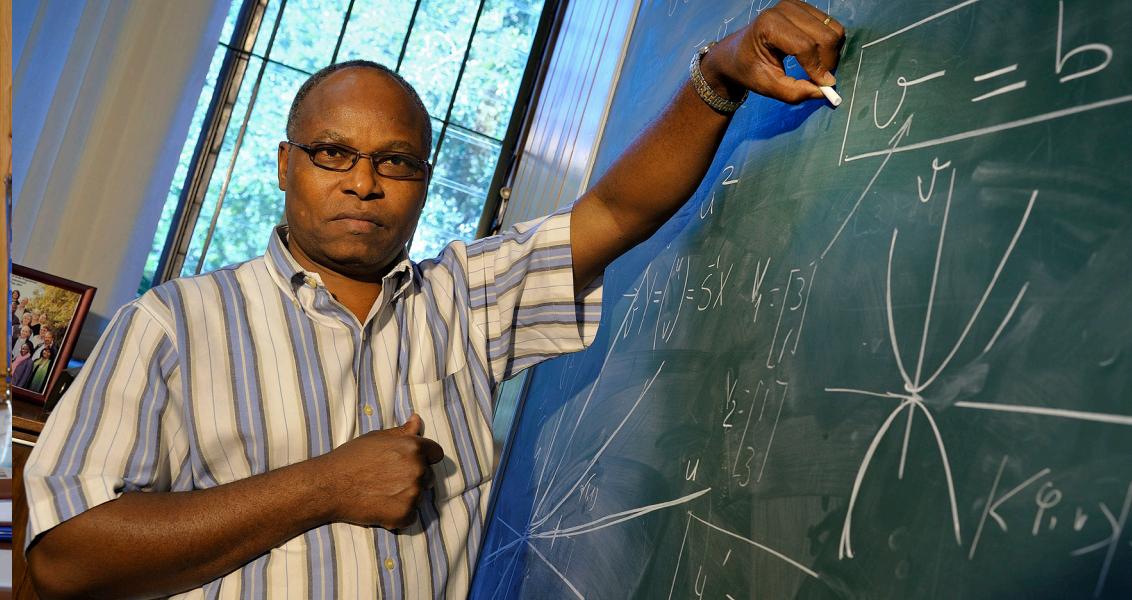


Prof Johann Kirsten, Agricultural Economics, Extension and Rural Development.

### The economic impact of climate change on crop production

This research followed an economic impact assessment approach that captures farmer adaptations to varying environmental factors to analyse the impact of climate change on crop farming in Ethiopia, based on data from farm households in different agroecological zones of the country. The seasonal marginal impact analysis indicates that marginally increasing temperatures during summer and winter would significantly reduce crop net revenue per hectare, whereas marginally increasing precipitation during spring would significantly increase net crop revenue per hectare. Moreover, the net crop revenue impact of predicted climate scenarios from three climate circulation models (CGM2, HaDCM3 and PCM) for the years 2050 and 2100 showed that reduction in net revenue per hectare by the year 2100 would be more than the reduction by the year 2050, indicating that the damage that climate change would cause would increase with time unless this negative impact is abated through adaptation. Additionally, results show that the net revenue impact of climate change is not uniformly distributed across the different agroecological zones of Ethiopia.

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Prof Jean Lubuma, Mathematics and Applied Mathematics.

### Food Science

#### Exploitation of kafirin, the protein from sorghum

Scientists from the Department of Food Science have developed a process for the preparation of protein bioplastic microspheres. The microspheres made by this process are small (1-10 µm), mainly spherical particles, with internal holes or vacuoles, resulting in a very large surface area. They have many potential and diverse applications in the food, biomedical and pharmaceutical industries. For example, microspheres made by this method can be used for encapsulation, as a method to deliver dietary antioxidants by controlled release. Between 50 and 70% total antioxidant activity was released under simulated gastric conditions over a period of four hours, when model polyphenolic antioxidants were encapsulated in these sorghum protein microspheres. Another application of these microspheres is to make very thin, edible, bioplastic films, which resemble commercial cling film. These biodegradable films are relatively strong, but not very extensible, and have good water barrier properties. This work has been reported in a series of three papers in international peer-reviewed journals and is the subject of a PCT patent application.

A sorghum protein-based edible coating has been shown to extend the shelf life and maintain the quality of export quality avocados by up to seven days once ripened. The coating is a good gas barrier and helps to decrease the respiration rate and ethylene production of the avocados. The coating also extends the period required to reach eat-ripeness by one week. South Africa is one of the world's major exporters of avocados and, as such, avocados generate a considerable income in foreign exchange.

Avocados are exported in a physiologically mature state, but they are not yet edible, as they are unripe. On ripening, the shelf life of the avocado is very short. The fruit are prone to physical damage and are subject to browning and softening, which is unacceptable to consumers and leads to large financial losses. These losses can now be reduced by using this sorghum protein-based edible coating. The intellectual property of this project is protected under a joint PCT application with the CSIR and is the subject of an Innovation Fund application to commercialise the process.

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## Animal and Wildlife Science

### Animal Production Physiology and Meat Science

The research focus in animal production physiology is on the reproduction, growth and development of domesticated, aquatic and wild animals, as well as the quality attributes of the carcass, meat, milk, eggs, wool and fibres. This encompasses a considerable part of the production cycle, notably from conception to consumption or utilisation. A basic systems approach is followed to understand the physiological principles of animal adaptation, growth, reproduction and the related effects on carcass and meat quality. The challenges are numerous, but most relate to the interactions between genetic, nutritional and other environmental factors, such as temperature and humidity, on the ability of animals to maintain homeostasis, while at the same time maintaining a high level of production and reproduction. The research in the Department of Animal and Wildlife Science culminated in an invited paper by Prof Edward Webb at the 2008 International Conference on Animal Production on the physiological limits of selecting livestock for growth and efficiency. The paper highlighted the fine balance between selecting for growth and efficiency and the increasing risks of anatomical and physiological defects, as well as associated effects on product quality. It is apparent that an in-depth understanding of the physiology of livestock will become increasingly important in managing intensive livestock production systems.

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### Ruminant nutrition and management

The ruminant nutrition programme focuses on the effect of different feed additive and nutrient supplementation strategies on the productivity of ruminants and the establishment of productive rangeland with high-yielding fodder shrubs.

Despite a wealth of knowledge concerning ruminant nutrition internationally, the considerable variability in animal performance observed in practice accentuates the need for a more comprehensive understanding of the nutritive value of veld under specific climatic conditions. Research also focuses on understanding the biology of the transition cow (time period before and after calving) and the development and evaluation of feed additives that could reduce the incidence of metabolic disorders, and increase productivity. The validation and improvement of existing prediction models such as the CPM Dairy and the CNCPS Sheep are another focus area. On the feedlot side, the focus is on investigating more natural alternatives for ionophores and antibiotics, such as yeast cultures and organic acids. A further study investigates the ensiling potential of maize distiller's grains and its potential in a sheep feedlot diet.

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### Problematic groundwater quality constituents

Investigations into the quality of groundwater used by rural communities throughout South Africa, funded by the national Department of Agriculture and the Water Research Commission, revealed bromide (Br) as one of the potentially problematic water quality constituents (WQCs) that occur at levels exceeding the recommended guidelines. These WQCs pose a risk as potentially hazardous chemical constituents (PHCCs) that can affect an animal's physiology negatively, and, through bioaccumulation in tissues, can become a biohazard to consumers. Studies on Br occurring in groundwater confirmed the risk of ingesting this PHCC through drinking water, and the potential of a significant accumulation of Br in tissues. However, two alleviating treatments were quantified. The controlled treatment of drinking water by adding total dissolved solids (TDS) has the potential of reducing the risk of accumulating Br and treatment with iodide (I) had a significant ameliorating effect on reducing the toxicity of Br. Research on the fitness of use of groundwater is continuing in order to develop further effective means of managing WQCs and PHCCs, thereby reducing risks to both animals and humans that depend on groundwater.

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## 6.9 Theology



The Faculty of Theology strives to make the University's vision and mission its own. Therefore, the faculty has a strategy in place to ensure that the mission gains stature through men and women who clearly reflect the envisaged profile of the University.

### Message from the Dean

Prof Johan Buitendag, Dean

By its nature, the faculty is involved in people-centred activities and all the programmes of the faculty have been specifically constructed to contribute meaningfully to the development of people. The training of ministers in religion, including sensitising students to the world view and religious affinity of other people, is an important part of this undertaking. Last year, the faculty completed the degree structure and corresponding curriculum regulations decreed by the Higher Education Qualifications Framework. In 2010, the first year of this curriculum will be implemented and new study guides associated with this part of the faculty's programmes will be developed.

The Faculty of Theology is the largest residential faculty of its kind in South Africa. Lecturers in the faculty hail from diverse denominational backgrounds and provide training for the ministry in various churches, both locally and abroad. The renewed curriculum of the faculty, coupled with a staff complement from a range of backgrounds, will help to chart a course for the faculty that meets the challenge of placing transformation high on the agenda for the faculty.

Theology, like philosophy, has a privileged position in the academic environment. This discipline serves as a cohesive field of study in the social and even the natural sciences. The Faculty of Theology aims to foster this interdisciplinary spirit in its official research focus areas, which include biblical tradition as a basis for theology, the systematic and historic formulation of the Christian message in traditional and present-day contexts, and the practical application of theology in relevant communities.

There is a steady growth in research outputs through the two accredited academic journals of the faculty, *Verbum et Ecclesia* and *HTS Theological/Theologiese Studies*, which is ISI

accredited. The faculty is the largest contributor per capita to the research output of the University of Pretoria. The weighted average article output per academic in the Faculty of Theology is 5.55, compared to 0.67 units for the rest of the University.

Through focused, well-planned and carefully monitored strategies, the faculty maintains an exemplary research record in its research areas. However, the faculty aims to remain an international leader in the discipline of theology. Thus, a meta-theological research programme is being established in the faculty, which aims to investigate the international status of theology as an academic discipline in keeping with recent trends in the development of epistemology and the theory of science.

The programmes offered by the faculty are well managed and responsibly controlled. The annual courses in research methodology are well attended and the faculty is convinced that this will undergird its research output in future.

Subsidies have been received for 130 journal articles and 17 books, chapters in books and conference proceedings. The faculty also excels in its number of NRF-rated researchers. It still boasts with 25% of its academic staff being NRF-rated researchers and aims to increase this to 28% in the foreseeable future. Prof Johannes Van Oort has now been placed in the A category at the A2 level in the NRF rating system. This is the first A-rating for this faculty and is unsurpassed by the traditional theological faculties in the country. Other rated staff members are Prof Dirk Human, Prof Andries van Aarde, Prof Jan van der Watt and Prof Hennie Pieterse.

As a consequence of its research stature, a large number of international scholars have visited the faculty and are part of its research programmes. The results of these meetings

have been published by respected international publishers, for example Mohr Siebeck, De Gruyter, T & T Clark, Brill Boekencentrum and Peters.

As is the case in many faculties, postgraduate enrolments are unfortunately declining. The faculty views this as an opportunity to further improve its postgraduate student recruitment strategies and aims to increase postgraduate enrolment by 1% per annum for the next three years.

Strategic measures that are to be pursued in this regard include the implementation of different and market-related programmes and encouragement of research-related master's degrees, the identification of talented master's students and encouraging them to enrol for doctoral programmes, and encouraging alumni to "advertise" courses.

In the year under review, the Department of Dogmatics and Christian Ethics focused on research in Christian natural theology, exciting interdisciplinary dialogue between natural sciences and systematic theology and the prospects of a Christian ethics of responsibility and its application to public discourse in the democratic South Africa. A contribution is made in the department to revisit natural theology and transform it to a theology of nature. It puts theology in the public sphere and opens it up for a broad and inclusive understanding of reality.

The Department of Old Testament Studies has been involved in contributing to and co-editing an internationally published volume of collected papers that was presented at the 50th anniversary of the Old Testament Society in South Africa, entitled *Exile and suffering*. The so-called Story of the Fall, as recounted in Genesis 2–3, was investigated and an alternative approach to the traditional Christian one of "sin" is being suggested.

The Department of New Testament Studies focused its research efforts on the abiding concern that the faculty needs to equip church leaders to be agents of moral regeneration in times of moral crisis. Research in this department has recently explored issues of ethics and morality in a changing, modern, democratic and pluralistic society. The point of departure in this research is that early Christianity embodied a new idiom of morality that inspired many in the Roman world and beyond. Early Christian morality was formed and adapted from older traditions of moral discourse, but it radically transformed the society of its day with respect to issues of slavery, inequality, love and compassion.

In its research, the Department of Practical Theology addressed, among other things, the topics of HIV and AIDS, water as a resource in poor communities and the task of the church and grounded theory research in homiletics. The latter topic has been applied to a research programme in the faculty, namely, *Grounded theory research of sermons on Matthew 25:31–46*. This research unites the Reformed and Dutch Reformed preachers on important issues relating to poverty and the poor.

The Centre for Public Theology is continuing with a research project entitled *The public role of churches in the democratic South Africa*, which is running for a three-year period (January 2009 to December 2011), while the Department of Science of Religion and Missiology continued research

on reconciliation and was invited to participate in the work of the Canadian School of Peacebuilding. This school provides a forum for practitioners, students and scholars from diverse religious and cultural backgrounds around the world to gather and deepen their practices of peacebuilding.

Research and Development for the Prevention of Poverty/Navoring en Ontwikkeling vir die Voorkoming van Armoede (NOVA) and the Institute for Missiological and Ecumenical Research (IMER) are continuing with the People's Power Project (PPP). The initial aim of this project was to determine the feasibility of a project to reduce domestic electricity use through behaviour change. The project team unites staff and students from the University of Pretoria, as well as church and industry representatives from South Africa and abroad. The project is funded by Imtech, the ICCO-Kerk in Actie (Church in Action) partnership and the South African-Netherlands Research Programme on Alternatives in Development (SANPAD). Initial research suggests that some households are saving up to 20% of the energy used in their homes, solely through changing their behaviour.

Prof Johan Buitendag  
Dean: Theology

## Dogmatics and Christian Ethics

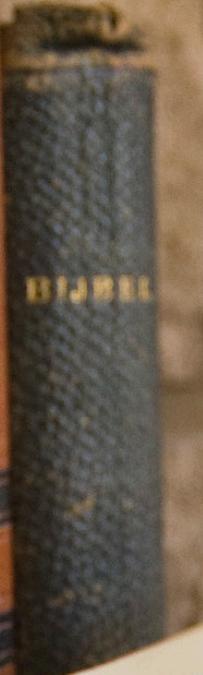
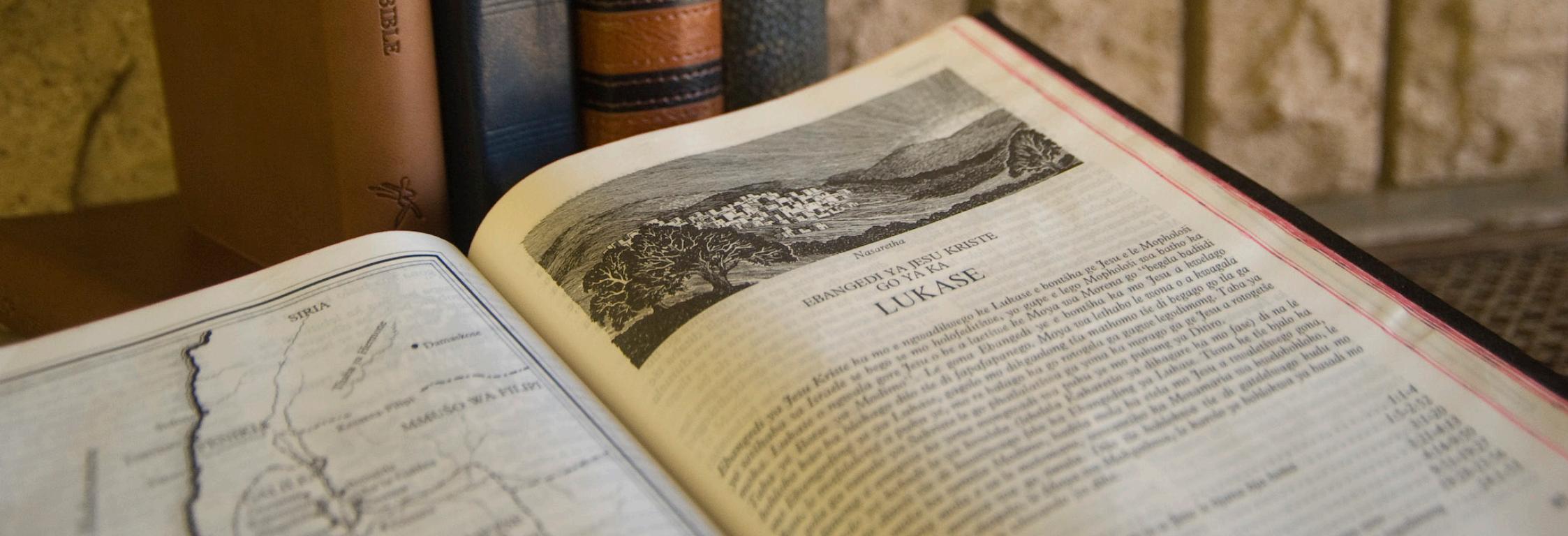
### Christian natural theology and Christian ethics

Prof Johan Buitendag's research in 2009 was devoted primarily to the exploration of the development of a Christian natural theology. He wrote two articles in this regard: *Natural theology revisited: an appraisal of some epistemological insights of Darwin* and *A theology of nature*. In another article, *Christ's descent into hell: a new approach*, he attempted to provide a more satisfactory interpretation of the clause "descendit ad inferna" in the Apostle's Creed than the metaphorical interpretation of Calvin.

Prof Ettien de Villiers proceeded with a comprehensive research project on the prospects of a Christian ethics of responsibility. His research in 2009 concentrated on an in-depth study of Max Weber's original conceptualisation of the ethics of responsibility. He started writing a book on the interpretation and legacy of Max Weber's view on an ethics of responsibility. He read a paper entitled *Public witness: an appropriate mode of public discourse in the democratic South Africa?* at a conference of the Centre for Public Theology in October 2009.

Prof Danie Veldsman read a paper on the academic contribution of the systematic theologian Johan Heyns at one of the conferences organised by the Faculty of Theology as part of its 150-year celebration in March 2009.

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## Old Testament Studies

### Exile and suffering

A volume of papers, *Exile and suffering. a selection of papers read at the 50<sup>th</sup> anniversary meeting of the Old Testament Society of South Africa*, was published in 2009. The papers were presented at the 50th anniversary of the Old Testament Society in South Africa. Prof Dirk Human was the co-editor, while Dr Gerda de Villiers and Prof Jurie le Roux were contributors. In her contribution, *Sin, suffering, sagacity: Genesis 2–3*, Dr De Villiers deals with the so-called Story of the Fall, as recounted in Genesis 2–3. She suggests an alternative approach to the traditional Christian approach of “sin”.

In the narrative of Genesis 2–3, knowledge plays a key role. Knowledge is first introduced by the Lord God’s prohibition to the man to eat from the “tree of knowledge” (Gen 2:17), warning him that if he does so, he will certainly die. This cue is taken up by the snake when he addresses the woman in the form of a suggestive question (Gen 3:1) and then points out the positive qualities associated with gaining insight, even becoming like God (Gen 3:5). Unlike God’s threat that the humans will drop down dead after they have eaten from the tree, the snake’s words become true and their “eyes open” (Gen 3:7).

In the Ancient Near East, snakes were not seen as evil. On the contrary, although they were feared for being dangerous, they were often revered as chthonic deities. Snakes were also associated with wisdom and knowledge, and due to the fact that they shed their skins, they were thought to possess the capacity to live forever. However, everlasting life was the privilege of the gods, not to be granted to human beings. Seen in this light, the narrative of Genesis 2–3 explains in the first place how death came into the world: the humans were tricked by the snake that actually protected a godly prerogative. At the same time, the snake also helped the humans, albeit in a rather indirect manner. When they ate from the tree, they became equipped with the necessary skill for survival in the world out there: knowledge.

In his contribution, *Suffering and hope during the exile*, Prof Le Roux deals with Pentateuch perspectives on the Babylonian exile of Israel. Too often it is stated that the critical study of the Pentateuch (the books of Genesis, Exodus, Leviticus, Numbers and Deuteronomy) severs the link with life and the problems of life. This article endeavours to show the inextricable link between text and theory, between the Pentateuch and the living context in which it originated. Put differently, this article is a “practical application” of the Pentateuch theory that is used in the context of Pro Pent. It focuses on the pain and suffering of the exiles and shows how our theory enables us to understand that suffering, but also the intellectual attempts that were made to reinvent their future. The article articulates the nagging question posed by the exiles: Did Israel have a future? Did the exile imply the end of God’s history with His people? In their spiritual odyssey, the dates 722 (the fall of Israel) and 586 (the fall of Judah) haunted them because they were historical markers accentuating defeat, suffering and loss. Would Judah also fade from the pages of history, as Israel had?

The Zadokite intellectuals had to provide answers and they did that in a brilliant way. They took three events that happened in the early history of Israel, namely the story of the golden calf, Moses’s intercession and the reissuing of the Ten Commandments, and reinterpreted these incidents in such a way that they could console the exiles with the hope of a new future (cf Dt 9:9–21; 10:1–5). This article intends to contribute to the importance of Pro Pent’s theory of the Pentateuch and its ability to open up living contexts.

In 2009, three articles by Prof Alphonso Groenewald were published. Two of them flowed forth from previous research that focused on the Psalms: *Psalm 16, ethics and the larger compositional group Psalms 15–24* was published in the *Journal for Semitics* 18/2 and *Psalm 51 and the criticism of the cult: does this reflect a divided religious leadership?* was published in *Old Testament Essays* 22/1. The article on Psalm 51 links to issues that are also dealt with in the current research focus, namely the book of Isaiah. The third article that was published focused on Isaiah. *Some notes on writing a commentary: Isaiah 1–12* was published in *Verbum et Ecclesia* 30/1.

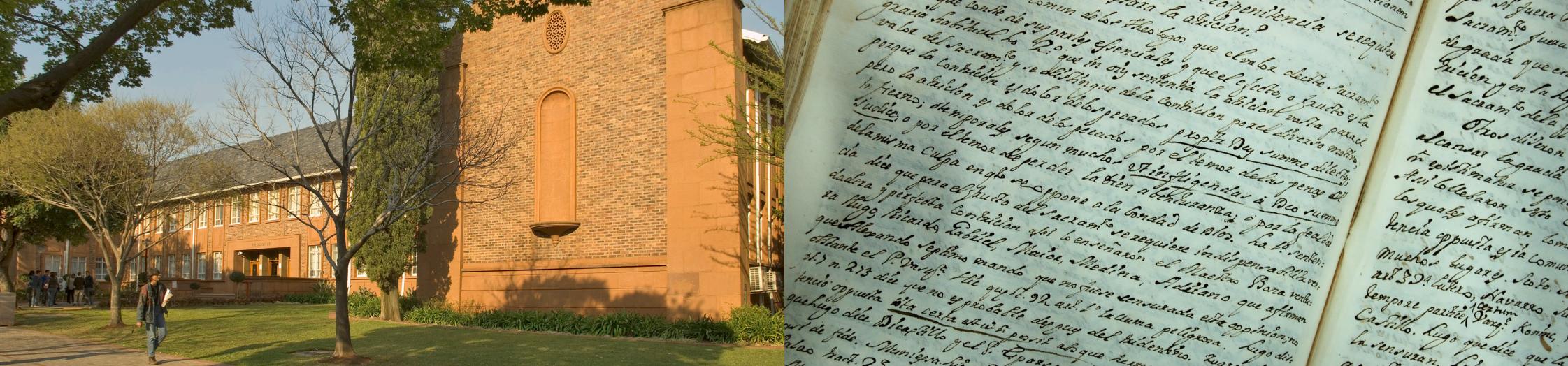
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## New Testament Studies

### Septuagint studies and Philo’s Therapeuta

Prof Gert Steyn published two articles during the year under review. *Notes on Ps 101 (LXX) and Ps 103 (LXX) in Hebrews 1 in the light of evidence from the Dead Sea Scrolls and Papyrus Bodmer XXIV* was published in *Acta Patristica et Byzantina* 20. It investigates the text forms and occurrences of the quotations from Septuagint (LXX) Psalms 101 and 103 in Hebrews 1 in view of evidence from the Dead Sea Scrolls and Papyrus Bodmer XXIV. It became clear regarding Ps 101 that it is especially the Septuagint that opens up the possibility of a Christological interpretation in Hebrews – principally with its inclusion of kurios, which the Hebrew equivalent lacks in the Hebrew texts. Regarding Ps 103, there were two traditions: the Masoretic Text and the Hodayot (1QH 1:10–12), and the Septuagint, Targum Jonathan and Hebrews, as well as the Syrian and other eastern versions of 2 Esdras.

The second article, *Perfecting knowledge and piety (Philo, Contempl. 3,25): intertextual similarities between Philo’s Therapeuta and Lukan Early Christianity*, was published in *Neotestamentica* 43/2. After briefly noting the similarities between the Essenes and Therapeuta (both of which were groups described by Philo), it compares some of the most striking features of the Therapeuta in Philo’s *De Vita Contemplativa* with similar features in New Testament early Christianity. There are striking intertextual similarities between the two groups on a number of points, particularly regarding the depiction of Jesus’s lifestyle,



Theology Building.

the beginnings of the church in the New Testament literature in terms of aspects relating to social structure, style of worship and the importance of interpreting Scripture.

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### Ethics and mission in the early church

Dr Kobus Kok has done research on the dynamics between ethics and mission in the early church. Early Christianity embodied a new idiom of morality that inspired many in the Roman world and beyond. Christianity's morality was formed and adapted from older traditions of moral discourse, but it radically transformed the society of the day as far as slavery, equality, love and compassion were concerned. In a time of moral crisis, ethics and morality in a changing society become a necessary focal point. This project aims at researching the field, and equipping the (church) leaders of tomorrow in a postmodern, democratic, pluralistic society to be agents of moral regeneration.

### Ethnicity and the parables

Prof Ernest van Eck has occupied the topics of ethnicity and parable research. In antiquity, group identity was based on cultural ethnicity. Groups used their ethnicity to define and delineate themselves as unique. Ethnicity was determined by characteristics like family (kinship), name, language, homeland, myths of common ancestry, customs, shared historical memories, phenotypical features and religion. The jewish temple religion and law-abiding jews in the early church (as depicted in Acts and the congregations of Paul) also used their

ethnic identity as an argument for justifying the exclusion of other groups and ethnic peoples from the temple and the early church. Jesus, Acts and Paul, on the contrary, proclaimed that ethnicity meant nothing when it comes to being in God's presence, being part of the early Christ-followers, or being part of any local (Pauline) congregation. For this reason, it can be concluded that the New Testament bears witness to an inclusive ecclesiology and, by implication, a race-free society.

The authenticity of the parables, as they appear in the Synoptics, cannot simply be assumed. Jesus told his parables in first-century Palestine, an advanced agrarian society under the control of the Roman Empire. Because of the exploitation of the elite, the peasantry in first-century Palestine struggled to live at the level of subsistence. To avoid an ethnocentric reading of the parables of Jesus, the interpreter must take cognisance of the dominant cultural values and norms of the first-century Mediterranean world. Social-scientific criticism facilitates a culture-sensitive reading of the parables of Jesus. The focus of Jesus's parables is the kingdom of God. Jesus's social location was that of the peasantry. Jesus's parables are atypical stories (comparisons) of social critique. They depict the Galilean as a social prophet. They are not theocentric, but make "theological" or ethical points. Finally, indeterminacy exists in the reading of the parables.

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## Practical Theology

### Theology in praxis

Prof Maake Masango was engaged in a team project with a PhD student on water as a resource in poor communities and the task of the church. An article entitled *Privatisation of water system: crime against humanity* emanated from this. He also published a chapter in a book entitled *Pastoral care in mission*, edited by Jonas N Dah.

Prof Malan Nel delivered research outputs on congregational studies. His articles include *Congregational analysis revisited: empirical approaches* and *Congregational analysis: a theological and ministerial approach*, published in *HTS Teologiese Studies/Theological Studies* 65(1). He also contributed to the theme of continuing theological training by publishing two articles, *Inviting and initiating youth into a life of discipleship*, published in *Verbum et Ecclesia* 30(2), and *Continuing theological training at the University of Pretoria*, published in *Verbum et Ecclesia* 30(3).

Prof Julian Müller concentrated on the interdisciplinary aspects of postfoundational practical theology, with HIV and AIDS research as a case study. A paper was presented at a humanities conference in Beijing, China, which formed the basis of the article, *Transversal rationality as a practical way of doing interdisciplinary work, with HIV and AIDS as a case study*, published in *Practical Theology in South Africa*, Vol 24(2) 2009.

Prof Cas Vos published his fifth anthology of Afrikaans poems, entitled *Intieme afwesige*.

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## Science of Religion and Missionology

### Missiology and the missional church

Prof Piet Meiring continued research on reconciliation. He was invited to participate in the work of the Canadian School of Peacebuilding, where practitioners, students and scholars from around the world and from diverse religious and cultural backgrounds can respectfully gather together to deepen their practices of peacebuilding. He also participated in the work of the Canadian Indian Residential Schools' Truth and Reconciliation Commission and published articles in a number of journals on the issue of reconciliation.

Prof Nelus Niemandt participated in a research project on missional churches in partnership with the South African Partnership for Missional Churches, the University of Stellenbosch and Communitas. The results were published. He delivered a paper at an international conference, *Acts for Today's Missional Church*. The project on Acts continues in 2010, when the University of Pretoria will host a conference on the theme. He also published articles in a number of journals on the issue of the missional church.

## Institute for Missiological and Ecumenical Research

### People's Power Project

During October 2009, a team comprising members from diverse backgrounds took part in the People's Power Project (PPP) of Research and Development for the Prevention of Poverty/ Navorsing en Ontwikkeling vir die Voorkoming van Armoede (NOVA) and the Institute for Missiological and Ecumenical Research (IMER). The aim of the project was to determine the feasibility of a project to reduce domestic electricity use through behaviour change.

The team consisted of six members from the Dutch industry, Imtech, one from Share People, an office of the ICCO-Kerk in Actie (Church in Action) partnership of the Protestant Church in the Netherlands, and two from Kessels and Smit, a consultancy firm. The team furthermore comprised two electrical engineering students from the Netherlands, six members of NOVA (a partner of the IMER) and one doctoral student in Psychology from the University of Pretoria. The project was funded by Imtech, ICCO-Kerk in Actie and the South Africa-Netherlands Research Programme on Alternatives in Development (SANPAD).

The team visited six households in Garsfontein, five in Mamelodi and five in the Woodhill residential areas. They installed meters in each house to measure the electricity use of different appliances over a few days. This made it possible to determine where the possibilities for savings are. The households that participated in home audits have received personalised feedback about their energy use and advice on how to conserve more. Some households saved up to 20% of the energy used in their homes, solely by changing their behaviour. This project will be continued in 2010.

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## 6.10 Veterinary Science



Prof Gerry Swan, Dean

The year under review was the fourth year of the faculty's four-year strategic plan, aimed at increasing its number of postgraduate students and making research a primary thrust to stimulate and focus its research programme on unique South African animal disease problems.

### Message from the Dean

A satisfactory growth in research output, mainly measured in terms of scientific publications and the NRF ratings obtained by the faculty's researchers, was achieved during the year. All four submissions for

rating were approved, but unfortunately the faculty also lost two of its previously rated staff members due to retirement. This meant that it had a total of 17 rated researchers in 2009, compared to 15 in 2008. Subsidy units earned for publications in 2007 were 62.73, which is lower than the 65.3 units attained for its publications in 2006, but still resulted in a slightly higher research budget of R1.1 million against R1.004 million the previous year.

This first decrease in the number of publications in more than a decade was mainly due to the loss of some of the faculty's most productive senior staff members. Fortunately, it was more than compensated for by an increase in the number of publications in 2008, resulting in 81.58 subsidy units. Again, as in previous years, all the publications were in ISI-accredited journals, reflecting the consistently high quality of the faculty's research.

According to the faculty's policy, 20% of the research allocation is allocated to the Faculty Research Fund, which is used by the Research Committee to support young or new researchers who have not yet established themselves for external funding purposes. Finally, the amount allocated to the faculty for postgraduate scholarships was increased to R440 000, which translated into 11 doctoral and 13 master's scholarships, auguring well for the future.

Excellence in research performance was again recognised by the identification of the faculty's top 10 researchers and the presentation of the Researcher of the Year award at the annual Faculty Day to Prof Vinny Naidoo, Director of the Biomedical Research Centre. This award measures productivity in terms of subsidy units earned. Similarly, two Young

Researcher of the Year awards were presented using slightly different criteria. The two individuals honoured in this way in 2009 were Dr Monty Saulez (academic staff) and Dr Lyndy McGaw (non-academic staff).

For the past 25 years, Faculty Day has represented the focal point of the academic year, serving as a platform to showcase the research activities in the faculty to colleagues and peers. In 2009, Faculty Day took place on 27 August. It was a special occasion and a huge success with 25 oral and 15 poster presentations. To make the event even more memorable, the Sir Arnold Theiler Memorial Lecture was presented by Prof Peter Doherty of Australia, the first and only veterinarian to have been awarded the Nobel Prize. He shared the prize in physiology or medicine with Dr Rolf Zinkernagel for their discovery of how the immune system recognises virus-infected cells. His lecture, entitled *Adventures in infection and immunity*, served as an inspiration to those present and emphasised that his training as a veterinarian provided him with a sound scientific foundation from which he was able to launch his remarkable scientific career.

Prof Gerry Swan  
Dean: Veterinary Science



## Paraclinical Sciences

### Aquatic toxicology research

Most South African rivers and dams are severely degraded and polluted. Aquatic animals, for example, the Nile crocodile (*Crocodylus niloticus*) and fish, are sensitive and very helpful indicators of freshwater ecosystem health. Nile crocodiles are becoming more threatened due to habitat destruction and the deterioration of freshwater quality. The investigation into the Nile crocodile mortalities, ascribed to pansteatitis, is still ongoing.

During a feeding experiment at the Faculty of Veterinary Science, it was determined that affected fat from crocodiles that had died of pansteatitis did not cause the disease in healthy crocodiles that consumed the fat over a period of a month. The hypothesis that cannibalism (eating sick crocodiles) caused the disease in healthy crocodiles after they had consumed the affected crocodiles could not be confirmed.

Pansteatitis was also discovered in sharptooth catfish (*Clarias gariepinus*) and large-scale yellowfish (*Barbus marequensis*) from the upper Olifants River. Inflammation of the fat deposits of fish had not been reported before from the upper Olifants River. However, similar lesions were found by Dr David Huchzermeyer (a PhD candidate from the Department of Paraclinical Sciences) in sick catfish from the Olifants River Gorge during the Nile crocodile die-off (pansteatitis) in 2009. It seems as if aluminium and iron are playing important contributing roles. Special stains were imported by the department to stain aluminium and iron in tissue samples from crocodiles and fish. Preliminary results look very promising.

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## Veterinary Tropical Diseases

### Cross-protection between *Trypanosoma congolense* strains of low and high virulence

The aim of this study was to assess the existence of possible cross-protection between *Trypanosoma congolense* strains of low and extreme virulence circulating in the same trypanosomosis focus. Groups of six mice were infected using one of three strains of low virulence and challenged with one of three strains of adverse effects of extremely virulent *T. congolense* strains. Results indicated that mice infected with one of the strains of extreme virulence developed high parasitaemia and a significant drop of the packed cell volume, compared to mice infected with a strain of low virulence and challenged with one of the strains of extreme virulence. With the exception of one strain of extreme virulence, the survival time of

mice infected with the strains of extreme virulence was shorter compared to mice infected with strains of low virulence and subsequently challenged with a strain of extreme virulence. These results suggest that in an area where trypanosomes of various virulence profiles circulate, livestock infected with *T. congolense* strains of low virulence can be protected against the adverse effects of extremely virulent *T. congolense* strains.

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### Canine babesiosis: does parasite genotype determine clinical manifestation of disease?

*Babesia rossi*, an intraerythrocytic protozoan, causes a severe, often life-threatening disease in domestic dogs. Dogs infected with *B. rossi* have varied clinical manifestations, ranging from uncomplicated (with a good prognosis) to complicated (with a poor prognosis). Blood samples from *Babesia*-infected dogs were screened by polymerase chain reaction (PCR) targeting the *Babesia rossi* erythrocyte membrane antigen gene (BrEMA1) and by sequencing of the polymorphic region (that is, the region with a variable number of hexapeptide repeats). Analysis of PCR products revealed 11 different gene profiles, visualised by gel electrophoresis. Twelve distinct BrEMA1 genotypes – identified by sequencing – were retrospectively compared to the clinical case data. The most frequently encountered genotypes were also the ones associated with the poorest prognosis. This preliminary finding suggests clinically important differences between the various manifestations of the disease.

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### Novel piroplasms in giraffes

Blood specimens were received from five cases in which young adult giraffe from different geographic origins in South Africa showed sudden onset of disease and subsequently died. Additional specimens from two translocated giraffe were also included in the study. Blood slides from some of these animals showed the presence of piroplasms. DNA was extracted, and the V4 hypervariable region of the 18S rRNA gene was amplified and analysed using the reverse line blot hybridisation assay. PCR products failed to hybridise with any of the *Babesia* or *Theileria* species-specific probes, and only hybridised with the *Babesia/Theileria* genus-specific probe, suggesting the presence of a novel species or variants of a species. Full-length 18S rDNA was amplified and cloned and the recombinants were sequenced. The 18S rRNA gene sequence similarity analysis revealed the presence of novel piroplasm species in both healthy and clinically sick or dead giraffes. Phylogenetic analysis grouped five of these organisms in the *Babesia sensu stricto clade* and three in

the *Theileria sensu stricto clade*. Although parasites were observed in blood smears, there is no direct evidence that the five giraffes died of piroplasmosis, although it seems likely.

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### **Molecular characterisation of *Babesia caballi* and *Theileria equi*, the aetiological agents of equine piroplasmosis in South Africa**

A molecular epidemiological survey of the protozoal parasites that cause equine piroplasmosis revealed the existence of as many as 25 distinct 18S rRNA sequences for *Theileria equi*, which belonged to three main groups, and six different *Babesia caballi* 18S sequences, which formed two distinct genetic groups. The researchers developed a TaqMan minor groove binder (MGB™) qPCR assay, targeting the 18S rRNA gene, for the detection of *B. caballi* infections in equine blood samples, and evaluated the ability of a recently developed *T. equi*-specific qPCR assay to detect all *T. equi* 18S rRNA variants identified in South Africa. Both tests were sensitive and specific and could detect the parasites in field samples.

Following the failure of a *B. caballi*-specific competitive-inhibition enzyme-linked immunosorbent assay (cELISA) to detect *B. caballi* antibodies in the sera of infected horses from South Africa, the rhoptry-associated protein gene (rap-1) from South African *B. caballi* isolates was characterised. Significant sequence heterogeneity in the rap-1 gene sequences and in the predicted amino acid sequences was found. Marked amino acid sequence differences in the carboxy-terminal region, and therefore the probable absence of the monoclonal antibody binding site, explains the failure of the cELISA to detect antibody to *B. caballi* in South African samples. This is the first comprehensive molecular study of the parasites that cause equine piroplasmosis in South Africa. The results add further to the existing knowledge of piroplasmosis worldwide and will be invaluable in the development of further molecular or serological diagnostic assays.

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### **The five-point check for deciding which animals will benefit from treatment for internal parasites**

A large, multinational consortium of researchers was funded by the European Union to undertake research into improved methods of controlling internal parasites of livestock. This project was known as PARASOL, a contraction of "parasite solutions", and ended in 2009 with a range of positive outcomes. South Africa's contributions included the

establishment and testing of a practical, affordable and reliable system for the application of targeted, selective treatment of sheep by farmers and their workers.

Through this method, animals are examined at five points on the body for signs that indicate the possible involvement of internal parasites as the cause. Methods of scoring for severity and recording results are given. The farmer is supplied with information helping to identify the probable causes for each abnormality observed, and a further table to give guidance on the best drug group to be used for each parasite indicated. This is accompanied by practical guidelines and precautions. The system was tested on both commercial and communal farms over three years and the farmer acceptance overall was 86%. It is now being introduced to farmers in both South Africa and elsewhere.

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### **Novel agents for targeting tumour vessels**

For several years, the 2-arylquinolin-4(1H)-ones and their derivatives have been the subject of investigations as a new class of antitumour agents. Although the antitumour activities of quinolone derivatives are well documented, their effects on angiogenesis have not been thoroughly studied. Angiogenesis is the formation of new blood vessels from existing vessels, and is a key event associated with tumor growth and metastatic dissemination. The inhibition of angiogenesis is thus a promising strategy in cancer treatment. Initial observations in studies conducted in the laboratory on the effects of quinolone derivatives on cancer and endothelial cell lines prompted the researchers to probe selected 2-aryl-3-bromoquinolin-4(1H)-ones and their NMe-4-oxo derivatives for potential antiangiogenic activity. The findings of the investigation showed that test compounds exhibit antiangiogenic activity in a rat aorta assay, with comparable potency to a well-known antiangiogenic agent, 2-methoxyestradiol. These compounds also decreased the levels of proangiogenic factors implicated in the pathogenesis of various cancers, such as bFGF and VEGF and PIGF. The most pronounced antiangiogenic activity in all the tests was observed for the 4-fluorinated derivative, and activity decreased when fluorine was replaced with a chlorine atom. The presence of a fluorine atom in a molecule is known to have a profound effect on the biological, chemical and physical properties of such derivatives. The 4-fluorophenyl NH-4-oxo derivative could thus serve as an excellent lead compound to provide good models for the further design of potent fluorinated 2-arylquinolone derivatives with the potential to serve as antiangiogenic agents for therapeutic application in cancer.

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## Highlights of the Giraffe Research Programme

The many years of gathering and analysing data in the Bubye Valley Conservancy in southeastern Zimbabwe were translated into several publications in 2009. It is clear that the study of giraffe biology has implications wider than the specific, ranging from the study of evolutionary processes to the pathology of human diseases. The first publication of 2009, produced in conjunction with colleagues at Bristol University, UK, and the University of London, proposed a common physiological mechanism to explain the physiological hypertension of giraffes and the pathological hypertension of man, which opened up new lines of research into the causes of human hypertension.

Researchers were also able to review the widely accepted hypothesis that the origin of the long neck of giraffes is sexual selection. Their data refuted this hypothesis and suggested that better explanations had to be found. The detailed results of the study of neck growth from foetus to adult in both sexes were accepted for publication. The research team also published the most comprehensive analysis of the giraffe cardiovascular system yet to be made, which is likely to be the benchmark for giraffe cardiovascular research for many decades. An aspect of cardiovascular function published separately entailed an analysis of the structure and function of the giraffe's jugular vein valves. The analysis proposed a general functioning of these valves in all ruminants. An important feature of the research programme is its ability to attract young veterinarians to research.

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## Influence of seminal plasma on fertility of fresh and frozen-thawed stallion epididymal spermatozoa

The freezing of spermatozoa (cryopreservation) has been successful and researched for the last few decades. Methods of harvesting spermatozoa if ejaculation is impossible, for example, in the case of unforeseen injury or death of males, have been investigated and the flushing of epididymal spermatozoa is one possible procedure. The epididymis is a reproductive organ that is anatomically connected to the testis and provides an environment for maturation and storage of spermatozoa before ejaculation. Cryopreservation of epididymal spermatozoa may be the only opportunity to preserve the valuable genetics of males, and the use of epididymal stallion spermatozoa for routine artificial insemination (AI) can secure easy future use of these valuable genetics. Pregnancy rates after AI with frozen-thawed epididymal stallion spermatozoa have been shown to be low, but literature was contradictory with regard to exposure or no exposure of stallion epididymal spermatozoa to seminal plasma. Seminal plasma is secreted at ejaculation by the testes, epididymides and accessory sex glands. It is a transport medium for spermatozoa, acts as a buffer, supplies nutrients and sustains the initial motility of spermatozoa. It is known to have positive as well as detrimental effects on spermatozoa after cryopreservation and is not absolutely necessary for fertilisation.

Furthermore, no data was available that directly compares the pregnancy rates of fresh and frozen-thawed stallion epididymal and ejaculated spermatozoa after conventional AI.

The aims of the study were to directly compare pregnancy rates for fresh and frozen-thawed stallion epididymal spermatozoa after conventional AI, and to investigate the effect of seminal plasma on the fertility of epididymal spermatozoa after insemination. Twenty-one mares were randomly assigned to three stallions. Mares were inseminated at five consecutive oestrus periods using fresh ejaculated spermatozoa (Fr-E, n=18), fresh epididymal spermatozoa that had been exposed to seminal plasma (Fr-SP+, n=12) or fresh epididymal spermatozoa that had never been exposed to seminal plasma (Fr-SP-, n=9), frozen-thawed ejaculated spermatozoa (Cr-E, n=18), frozen-thawed epididymal spermatozoa that had been exposed to seminal plasma prior to freezing (Cr-SP+, n=18) and frozen-thawed epididymal spermatozoa that had never been exposed to seminal plasma (Cr-SP-, n=15). Pregnancy examinations were performed 14 days after each ovulation. Pregnancy rates were 55.6% (Fr-E, 10/18), 75% (Fr-SP+, 9/12), 22.2% (Fr-SP-, 2/9), 38.9% (Cr-E, 7/18), 27.8% (Cr-SP+, 5/18) and 6.7% (Cr-SP-, 1/15). Overall pregnancy rates for fresh and frozen-thawed epididymal spermatozoa that had been exposed to seminal plasma were significantly better than for epididymal spermatozoa that had never been exposed to seminal plasma. Overall, comparison between fresh and frozen-thawed ejaculated spermatozoa with epididymal spermatozoa that had been exposed to seminal plasma showed that pregnancy rates were similar. The research concluded that the exposure of stallion epididymal spermatozoa to seminal plasma improves pregnancy rates and recommended seminal plasma as a flushing medium to harvest stallion epididymal spermatozoa prior to use and/or cryopreservation.

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