

A Note from the Head of Department

The Chemistry Department at the NMMU experienced a fruitful 2009, with successful activities in teaching, research and community involvement. A total of 8 doctoral, 5 Magister and 10 Honours students graduated in 2009, and these graduates have either continued their studies, or taken up positions in industry or academia. Their success is partially the result of the commitment and professionalism of all our staff (both technical and academic), whose efforts were often beyond the call of duty.

On the research front several presentations have been made at both international and local Chemistry conferences by both staff and students. A total of 12 research papers have been published in international Chemistry journals, and *Innoventon* is unquestionably the pioneer in innovation and the application of chemical technology in South Africa. We pride ourselves in our collaborative projects with international institutions, which are indicative of the Chemistry Department's standing in the chemical community.

The staff of our Department is committed to make 2010 an even greater year than 2009!

Tommy Gerber: HoD Chemistry

Retirement of Prof Hans Rohwer



Prof Rohwer officially retired from the Chemistry Department at the end of 2009, after 41 years of dedicated service. He joined this University, then known as the University of Port Elizabeth (UPE), in 1968 from Stellenbosch University, where he completed his studies, and since then has played a major role in the fields of Analytical / Inorganic chemistry and Instrumental Analysis. Over the years he has also lectured Physical Chemistry, when the need arose.

Prof Rohwer has been involved in industrial consulting for many years.

During 2009 he was invited by several Universities in Germany (Freiburg, Stuttgart, Jena) to give lectures on his research work dealing with Rhodium-, Osmium-, Ruthenium- and Platinum chemistry. These Platinum-Group-

Metals are very important for the South African Industry. As a *Von Humboldt-fellow* he remains in contact with these and other universities in Europe. His environmental interests bring him into contact with instrument manufacturers, especially dealing with the development of gas-sensors and - detectors for sulfur- and nitrogen- containing gases. Although Prof Rohwer is officially retired, he will still be active as a research associate in the Department.

OPEN DAY Activities

This annual event took place on 8 and 9 May in the Sports Centre on the South Campus and as usual we had a continuous stream of scholars moving through the various stalls in search of careers. The Chemistry activities consisted of eye-catching demonstrations, performed mainly by **Dr Gletwyn Rubidge** and co-workers, and fairly loud bangs outside the building, in order to attract attention. Chemistry pamphlets outlining qualifications and possible careers were handed out and discussed. In addition a miniature fuel cell, based on the electrolysis of water, was also running.



Dr Gletwyn Rubidge and Mr Harold Marchand in action at Open Day

Successful Winter School

This was run during the Science Discovery week, 29 June – 3 July, and Matric learners from various schools in PE and surroundings were given a Chemistry demonstration by **Prof C McClelland** and **Mr H Marchand**; a career and Chemistry lecture by **Prof Loyson** and a conducted tour around our labs. Demonstrations and some practical work in the laboratory also formed part of the day's activities. Numerous people from the Department played a role to make this a success.

Altogether around 150 students attended this Chemistry orientation which was part of the week-long Science Discovery event.



Matric students in the lab during the Winter school



Harold Marchand doing his Chemistry demo during the Science Discovery week, with Prof Cedric McClelland keeping a watchful eye in the background

Fire in Organic Chemistry Research Lab

On 22 September 2009 a fire started in the Organic Chemistry Research Laboratory, on the third floor, in Building 13 on the South Campus, which caused serious damage.

Three research benches and two fume cupboards were destroyed. In addition, the resultant soot, fumes and water caused extensive damage to research equipment in the laboratory.

It is anticipated that the laboratory will be fully operational again by June 2010.



A section of the Organic research laboratory after the fire

New Instrument to evaluate Batteries

At the beginning of 2009 there was the successful commissioning of a Bitrode battery tester which was installed in the Physical/Polymer Laboratories in building 13 on the South Campus, sponsored by Willard Batteries. The tester is capable of testing up to 5 batteries simultaneously up to 50A and 16 batteries simultaneously up to 10A through various pre-programmed test sequences of charge, discharge, power or temperature. This allows one to simulate a testing sequence of a number of different types of batteries such as Pb-acid or Li-ion used in typical automotive applications for starting or propulsion. By then varying the electrode components of the battery being researched, one can determine which material factors contribute to the expected life cycle within a typical

application. These tests become important with the drive to full electric vehicles (EV) using either fuel cell technology or battery systems.

The system has been used extensively during 2009 in Battery Electrochemistry research projects, in collaboration with Willard Batteries, and in 2010 there will be additional research carried out both on Pb-acid and Li-ion systems.



The new battery testing facility being used by a Master student C Snijders

Internal Temperature monitors for Pb-acid batteries

The Battery Research group, in collaboration with Willard batteries, are in discussion over the commercialisation of an “Internal temperature monitor for lead-acid batteries”. This is a widget developed by the group and the patent was filed in 2008. 100 Prototypes of the indicators were made and are installed in a number of industrial size batteries across the country in various applications from mining locomotives to forklift trucks.

Graduation news

The Science Faculty graduation ceremony was held on 18 April 2009.

The following Diplomas in Chemistry were presented :

- *National Diploma in Analytical Chemistry* : 16 students
- *National Diploma in Polymer Technology* : 8 students

The following Degrees were awarded :

- *B Tech : Chemistry* : 5 , with one cum laude : Brenton Simpson
- *B Sc with Chemistry as major* : 6
- *B Sc Hons* : 5 (cum laude : Kim Potgieter)

Master Degrees

M Sc : Chemistry (5)

Geswindt, Theodor Earl

Title of dissertation : *The Reaction of Osmium (VIII) in Hydroxide Medium –*
Supervisor : Prof H E Rohwer

Kleyi, Phumelele Eldrige

Title of Dissertation : *Solvent-Free Synthesis of Bisferrocenylimines and their Coordination to Rhodium (I)*
Supervisor: Prof C Imrie; co-supervisors Prof CW McClelland and Prof TIA Gerber

Louw, Marissa

Title of dissertation : New Platinum and Palladium Complexes – Their Anticancer Application
Supervisor: Prof JGH Du Preez

Myburgh Jolanda

Title of dissertation : *Synthesis and Characterization of Novel Platinum Complexes – Their Anticancer Behaviour*
Supervisor : Prof JGH Du Preez

Williams, Damian Christopher

Title of dissertation : *The Influence of Nano Zinc Sulfide on the Bisbenzothiazole-2,2-disulfide accelerated Sulfur Vulcanization of Natural Rubber*
Supervisor : Dr C Woolard

Doctoral Degrees

There were 8 candidates, 3 for *Doctor Technologiae* and 5 for *Philosophiae Doctor*

D Tech : Chem



Dr Buddoo



Dr Gordon



Dr Rust

Buddoo, Subash Rammarain

Title of thesis : *Development of a Process for the Preparation of Linalool from cis-2-Pinanol*

Promoter : Prof B Zeelie, co-promoter Dr J Dudas

Gordon, Gregory Ernest Robert

Title of thesis : *The Development of a Biocatalytic Process for the Preparation of 5-Methyluridine*

Promoter : Prof B Zeelie, Co-promoter : Dr G Dugmore

Rust, Nico

Title of thesis : *The Development of a Commercial Production Process for p-Menthane-3,8-diol*

Promoter : Prof B Zeelie, co-promoter: Dr G Dugmore

D Phil : Chemistry



Dr Abrahams



Dr Bouwer



Dr Jaganath



Dr Mama



Dr Oosthuizen

Abrahams, Abubak'r

Title of thesis : *The Co-ordination Chemistry of Rhenium (V) with Multidentate NO-Donor Ligands*

Promoter : Prof TIA Gerber

Bouwer, Yolanda Ann Martha

Title of thesis : *Novel Aspects of Platinum-amine Coordination Compounds : their Chemistry and Anticancer Application*

Promoter : Prof J G H Du Preez

Jaganath Yatish

Title of thesis : *Advances in Platinum-amine Chemotherapeutic Agents : their Chemistry and Application*

Promoter : Prof J G. H. Du Preez

Mama, Neliswa

Title of thesis : *Novel Camphor Derivatives as Ppotential Asymmetric Alkylation Auxiliaries*

Promoter : Prof C W McClelland

Oosthuizen, Lukas Marthinus

Title of thesis : *New Platinum Coordination compounds : their Synthesis, Characterization and Anticancer Application*

Promoter : Prof J G H Du Preez, co-promoter Dr B J A M van Brecht

Staff research achievements

- **Prof Tommy Gerber** was once again elected as the top researcher in the Faculty of Science (also for 2008)
- **Dr Abubak'r Abrahams** was elected the Emerging Researcher of the Faculty for 2009.

Noteworthy achievements:

- **Prof T Gerber** was appointed to the Scientific Committee of the *International Symposium on Technetium and Other Metals in Nuclear Medicine*, to be held in 2010 in Bressanone, Italy, and to the Steering Committee of the *Science and Application of Radiometals*, to be held in Moscow in 2011.
- **Prof T Gerber** served on the appointments panel of Chemistry of the University of Zürich.
- **Prof T Gerber** was invited by the Editor of the journal *Inorganic Chimica Acta* to contribute a research paper to the special volume of the journal to commemorate the contributions of Oxford University Chemistry Professor Jonathan Dilworth on his retirement.

Noteworthy invitations :

- June 2009, **Dr E. Ferg** attended a DST initiated workshop at the CSIR in Pretoria to formulate a value proposition to the South African government to fund centres of excellence (Hubs) that will research and help establish unique advanced battery manufacturing facilities (primarily Li-ion) in South Africa with the main focus of supplying batteries for electric vehicles and the electrical power utilities. The outcome of the submission of the application would be available towards the end of 2010.

Conferences attended

Taibah International Chemistry Conference, 22-25 March 2009, Medina, Saudi Arabia (**Dr Abubak`r Abrahams**)

10th International Meeting in Inorganic Chemistry, 1 – 4 July 2009, Palermo, Italy (**Prof Tommy Gerber**)

16th European Symposium in Organic Chemistry, 12 - 16 July 2009, Prague, Czech Republic
(**Prof Tommy Gerber**)

European Institute of Oncology in Milan, Italy: Lecture by **Prof T Gerber**

Inorganic 2009 Symposium in Bloemfontein:

Posters presented : (5)

- Reactions of the fac-[Re(CO)₃]⁺ and [ReO]³⁺ moieties with aromatic multidentate N-donor ligands – **I Booyesen**, T. Gerber, P Mayer
- Rhenium complexes with multidentate nitrogen and oxygen donor ligands – **K. Potgieter**, P. Mayer, T. Gerber, I. Booyesen
- Complexing interactions with tris (2,2' – bipyridyl) ruthenium (II) – **Sipeng Zheng**, H Rohwer, E Hosten
- Oxidation of rhenium (III) in the presence of Schiff bases – **N Yumata**, P Mayer, A. Abrahams, T Gerber
- The oxidizing behaviour of RuO₄ in acidic media – **W van Aswegen**, J Davis, H Rohwer and E Hosten.

South African Chemical Engineering Conference (SACEC) 20-23 Sept 2009, Stellenbosch (Innoventon)

- **Dr Gary Dugmore** : The development of a commercial small production platform for the production of p-menthane-3,8-diol (N Rust, B Zeelie)
- **Peter Makgwane** : Oxidation of p-cymene in a falling film micro-structured reactor (B Zeelie, N. Harmse, E Ferg)

Grove Fuel Cell Symposium, London 2009, 22-24 Sept, (Innoventon)

- Poster : Hydrogen from water electrolysis , presented by **Dr S Gouws**, co-workers N Gojela, B Pollet and B Zeelie

Goudini Spa, Worcester, Sept 2009 (Innoventon)

- Lecture : **Batsho Mpuhlu** : Comparison of microstructured and fixed bed reactors for the selective oxidation of cyclohexane to cyclohexanol and cyclohexanone (B Zeelie, G Dugmore)

International Kinetic and Analytical Symposium, Cape Town, 2-4 Dec 2009 (Innoventon):

- Lecture by **Dr S Gouws** : Hydrogen production from water electrolysis

Lecture for the NMMU Biochemistry/ Pharmacy Departments :

- **Prof P Loyson** : *Pharmacy and Medicine in ancient Egypt*, 4 Sep 2009

Annual Eastern Cape Post Grad Mathematics and Applied Maths Seminar, 25-26 Sep 2009, NMMU

- Key note lecture : **Prof P Loyson** : *Ancient Greek Mathematics*

Lectures presented to outside organizations

Pharmacy and Medicine in Ancient Egypt : **Prof P Loyson** at Rhodes University, Grahamstown for the Dept of Biochemistry and Science Club, 22 Sept 2009

The importance of chemistry and why study chemistry : **Prof P Loyson**, guest speaker at Alexander Road Highschool, at a function attended by 10 different school science clubs to celebrate Mole Day, 6.02 am on 23 Oct 2009.

Dr E Ferg was invited to give a lecture in April 2009 on Pb-acid batteries at Wits University

Papers published (12)

The following research papers were published by staff in peer-reviewed Journals

Oxorhenium (V)-mediated Synthesis and Structures of Oxypyridinium-Ammonium Zwitterions - A. Abrahams, T.I.A. Gerber*, P. Mayer
Turk. J. Chem., 2009, **33**, 569-577.

Solvent-free Reactions of N,N'-Thiocarbonyldiimidazole with Ferrocenylcarbinols.
D. Onyancha*, V. Nyamori, C.W. McClelland, C. Imrie, T.I.A. Gerber
J. Organomet. Chem., 2009, **694**, 207-212.

Synthesis and Characterization of Palladium(II) and Platinum(II) Complexes with Ferrocenylimidazole - D. Onyancha*, V. Nyamori, C.W. McClelland, C. Imrie, T.I.A. Gerber
J. Organomet. Chem., 2009, **694**, 1407-1418.

Coordination Behaviour of Acetylacetonone-derived Schiff Bases towards Rhenium(I) and (V) - P. Mayer, T.I.A. Gerber*, B. Buyambo, A. Abrahams
Polyhedron, 2009, **28**, 1174-1178.

Synthesis and Structural Characterization of a novel Ligand-bridged Dimer of Oxorhenium(V) - P. Mayer, E. Hosten, T.I.A. Gerber*, A. Abrahams
Bull. Korean Chem. Soc., 2009, **30(5)**, 1204-1206.

Coordination Behaviour of the Multidentate Schiff base 2,6-Bis(2-Hydroxyphenyliminomethyl)pyridine towards the fac-[Re(CO)₃]⁺ and [ReO]³⁺ Cores - K. Potgieter, P. Mayer, T.I.A. Gerber*, I. N. Booyesen
Polyhedron, 2009, **28**, 2808.

N,N'-(1,2-Phenylene)bis(2'-Aminobenzamide) - I. Booyesen, T.I.A. Gerber*, E. Hosten, P. Mayer
Acta Cryst., 2009, **E65**, o850.

2-(2,3,5,6-Tetrahydrobenzimidazo[1,2-c]quinazolin-5-Benzeneamine Methanol Solvate - I. Booyesen, T.I.A. Gerber*, E. Hosten, P. Mayer
Acta Cryst., 2009, **E65**, o1565.

2-(Tetrahydrobenzimidazolium[1,2-c]quinazolin-5-)phenol Bromide Ethanol Solvate - I. Booyesen, T.I.A. Gerber*, E. Hosten, P. Mayer
Acta Cryst., 2009, **E65**, o2216.

*Bmim ionic liquids as media for the electrochemical oxidation of 2,6-di-*t*-butylphenol* - P Loyson*, C. Imrie, S Gouws, B Barton
J. Appl. Electrochem., 2009, **39**, no 7, 1087-1095.

The influence of ancient Greek on chemical terminology - P Loyson
J. Chem. Educ. 2009, 86, **10**, 1195-1199.

Archaeology benefits from neutron tomography investigations in South Africa
F.C. de Beer, H. Botha, E. Ferg, R. Grundlingh and A. Smith;
Nuclear Instruments and Methods in Physics Research A; **605**; (2009) 167-170

INNOVENTON NEWS

Overseas visits

During March 2009 **Dr Shawn Gouws** visited the Birmingham University's Chemical Engineering Department to set up a collaboration network in Fuel Cell Research. His work there involved making membrane electrode assemblies for fuel cells. He also visited the Institut für Mikrotechnik in Mainz, Germany, to study adhesion of various catalysts on metal surfaces, the catalysis processes used in the steam reforming process, and the purification of hydrogen gas.

During May 2009, **Prof B Zeelie, Dr Gary Dugmore and Mr Peter Makgwane** (Doctoral student) spent two weeks in Germany, visiting various Universities and research organizations for possible collaboration on microstructured reactor technology and algae research. The following universities were visited: *Johannes Gutenberg University* in Mainz, *Jacobs University* in Bremen, *Rostock University* Institute, *Brandenburg University of Technology*. Additional places visited were the Technology Park in Luckenwalde and Phytolutions / Evonik Industries.

Dr Shawn Gouws attended the 2009 Hydrogen and Fuel Cells Convention in Vancouver, Canada and visited the National Research Centre near the University of British Columbia, where the Hydrogen and Alternative Fuels Program is advancing the use of hydrogen as an energy carrier through research and engineering, eg in hydrogen-driven vehicles.

Overseas visitor : **Holger Loewe**, *Johannes Gutenberg University* in Mainz, and *Institut für Mikrotechnik*, Mainz, Germany. Lecture presented : Chemical Micro Process Technology – The Shortcut between Research and Production.

Courses offered by Innoventon

Five short courses were offered during the year :

- Applied Biostatistics with Excel (x 2)
- A Practical Approach to Handling and Storing Chemicals Safely (x 1)
- Data Analysis with Excel for Analysts, Scientists and Engineers (x 2)

SA Chemical Institute matters

The following lectures were presented during the year at NMMU:

- 25 Feb Prof Loyson : Chemistry in ancient Egypt
- 19 May Dr E Ferg : The Chemistry of Pb-acid Batteries
- 9 Sep Dr S Gouws : Hydrogen Production of renewable Energy Sources

Life membership awards were presented by Prof Loyson to Prof Goosen and Prof Du Preez, both retired professors from NMMU.

The annual Chemistry post grad seminar took place this year at Fort Hare , 23 October . One of our M Sc students, **Farzaana Francis** walked away with the 2nd prize in the Junior section with a title: *Solid-state photo stability of a light-sensitive pharmaceutical compound*. Another NMMU student, **Lance Brooks**, took 3rd prize in the senior section with the title: *Synthesis of bromochloromethane using phase transfer*.

At the function the *James Moir Medal* for the top student in BSc(Honours) at NMMU was presented to **Miss Kim Potgieter**.

At an earlier function at Aspen Pharmacare, the *James Moir Medal* for top B Tech student was presented to **Mr Brenton Simpson**. He attended the course part-time over 2 years and achieved an average of 81 %.



Prof Peter Loyson, chairman of the EP Section of SACI, handing over the James Moir medal to Brenton Simpson at Aspen/Pharmacare



Kim Potgieter with her SACI medal and her promoter Prof T Gerber



Students and staff who attended the SACI post grad Chemistry Seminar at Fort Hare

Compiler: Prof. Peter Loyson