ELECTRON MICROSCOPE UNIT

ANNUAL REPORT

2006

Permanent Staff

Director	**B.T. Sewell**
Principal Technical Officer (Part Time)	**J. Duncan**
Chief Technical Officer	**M. Jaffer**
Chief Scientific Officer	**B. Weber**
Chief Technical Officer	**M. Waldron**
Technical Assistant	**S. Karriem**

Temporary Staff

Lecturer in Structural Biology (T3)	**A. Varsani**
Computer Manager	**R. Austin**
Conference Organizer/ Web programmer	**A. Gillespie**

HIGHLIGHTS OF 2006

UPGRADE OF MR. SEAN KARRIEM'S POST

Mr. Sean Karriem's post was re-evaluated and as a result upgraded from payclass 6 to payclass 7. Mr. Karriem has taken responsibility for a large component of the film digitization and preliminary data processing work of the Unit. This work largely replaces photographic processing but requires a higher level of skill. In addition, his job description now formalizes his responsibility for maintaining the services, service laboratories and toxic waste disposal. Attention needs to be given to a career development path which will enable him to improve his skill levels.

ESTABLISHMENT OF A PROTEIN PURIFICATION LABORATORY

Structural work on proteins requires as a prerequisite that the proteins can be prepared and purified. A laboratory for this purpose has been established in the MCB building largely by Dr. Weber, Dr. Varsani and Mr. van Rooyen. The laboratory has the capacity to produce mutant proteins, express, purify and crystallize proteins and assess the quality of the product. The laboratory, which was paid for entirely out of grant funding, has taken several years to establish and is a major resource.

FIRST AFRICAN STRUCTURAL BIOLOGY CONFERENCE

The unit staff - especially Mrs. Miranda Waldron - played an important role in organizing the First African Structural Biology Conference held at the Wilderness from 24-27 October 2006. Funds to hold this remarkable event were raised largely from the ICGEB, the DST and the NRF as well as a number of commercial donors. Ms Eulashini Chunthatpursat and Ms Amanda Gillespie were employed (sequentially) as the Conference Organizers. The conference attracted seventeen international plenary speakers and 139 delegates, including 6 from other African countries. The complete report is appended.

USER MEETINGS

A series of user meetings was initiated with the following format: A user is invited to present their work which is then discussed by the other users present and the EM staff. The focus is on discussion which will enable the Unit staff the understand the needs of the user and the user to understand how best to use the capabilities of the Unit to solve their problems. The meetings are held fortnightly on Mondays in RW James LT D at 1pm. A register of attendance is maintained.

THE ACQUISITION OF A 200 kV FIELD EMISSION TRANSMISSION ELECTRON MICROSCOPE

The replacement of the JEOL 200CX instrument purchased in 1980 has been a subject of discussion since 1992. Several applications for the purchase of a new instrument were made during the time preceding 2006. All were unsuccessful but they had the purpose of honing the case for the new instrument. An opportunity arose in 2006 to acquire the four year old Tecnai F20 owned by the Laboratory of Molecular Biology at the Medical Research Council, Cambridge UK for GBP100,000. Tecnai F20's are popular workhorse instruments that have successfully been used in both Biological and Materials sciences. FEI agreed to translocate the instrument under guarantee for EUR109k. Our application to the NEP - based entirely on the Structural Biology needs - succeeded in raising R1.6M. Additional money has been sought from the DST and from the residual money remaining in the Carnegie Corporation grant. The instrument should be installed at UCT by early August 2007 as considerable delays were experienced by the MRC in obtaining a replacement instrument. As it stands the instrument is a baseline cryo FEGTEM equipped with a focussing camera and two (old) cryo stages. In due course it will be necessary to purchase a CCD camera, new cryo stages, stages for materials applications and a software upgrade. A site survey done in November 2006 by Mohammad Darai (a pre-installation consultant) in order to prepare the room for the installation Tecnai F20. The site was found to be suitable subject to us completing the following modifications: widening of door to room 228 and removal of panel and dry wall in same room, removal of false ceiling, installation of air conditioning unit (done in consultation with Mr Andre Thuys) and installation of acoustic tiles and curtaining.

(Budget details are given in Appendix B)

MEETINGS OF THE ELECTRON MICROSCOPE UNIT ADVISORY BOARD

A meeting of the EMU Committee was held on Monday 14th August 2006. The meeting was attended by Prof. de La Rey, Prof. Tait, A/Prof. Sewell, Prof. Parker, Prof. Rybicki, A/Prof. Lang, A/Prof. Knutsen, Prof. le

Roux, Mrs. Thomas and Mrs. Windvogel. The committee discussed the 2005 annual report and after suggesting a few changes, the report was approved. The EMU Operational and Strategic plans were also approved by the Committee. The DVC proposed that the EMU should undergo a process of review in 2007. Professor Driver agreed that the science faculty would provide administrative support for the Unit.

MAJOR EQUIPMENT PURCHASES IN 2006

New Equipment - Glow discharge unit, Thermoshaker, Gilson 506C system plus software,

Replacement equipment - Anti-vibration coupling, Ion pump, Printer, computer for the digital camera on the light microscope.

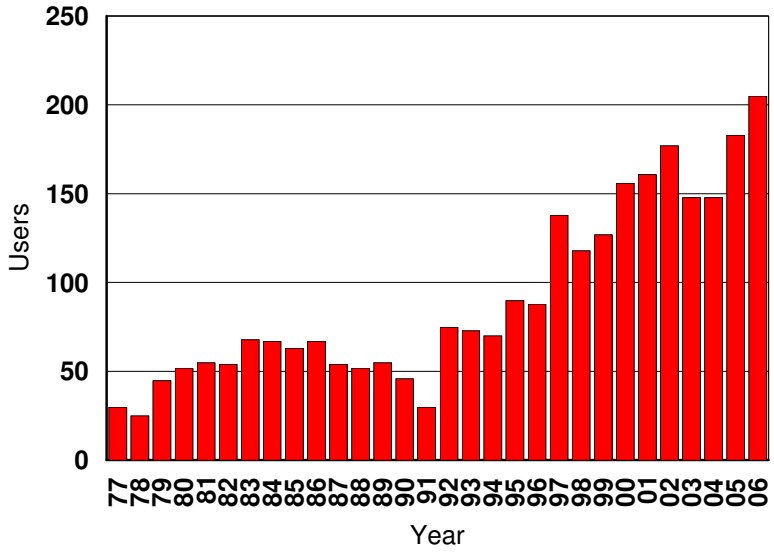
HEALTH AND SAFETY

In response to the EMU committee meeting in 2006, Michael Langley was contacted to help in drawing up a waiver form and to assist with responsibility in the event of equipment damage. External users are now required to sign this form.

USE OF THE UNIT

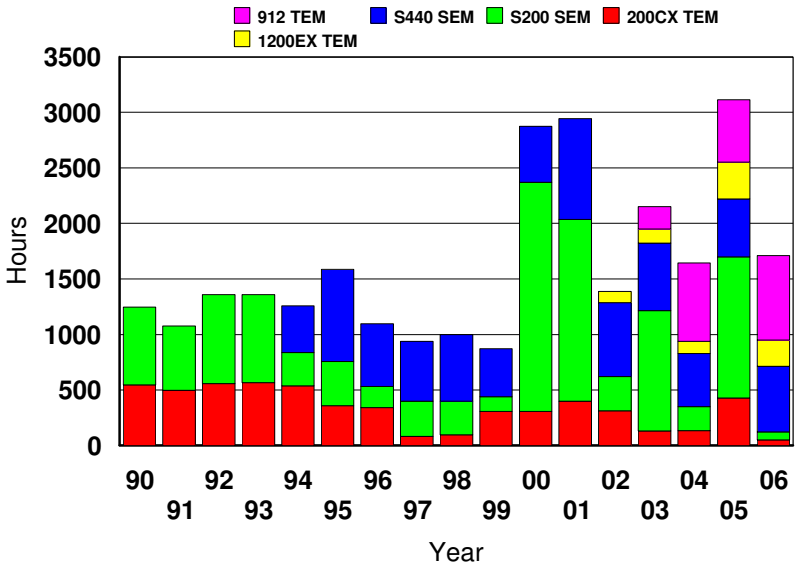
Services provided by the Unit during 2006 are listed in Table 1. Frequent usage was made of all key services of the Unit.

Fig 1: Number of users per year 1977-2006



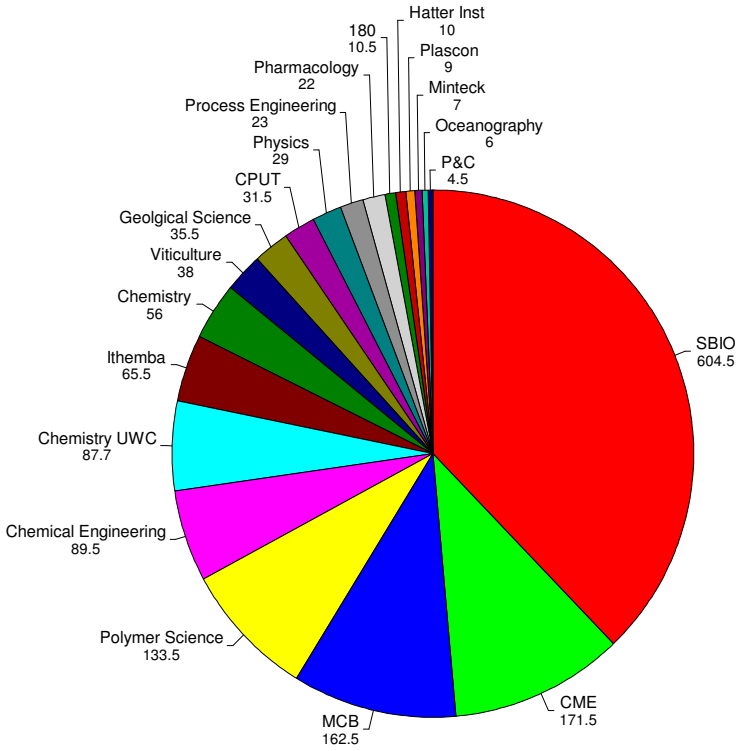
205 people made use of the microscopy services of the Electron Microscope Unit in 2006, this is a slight increase from 2005. Eleven further users utilized services other than those related to microscopy, notably printing and liquid nitrogen collection. The names and departments of the users are listed in Table 2.

Fig 2. Microscope Usage, 1990-2006



Total time spent using the Unit's microscopes was 1713 hours in 2006 which is quite a lot lower than the usage in 2005. This decrease is largely due to the fact that the S200 was hardly used for EBSD by Materials Engineering in 2006.

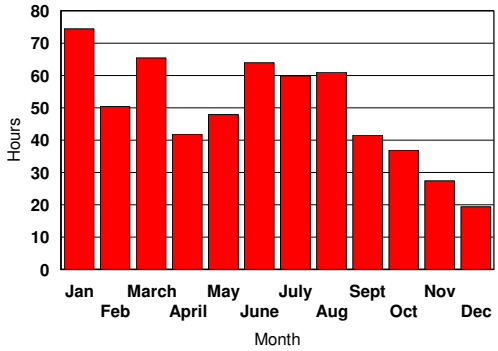
Fig 3 : Microscope usage by department, institution or company



ELECTRON MICROSCOPES AND ASSOCIATED EQUIPMENT

LEO STEREOSCAN S440 SEM

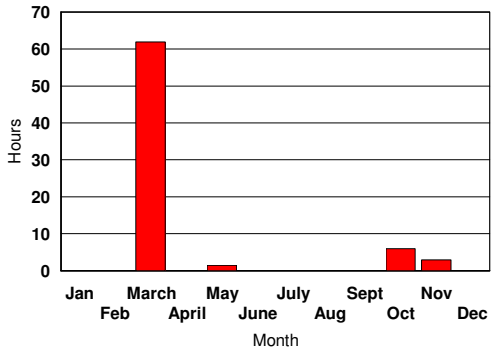
Fig 4. Use of the S440, 2006



The S440 was used for a total of 591 hours which is a slight increase on the usage in 2005. Fifty seven people from UCT made use of the instrument and there were 65 outside users. This is the first time the instrument has been used by more people off-campus. Both the number of users and the number of hours the instrument was used were more than last year. The trend of a high number of people using the SEM for a short time continued. The instrument was down for approximately 10 days during 2006, as a result of power cuts and a vacuum leak. The microscope was operated most of the year with a LaB6 filament which was replaced with the tungsten filament in November whilst waiting for spare parts to fix the vacuum leak.

CAMBRIDGE S200 SEM

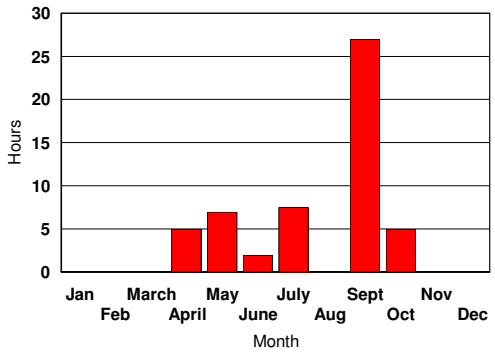
Fig 5 Use of the S200 SEM, 2006



The S200 was only used 72 hours, most of this in one month. One person used the EBSD and 2 people used the instrument for secondary electron imaging. The instrument was down for most of January because of problems with filament stability. Spare parts were taken from the old S200 that used to be housed in Materials Engineering.

JEOL 200CX TEM

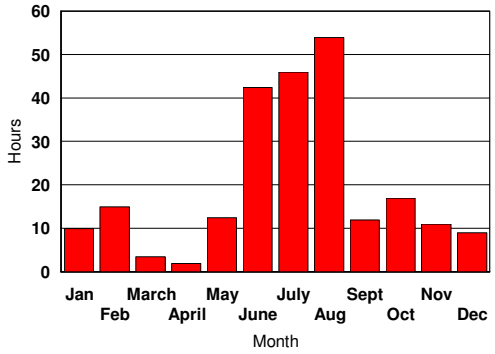
Fig 6: Use of the Jeol 200CX TEM, 2006



The 200CX TEM was only used for 53.5 hours, a large decrease from 2005. It was only used by 2 people from UCT and one of these only used the instrument for 2 hours. The main user was a Materials Engineering PhD student who was nearing the end of her project. The instrument is obsolete and it will be taken out of service in 2007. All attempts to find an institution to which to donate this 30 year old instrument failed. Presumably very few, if any, of these instruments remain in operation.

JEOL 1200EX TEM

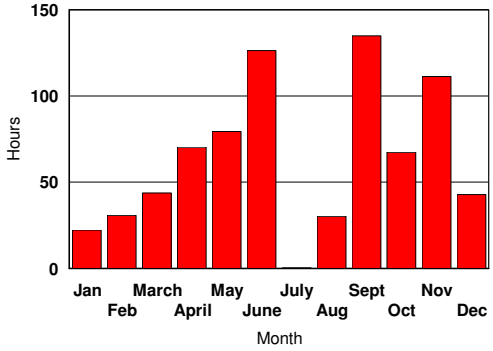
Fig 7: Use of the 1200EX, 2006



The Jeol 1200EX was fully operational all year and was used for a total of 234 hours, by 20 users from UCT and a further 15 from outside UCT. Although the main usage of this instrument remains the Structural Biology MSc students, it was also used as a back up when the Leo 912 was not operational.

LEO 912 TEM

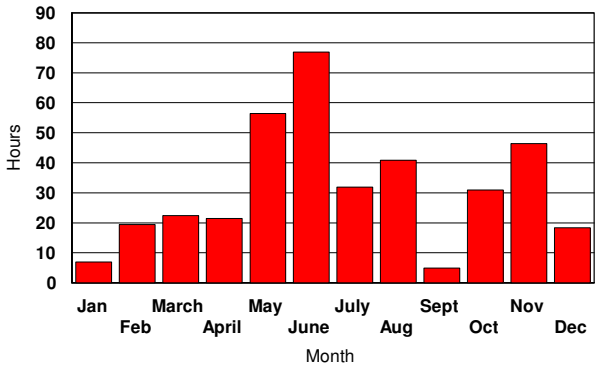
Fig 8: Use of the Leo 912 TEM, 2006



The Leo 912 proves to be the most popular and well-used instrument in the department and was used for a totalof 762 hours by 42 people from UCT and 26 outside users. This is a substantial increase in last years usage (563hours), despite the instrument being down for 7 weeks. The instrument was down from November 2005 to mid-January 2006 because of a fault in the beam deflector system. This was finally traced to a broken capacitor costing a less than R1. However as a result of interactions with Zeiss during this time we were finally supplied with extensive service information and service tools.The microscope was also out of action in July and August because of a faulty power supply. A new power suplpy was ordered from Zeiss and installed by Mr Duncan.

ULTRAMICROTOME

Fig 9: Use of the Ultramicrotome, 2006



Use of the ultramicrotome was 378 hours, the same as last year. Cryomicrotome facilities were used by Cape Heart Centre, MCB, CSIR and Oenology and Viticulture at University of Stellenbosch.

LIGHT MICROSCOPY

All the light microscopes and Zeiss Axiocam continued to be used throughout the year. At the beginning of the year, the fluorescent microscope was cleaned and serviced by the Zeiss agent. The computer with the Axiocam software crashed towards the end of the year and the opportunity was taken to upgrade the software and replace the computer.

IMAGING CENTRE

The imaging centre has sophisticated software capability aimed at image enhancement and three dimensional reconstruction. Photographic negative digitization using the Nikon LS4500 and Leafscan scanners is the basis of data analysis. **0The** HP2000C inkjet printer was replaced. Printing resources were used for theses and plates for publications. Dye sublimation printing services were discontinued.

MSSA 2006

The MSSA annual conference was held at the Nelson Mandela Metropolitan University in Port Elizabeth this year. Prof. Sewell attended the conference.

TEACHING AND EXTENSION

INDIVIDUAL TRAINING

Leo 912

MCB 7: Vundli Ramakolo, Ramon Parreira, Oliver Windram, Kyle Dent, Inonge Mulako, Allison Lynch, Jelena Bajic
Geological Sciences 1: Sarah Staniland
Process Engineering 1: Jim Motsweni
CPUT 1: Michelle Cameron
Structural Biology 3: Jennifer Miller**,** Johan Eicher, Michelo Simuyandi

Jeol 1200EX

Structural Biology 3: Jennifer Miller**,** Johan Eicher, Michelo Simuyandi

Leo S440.

Structural Biology 1, Jeremy Woodward
Polymer Science 1, Anton Roux
Chemistry UWC 1, Patrick Ndungu
Geological Sciences 1, Chris Brough
Physics 2, Adetula Bolade and Girma Goro Gonfa
Materials Engineering 1, Sarah George

Ultramicrotome

MCB 15: 12 x 3rd yr. students, Ramon Parreira, Arox Kamngoma, Livio Heath
CPUT 1: Michelle Cameron
Chemical Engineering 3: Virginia Chang, Melissa Julies, Peter Cairns
Polymer Science US 3: Adine van Schalkwyk, Lisah Harmse, Nagi Greesh

Cryo-ultramicrotomy

Cape Heart Centre: Helen Ilsley
MCB: Richard Halsey
CSIR: Thandi Mgwebi
Viticulture and Oenology: Pieter Raath, Beatrice du Plessis

SCHOOL VISITS

Four Bishops A Level students and 3 A level Students from Hout Bay International School visited in February

MICROSCOPY FOR BIOLOGISTS

The Microscopy for Biologists course was held in April and attended by 20 MCB honours students.

STRUCTURAL BIOLOGY MSC STUDENTS

3 students from the Structural Biology Masters programme spent 2 weeks in the Unit. They were taught cryo TEM on the Jeol 1200EX and how to operate the Leo912 TEM

RESEARCH ACTIVITY

Research was generally carried out in collaboration with other departments and laboratories. The following projects which depend on the initiatives of Unit members were active during 2006:

Viruses

Main area of research is virus structures, analysis of virus evolution through genetic recombination and analysis of protein structural constraints on viral evolution.Ms Miller is studying the capsid structure of HcRNAV, an algal virus for her MSc. Three papers have been published on viral recombination in the Journal of Virology, the Journal of General Virology and AIDS Research and Human Retroviruses repectively. Three papers have also been published on viral diversity in the journal of General Virology and the Journal of Virological Methods.

Chromatin

T. Frouws, B.T. Sewell, H.-G. Patterton

The project involved the use of modern techniques to re-determine the three dimensional structure of the histone octamer particle in helical crystals. The study produced a new insight into the into the packing of the histone cores in the helical crystals which is relevant to the *in vivo* packing of nucleosomes in the 30nm chromatin fibre. Mr Frouws completed his MSc. A paper directed at the Biophysical Journal is in an advanced stage of preparation. Mr Frouws has continued his studies at the ETH in Zurich.

Glutamine synthetase

J. van Rooyen, B.T. Sewell, V.R. Abratt

Glutamine synthetase is the central enzyme controlling nitrogen flux in all organisms. The allosteric mechanism of this potentially important drug target remains unknown. The type III enzyme from *Bacteroides fragilis* is the largest yet discovered and is an ideal object for study by high resolution cryo-electron microscopy. This technique coupled with X-ray crystallography and molecular modelling has the best chance of determining the allosteric mechanism. A major paper was published in the Journal of Molecular Biology.

3D reconstructions from metal coated objects

J.D. Woodward, B.T. Sewell, M. Goldberg (University of Durham), F. Nicolls

Metal coating remains an important technique for obtaining contrast from biological objects especially in the scanning electron microscope. The primary purpose of the study was to explore the possibilty of producing high resolution three dimensional reconstructions from this technique. An additional project has been the reconstruction of unidirectionally shadowed helical objects. Mr Woodward completed his MSc. A paper on the unidirectional shadowing has been prepared for the Journal of Structural Biology.

Angiotensin converting enzyme

J. Watermeyer, I. Chitapi, B.T. Sewell, E. Sturrock

Angiotensin convering enzyme is an important and validated drug target in the control of blood pressure. Several ketone based binders designed by A. Nchinda were visualised by x-ray diffraction using synchrotron radiation. The binders were found to be converted to a gemini-diol transition state. Mr Chitapi completed his MSc. Two papers have been published in Biochemistry.

Nitrile hydratases from *Geobacillus pallidus* and *Rhodococcus rhodochrous* I-small

T. Tsekoa, J. van Wyk, S.K. Kwofie, B.T. Sewell, J. Frederick, B.W. Weber, A. Varsani, D. Brady (CSIR), O.T. Bishop, M. F.-R. Sayed (UWC), D.A. Cowan (UWC)

Nitrile hydratases are the world's most profitable industrial enzymes, being responsible for the production of 30,000 tonnes of acrylamide annually. We are exploring their use in the production of fine chemicals and drugs ans well as engineering them for increased thermostability. Mr Tsekoa completed his PhD. Mr Kwofie completed his MSc. A paper was published in Biochemical and Biophysical Research Communications. Two further papers are in preparation.

The amidase from *Geobacillus pallidus*

S.W. Kimani, B.T. Sewell, A. Varsani, B. W. Weber, M.F.-R. Sayed (UWC), D.A. Cowan (UWC)

The hexameric amidase structure is first entirely novel protein structure to be determined by x-ray crystallography in Africa. It is a potentially important idustrial enzyme in its own right but its study has led new ideas for drug targets directed against both Malaria and tuberculosis. Miss Kimani completed her MSc. Two papers were published in Structural Biology and Crystallization Communications and Applied Microbiology and Biotechnology. Another (major paper) has been accepted by Biological Crystallography and will appear shortly.

Structure of the nitrilases from *Rhodococcus rhodochrous* J1, *Bacillus pumilus, Pseudomonas stutzeri, Geobacillus pallidus*, *Neurospora crassa* and *Gloeocercospora sorghi*

R. N. Thuku, K.C. Dent, J.D. Woodward, J. Eicher, M.P. Scheffer, D. Brady (CSIR), B.T. Sewell, B. Weber, A. Varsani, M.J. Benedik (Texas A&M University)

The nitrilses are sought-after catalysts for the production of fine chemicals. The cyanide degrading enzymes have of potential use in environmental remediation. We have solved seven structures at varying resolutions by single particle techniques and made substantial progress on several others. Progress was made towards the creation of an atomic model on the basis of homology with two known structures. Mr Thuku and Ms Scheffer completed their MSc's. A major paper was published in FEBS Journal. Two further papers are in an advanced stage of preparation.

PUBLICATIONS

Publications, for 2006, that resulted from research in which the EM Unit staff have been directly involved are listed:-

Agarkar,V.B., Kimani, S.W., Cowan, D.A., Sayed, M. F-R and Sewell, B.T. (2006). The quaternary structure of the amidase from Geobacillus pallidus RAPc8 is revealed by its crystal packing. Acta Cryst: **F62.** 1174-1178.

Heath, L., van der Walt, E., Varsani, A. and Martin, D. (2006). Recombination Patterns in Aphthoviruses mirror those found in other picornaviruses. Journal of Virology: **80 (23).**11827–11832 .

Kohl, T., Hitzeroth I. I., Stewart D., Varsani A., Govan V. A., Christensen, N D., Williamson A.-L. and Rybicki. E. P.(2006). Plant-Produced Cottontail Rabbit Papillomavirus L1 Protein protects against tumor challenge: a proof-of-concept study. Clinical and vaccine Immunology: **13(8).** 845–853.

Shepherd, D.N., Martin, D.P., Varsani, A., Thomson, J.A., Rybicki, E.P. and Klump,H.H. (2006). Restoration of native folding of single-stranded DNA sequences through reverse mutations: An indication of a new epigenetic mechanism. Archives of Biochemistry and Biophysics: **453**.106–120.

Tastan-Bishop, A.O. Sewell, T. (2006). A new approach to possible substrate binding mechanisms for nitrile hydratase. Biochemical and Biophysical Research Communications **343.** 319-325.

van Rooyen, J., Abratt, V. and Sewell, B.T. (2006). Three-dimensional structure of a type III Glutamine Synthetase by single-particle reconstruction. J.Mol Biol .**361:**796-810.

Varsani, A., Williamson, A-L., Stewart, D., Rybicki, E. (2006). Transient expression of Human papillomavirus type 16 L1 protein in *Nicotiana benthamiana* using an infectious tobamovirus vector. Virus Research: **120**. 91–96 .

Varsani, A., van der Walt, E., Heath, L., Rybicki,E., Williamson A-L. and Martin, D (2006). Evidence of ancient papillomavirus recombination. Journal of General Virology : **87**. 2527–2531.

Varsani, A., Williamson, A-L., Jaffer, M.A. and Rybicki, E.P.(2006). A deletion and point mutation study of the human papillomavirus type 16 major capsid gene. Virus Research **122.** 154–163.

Watermeyer, J.M., Sewell,B.T., Schwager, S.L., Natesh, R., Corradi, H.R., Acharya, K.R. and Sturrock, E.D. (2006). Structure of Testis ACE Glycosylation Mutants and evidence for conserved domain movement. Biochemistry: **45.** 12654-12663.

PUBLISHED CONFERENCE PROCEEDINGS

J.M.van Rooyen, V.R. Abratt and B.T. Sewell. Three-Dimensional structure of a type III glutamine synthetase by a single particle reconstruction**.**

PUBLICATIONS BY USERS OF THE UNIT

The following list includes those papers given to the Unit by users. It is unfortunately not a complete list of published work that has been conducted in the Unit. A great deal of the work done by users is published only as conference proceedings, such work is not reflected here.

Balasundaram, B. and Harrison, S.T.L. (2006.) Study of Physical and Biological Factors Involved in the Disruption of E. coli by Hydrodynamic Cavitation. Biotechnol. Prog. **22**, 907-913.

Balsam, R, Van der Willigen, C. and Farrant, J.M. (2006). Relating leaf tensile properties to drought tolerance for selected species of *Eragrostis*. Ann. Bot. **97**. 985-991.

Barkhuizen, D., Mabaso,I., Viljoen, E, Welker, C., Claeys, M van Steen, E. and Fletcher, J. (2006). Experimental approaches to the preparation of supported metal nano-particles. Pure and Applied Chemistry **78(9)** 1759-1769.

Cairns, P. Dry, M.E. Van Steen, E. and Claeys,M. (2006). Copper as a selectivity promoter in iron based Fischer-Tropsch synthesis. Proc. 23rd International Pittsburgh Coal Conference 25-28.

Compton, J.S. (2006). The mid-Holocene sea-level highstand at Bogenfels Pan on the Southwest Coast of Namibia. Quaternary Research, **66**. 303-310.

Compton, J.S. (2006). Holocene evolution of the Anichab Pan on the Southwest coast of Namibia. Journal of Sedimentology, 2006. 45-51.

Egan, T.J., Chen, J.Y-J., de Villiers, K.A., Mabotha, T.E., Naidoo, K.J., Ncokazi, K.K., Langford, S.J., McNaughton, D., Pandiancherri, S. and Wood, B.R.(2006). Haemozoin (β-haematin) biomineralization occurs by self-assembly near the lipid/water interface. FEBS Lett. **580**:5105-5001.

Egan, T.J. and Tshivase, M.G.(2006). Kinetics of β-haematin formation from suspensions in aqueous benzoic acid. Dalton Trans. 5024-5032.

Franceschini, G, and Compton, J. (2006). Holocene evolution of the sixteen mile beach complex, Western Cape, South Africa. Journal of Coastal Research, **22**.1158-1162.

Huang, D-G., Liao, S-J., Lui, J-M.., Dang, Z. and Petrik, L. (2006). Preparation of visible-light responsive N-F codoped TiO2 Photocatalyst by a sol-gel-solyothermal method. Journal of Photochemistry and Photobiology. **184 (3).** 282-288.

Gtiari, W., Petrik, L.,Etchebers, O., Key, D.L., Iwuoha, E. and Okujeni, C. (2006). Treatment of acid mine drainage with fly ash: removal of major contaminants and trace elements. J.Environ. Sci. Health A Tox. Hazard Subst. Environ. Eng. **41(8).**1729-47.

Iwuoha, E., Manvundla, I., Somerset, V., Petrik, L., Klink, M., Sekota, M. and Bakers, P. (2006). Electrochemical and spectroscopic properties of fly ash-polyaniline matrix. Nanorod Composites Microchip Acta **155**453-458.

Klump, H., Koch, K., Lin, C.T. (2006). DNA-mediated biomineralization of a new planar Pt-complex : research letter. South African Journal of Science. **102**. 264-266.

Lui, J-M., Liao, S-J., Jiang, G-D., Zhang, X-L and Petrik, L. (2006). Preparation, Characterization and catalytic activity of Zr embedded MSU-V with high thermal and hydrothermal stability. Microporous and Mesiporous Materials. **95(1-3).** 306-311.

Moore, J.P., Cannesan, M.A., Chevalier, L.M., Lindsey, G.G., Brandt, W., Lerouge P., Farrant, J.M., and

Driouich, A. (2006). The response of the leaf cell wall to desiccation in the resurrection plant *Myrothamnus flabellifolius*. Plant Physiology **141**. 651-662.

Moore, J.P., Lindsey, G.G., Farrant, J.M. and Brandt, W. (2006). An overview of the biology of the desiccation tolerant resurrection plant *Myrothamnus flabellifolia*. Annals of Botany, **99.** 211-217.

Mtwisha, L., Farrant, J.M., Brandt, W., Hlongwane, C and Lindsey, G.G. (2006). ASP53, a 53 kDa cupin-containing protein with a dual role: storage protein and thermal protectant. In: Seeds: Biology, Development and Ecology, 57-70. Eds S. Navie, S. Adkins, and S. Ashmore. CAB International, Walingford, UK.

Ndungu, P., Onyegbule, N., Bucher, R., Nechaev, A. and Linkov,V. (2006). The use of LPG for the synthesis of carbon nanotubes on various substrates. New Diamond and Frontier Carbon Technology. **16**. 39-49.

Newton, R.J., Bond, W, and Farrant, J.M. (2006). Effects of seed storage and fire on germination in the nut-fruited Restionaceae species *Cannomois virgata*. South African Journal of Botany, **72**.177-180.

Ntuli, F. and Lewis, A. (2006). The effects of a morphology modifier on the precipitation behavior of nickel powder. Chemical Engineering Science **61(17).**5827-5833.

Wrigley, R. and Compton, J.S. (2006). Late Cenozoic evolution of the outer continental head of the Cape Canyon, South Africa. Marine Geology **226**. 1-23.

Zhuang, Y. and Lewis, A.E. (2006). Effect of crystallisation on the reaction kinetics of nickel reduction by hydrogen. Chemical Engineering Science **61(12).**4120-4125.

Zhuang, Y., Claeys, M. and van Steen, E. (2006). Novel synthesis route for egg-shell, egg-white and egg-yolk type of cobalt on silica catalysts. Applied Catalysis A: General **301** 138-142.

PHD THESES

Moore, John, MCB: The role of polyphenols and the cell wall in relation to the desiccation tolerance of the resurrection plant, *Myrothamnus flabellifolia* (Welw.).

Napier, Hugh, Human and Cell Biology: Ontogenesis of the cornea and ciliary body: a morphological and molecular study.

Smith Meris, Geolgical Sciences: Prediction, control and rehabilitation of iron encrustation in water supply boreholes, Western Cape, South Africa: a Geochemical approach.

MSC THESES

Carelse, Muneeba, Materials Engineering: Investigation of the hardening behavior and ordering transformation in Pt 14 at. % Cu.

Chitapi, Itai, Structural Biology: Structural characterization of Angiotensin-Converting enzyme active site sub-sites .

Galada, Ncebakazi, UWC Chemistry: Exploring diversity and ecology of nonarchaea in hydrothermal biotopes.

George, Sarah, Materials Engineering: Evaluation of the stress relaxation technique for measuring softening kinetics in aluminum alloys.

Etmimi, Hussein Mohamed, Institute of Polymer Science: Hydrophobic core/shell particles via miniemulsion polymerization

Frouws, Timothy, Structural Biology: Iterative helical real-space reconstruction of histone octamer tubular crystals and implications for the 30nm chromatin fibre.

Greesh, Nagi. MSc Polymer Science (US) Preparation of polymer-clay nanocomposites using emulsion polymerization: Influence of clay modifiers on the final nanocomposites morphology.

Kwofie, Samuel, Structural Biology: The Crystal Structure of a mutant Nitrile Hydratase

Meletse, Thabo, Materials Engineering: Development of low cost thermal insulating materials.

Monjane, Adérito, MCB: Production of diospyrin by *Euclea natalensis* seedlings and in vitro cultures.

Moumakwa, Donald, Materials Engineering: Tribology in coal-fired power plants.

Scheffer, Margot, Structural Biology: Helical structures of the cyanide degrading enzymes from *Gloeocercospora sorghi* and *Bacillus pumilus* providing insights into nitrilase quaternary interactions**.**

Thamahane, Tankiso, UWC Chemistry: Development of an anodic electrocatalyst and optimization of the membrane electrode assembly (MEA) for hydrogen production by water electrolysis.

Thuku, Ndoria Structural Biology: The structure of the Nitrilase from *Rhodococcus rhodococcus* J1: Homology modeling and three-dimensional reconstruction.

FINANCE

Details of the Unit's accounts are presented in Table 3.

OTHER MATTERS

UCT/UWC COLLABORATIVE COMPUTING SYSTEM

A microwave link between UCT and UWC and data storage and processing system has been installed and developed by Mr Rory Austin. The system and Mr Austin's post was funded by a grant from the Ford Foundation**.**

EMU WEBSITE DEVELOPMENT

A revamp of the Unit's websites is in progress. Ms Amanda Gillespie has been employed to do this using the profits from the First African Structural Biology Conference. The new websites have a modern look and are coded to facilitate education, data gathering and reporting. See http://sbio.uct.ac.za/Webemu

IMPROVING DIGITAL INFRASTRUCTURE/DATABASE MANAGEMENT SYSTEM

In accordance with the operational plan a relational database and web-based database management system is being created by Ms Gillespie. This will allow users to register annually through an online form, maintain their registration information, register details of research programmes and student projects making use of EMU equipment, register publications resulting from work at the EMU, upload images resulting from use of the EMU equipment, etc. This information will then be used to drive dynamic content on the EMU websites, as well as generate data for annual reports, etc.

LEAVE BY THE DIRECTOR

In February Prof Sewell collected diffraction data on six angiotension drug (binder) complexes in on BM14 at ESRF in Grenoble and in March he collected cryo EM data on the cyanide hydratase from *Gloeocercospora sorghi* at Birkbeck College in London. In June Prof Sewell was invited to give a plenary lecture at the Gordon Conference on three-dimensional Electron Microscopy in Barga, Italy. In July he spent two weeks at the University of Virginia where he collaborated with Prof Ed Egelman.

SERVICE TO INDUSTRIAL AND OTHER EXTERNAL USERS

The Unit offers its facilities on an ad hoc basis to external users. Clients exploiting these services during 2006 were: Atlantis Foundries, CSIR, CGI, Corocraft, D. Klatzow, Fine Chemical Corporation, Glaxo Smith Kline, Industricon, iThemba Labs, Mintek, MITTAL Saldanha Steel, National Botanical Institute, One Eighty Degrees, Patterson and Cooke, Pfizer, SANS Fibers, SRK Consulting, Southern African Large Telescope (SALT) and Zama Cleaning. These clients almost exclusively use the S440 SEM and the 912 TEM and together accounted for 112 hours instrument time.

VISITORS TO THE UNIT

Dr.Mike Lawrence, Dr.Gwen Nneji, Professor Joachim Frank, Professor Edward Egelman, Professor Helen Saibil

SUMMARY

Considerable effort was invested by all staff training new microscopists and in completing projects so that the work could be published. A decision to dispose of the JEOL 200CX and acquire a modern 200kV instrument was finally taken. The unit is indisputably the leading national resource in biological electron microscopy and it has maintained its ability to serve a wide range of users.

Prepared by: Associate Professor B.T. Sewell and Mrs. Miranda Waldron

TABLE 1

Services Offered by the Unit during 2006

Service	Comment
Access to 200CX TEM	Used by 2 people
Access to 1200EX TEM	Used by 35 people
Access to S440 SEM	Used by 122 people
Access to S200 SEM	Used by 3 people
Access to 912 TEM	Used by 68 people
Training on 200CX	No new users were trained
Training on the 1200EX TEM	1 new user was trained
Training on S440 SEM	7 new users were trained
Training on the 912 TEM	11 new users were trained
Access to Ultracut S Ultramicrotome	Used by 28 people
Training on Ultracut S	26 new users were trained
Cryo-microtomy and immunolabelling	Well used
Sectioning of blocks supplied by the user	Well used
Embedding of biological specimens in methacrylate and epoxy	Well used
Freeze substitution	Used
Sputter Coating of specimens supplied by user	Very popular service
Critical point drying of specimens supplied by the user	Very popular service
Printing of EM films	Service used
Access to optical microscopy facilities	Used
Access to Image Processing and Analysis (Analysys)	Used
Element analysis by EDS	Well used.
"Introduction to EM for Biologists"	This course was held once.
Access to specimen polisher	Used
Access to high vacuum coating plant and accessories	Adequately used
Store of EM consumables	Used by most users
Access to prep lab	Well used
Collection of books and journals on microscopy	Used
Vacuum Leak Detection	Used
Production of CD ROMS	Used
Digitization of transparent media on LS4500	Used
Digitization of transparent media on Leafscan	Used
High quality ink-jet printer	Very popular
Flat bed scanner	Well Used

TABLE 2.

2006 User list

* Indicates non- microscope users

UCT USERS

Archaeology		
	Galimberti, L.	PhD
Botany		
	Aronson, E.	Hons*
	Rand,A.	Staff*
	Biccard, A.	Hons
	Hattas, D.	MSc*
	Muasya, A.	Staff*
	Schutz, A.	Staff*
	Smart, M.	MSc*
	Wisswedal, S.	Hons
	Verboom, A.	Staff*
	Yates, M.	Staff*
Cape Heart Center		
	Ilsey, H.	PhD
Cardiology		
	Shaboodien,G.	PhD
Center for Materials Engineering		
	Ariano, K.	Hons
	Camagu, S.	Msc
	Evans, E.	Hons
	George, S.	MSc
	Khuzwato, P.	Hons
	Knutsen, R.	Staff
	Lungiswe, G.	Hons
	Marekwa, M.	PhD
	Miller, D.	Staff
	Mlotchwa, K.	Hons
	Nolwansi, C.	Hons
	Park-Ross, P.	Staff
	Silethelwe, N.	PhD
	Soe, L.	Hons
	Zaheer, F.	Hons
Chemistry		
	Liu, J.	Post Doc
	Nonto, M.	Hons
	Ntsapo, N.	Msc
	Mabotha,T.	PhD
	Ruiter, P.	Hons
	Teleke, S.	Hons
	Webber, D.	Post Doc
Chemical Engineering		
	Cairns**,** P.	Staff
	Bennett, D.	Hons
	Blignaut, A.	MSc
	Chang, V.	PhD
	Chiang, J.	Hons

Goven, S. MSc

	Gwagwa, Y.	MSc
	Hove, M.	PhD
	Julies, F.	MSc
	Maluleke, W.	MSc
	Mokone, T.	PhD
	Nazneen, G.	MSc
	Nemugumoni, G.	MSc
	Newell, A.	PhD
	Ntuli, F.	PhD
	Parolis, L.	Staff
	Petersen, K.	Hons
	Qui, Y.	MSc
	Sandile, D.	MSc
	Spurr, N.	MSc
	Thebe, M.	MSc
	Toma, N.	MSc
	Vardy, Y.	Hons
	Vasic, S.	Staff
	Welker, K.	PhD
	Wisani, B.	MSc
Civil Engineering		
	Poinapen, D.	PhD
Geological Sciences		
	Brough, C.	Staff
	Minter, L.	Staff
	Staniland, S.	Post Doc
	Vigneau, A.	Post Doc
Hatter Institute		
	Chan, V.	MSc
Molecular and Cell Biology		
	Bajic, J.	MSc
	Banda, E.	Staff*
	Chauhan, M.	Staff*
	Cooper, K.	Staff
	Dent, K.	Hons
	Farrant, J.	Staff
	Halsey, R.	PhD
	Heath, L.	MSc
	Horowitz, R.	Staff*
	Hunt, B.	PhD
	Inonge, P.	MSc
	Iyer, R.	PhD
	Jaffa, I.	Hons
	Jelana, M.	MSc
	Ka'mngora, A.	MSc
	Karreman, R.	MSc*
	Kirby, B.	PhD
	Lynch, A.	PhD
	McLain, J.	MSc
	Mebie, G.	MSc
	Meyers, A.	Staff
	Meyers, P.	Staff
	Mulako, I.	MSc

Parreira, R. MSc

	Rafudeen, S.	Staff
	Ramakolo, V.	MSc
	Ramon, R.	PhD
	Reid, S.	MSc
	Rholand, J.	PhD
	Roden, L.	MSc*
	Rybicki, E.	Staff
	Shibamba, L.	MSc
	Teidt, F.	Staff
	Windram, O.	Hons
Mechanical Engineering		
	Floweday, G.	PhD
	Mumenza, H.	MSc
	Velaers, A.	MSc
Oceanography		
	Waldron, H.	Staff
Pharmacology		
	Hoppe, H.	Staff
	Seaman, T.	PhD
Physics		
	Bolade, A.	MSc
	Britton, D.	Staff
	Goro, G.	PhD
	Odoele, A.	PhD
	Sigcau, Z.	PhD
Structural Biology		
	Cope, J.	Hons
	Dent, K.	Hons
	Eicher, J.	MSc
	Frouws, T.	MSc
	Miller, J.	MSc
	Sewell, B.	Staff
	Simuyandi, M.	MSc
	Thuku, N.	MSc
	Van Rooyen, J.	PhD
	Varsani, A.	Staff
	Weber, B.	Staff
	Woodward, J.	MSc
Zoology		
	Merl, D.	PhD
	Picker, M.	Staff*
	Staniland, S.	MSc

OTHER HIGHER EDUCATIONAL INSTITUTIONS

Cape Peninsula University of Technology

Chemical Engineering		
	Sheldon, M.	PhD
Food Technology		
	Cameron, M.	Mtech
	Saayman, M.	Hons
	Siphokazi, B.	Mtech
	McMaster, L.	Staff

	Mgwebi, T	Staff
iThemba		
	Christopher	Staff
	Fasasi, B.	Post Doc
	Imane, M.	Post Doc
	Maaza, M.	Staff
	Manyawa, J	MSc
	Reamu, K.	Post Doc
	Sibaya, S.	PhD
	Topic, M.	Staff
University of Stellenbosch		
Food Science		
	Cameron, L.	PhD
Institute of Polymer Science		
	Bailly, R.	MSc
	Bawes	MSc
	Bayley	MSc
	Cloete, V.	Staff
	Fazi, J.	Post Doc
	Gnaesen, F.	PhD
	Greyling, C.	PhD
	Greesh, N.	MSc
	Harmse, L.	MSc
	Mabanja, M.	MSc
	Marco, I.	MSc
	Matari, M.	PhD
	Matahwa, J.	PhD
	Nagi, K.	MSc
	Pretorius, J.	MSc
	Ramiah, V.	PhD
	Roux, N.	PhD
	Sauti, D.	Post Doc
	Skillington, P.	Staff
	Smit, E.	Staff
	Swart, T.	MSc
	Tichagwa, K.	PhD
	Van Dungen, E	PhD
	Van Schalkwyk, A.	MSc
Plascon Research Center		
	Awkes, M.	PhD
	Fourie, K.	MSc
	Reyskins, D.	Staff
	Treurnicht, J.	Staff
	Verwoerd, H.	Staff
Process Engineering		
	Bruce. J.	PhD
	Lakay, E.	MSc
	Motshweni, J.	Msc
Viticulture and Oenology		
	Raath, P.	Staff
	Du Plessis, B.	MSc
University of the Western Cape		
Biotechnology		

Casaneva, L. MSc

	Janjua, M	MSc
	Muyanga, G.	MSc
	Tuffin, M.	Post Doc
Chemistry		
	Bertrand, F.	Msc
	Botha, N.	PhD
	Ellandt, E.	Msc
	Fatoba, D.	Msc
	Galada, J	Msc
	Gitari, H.	PhD
	Immaculate, S.	PhD
	Klink, M.	PhD
	Li, J.	Post Doc
	Meyer, C.	Msc
	Naidoo, J.	PhD
	Ndungu, P.	Post Doc
	Petrik, L.	Staff
	Ruiter, G.	Hons
	Sone, B.	Msc
	Tussein,A.	PhD
	Vadapllai, R.	Post Doc
	Wang, Y.	Msc
	Williams,A.	PhD
Dentistry		
	Schondelmeyer, M.	Post Doc
Geology		
	Van Bloemenstein, C.	MSc

COMMERCIAL USERS

180^{o} Engineering Solutions		
	Basson**, J**	Staff
Atlantis Foundries		
	Mnisi, A.	Staff
CGI		
	Beja, B.	Staff
	Barron, M.	Staff
Corocraft		
	Mason, C.	Staff
Glaxo Smith Kline		
	Van Balleygooyen, J.	Staff
Industricon		
	Wepener, V.	Staff
Mintek		
	Barkhuizen, D.	Staff
NBI		
	Sniyman, D.	Staff
	Van Jaarsveld, A.	PhD
Pfizer		
	Delport, E.	Staff
Private		
	Van Rensberg, B.	
	Klatzow, D.	

	Magubane, T.	Staff
	Van Sittert, F.	Staff
Saldahna Steel		
	Baard. A.	Staff
Southern African Large Telescope		
	Gajar, G.	Staff
South African Nylon Spinners		
	Lyth, C.	Staff
	Munoz , A,	Staff
SRK Consulting		
	McGugan, B.	Staff
Zama Cleaning		
	Lambert, V.	Staff

TABLE 3

E.M.U. Finances, 2006

Summary Statement

Opening balance	**759,550**
Income	
Operating Grant	151,116
Internal Users	118,084
External Users	107,937
Equipment Grant	72,464
Total	**449,601**
Expenditure	
Operating	257,292
Equipment	269,000
Repair and Maintenance	61,068
Total	**587,360**
Closing Balance	**621,791**

Detailed Statement

		Operating 000516	External Services 001258	Equipment 170025	Consumables 000933	Maintenance 000995
Opening Balance		8,840	245,997	327,390	38,701	138,622
Income		151,116	107,937	72,464	57,508	118,084
Expenditure		-125,973	-2,782	-278,260	-70,593	-109,752
Closing balance		**33,983**	**351,152**	**121,594**	**25,616**	**146,954**
Income						
Grant Transfers		6,000				
Operating Grant		104,145				
Budget allocation		40,971		72,464		
Internal recoveries					38,709	118,084
External recoveries			107,937			
Sales revenue					18,799	
Total		**151,116**	**107,937**	**72,464**	**57,508**	**118,084**
Expenditure						
Admin/Operating	Tel, Postage, Fax	40,211	1,959			1,740
	PC Consumables	7,591		71,045	1,635	
	PC components	9,422				
	Photocopy/Print	2,520				
	Stationery	1,757			269	113
	Travel	25,153	312			25,758
	Conferences	1,820				
	Cleaning	55				
	Utilities	6,871	511		16,072	
	Periodicals	2,871				
	General Operating	25,181		33,012	51,057	1,402
	Repair and Mantenance	2,470		15,085		58,598
	Minor Equipment	51		15,903	1,560	6,665
Equipment				143,215		15,476
Total		**125,973**	**2,782**	**278,260**	**70,593**	**109,752**