ELECTRON MICROSCOPE UNIT
ANNUAL REPORT
1995

Director	**B.T. Sewell**
Principal Technical Officer	**D.A. Gerneke**
Chief Technical Officer (Part Time)	**J. Duncan**
Senior Technical Officer	**M.A. Jaffer**
Technical Officer	**C. Bruintjies**
Photographic Assistant	**W. Williams**

April 1996

TERMS OF REFERENCE

The Electron Microscope Unit is an Inter-faculty facility. The following terms of reference were approved by Senate (PC 11/87) and confirmed by GPC (1/2/88).

"The prime objective of the EM Unit is the provision of a dedicated service to the University's research and teaching community."

"The Unit should aim at a high level of maintenance of the instruments, with a minimum of down-time".

"The Unit should ensure the provision of an adequate basic teaching in electron microscopy for users".

The Senate (PC 11/87) also approved the establishment of an E M Unit Steering Committee.

HIGHLIGHTS OF 1995

RECONDITIONING THE ZEISS EM109

The Zeiss EM109 which was housed in the Molecular Biology building was moved to the Unit on 18 May 1995. The instrument had been inoperable since 1990 due to problems with the vacuum system. Funds for a replacement vacuum system were granted by the Equipment Committee and the new system was installed during August and September by Mr James Duncan. The instrument was operational on September 15. It was calibrated and tested during the remainder of the year and brought into service at the beginning of 1996.

STAFF

Mr C.S. Bruintjies who has been with the Unit as a Technical Officer since June 1989 resigned with effect from 30 March 1996 in order to follow his calling as a minister in the Church of God. Mrs M.E. Waldron was recruited to fill the post.

DOWNTIME AND MAINTENANCE

The reliability of the EM service has increased substantially. The total time during which it was necessary to send users away due to instrument failure was less than 80 hours throughout the year. This does not mean that no problems occurred, but the Unit now has the capacity to reallocate resources and reschedule events so as to minimally inconvenience experienced users.

The Unit is also moving towards a situation in which maintenance is planned rather than stochastic and in which major repairs can be budgeted in the annual application to the equipment committee rather than through ad hoc applications to the Emergency Repair Fund. It should also be noted that a substantial maintenance fund is being built up by the users of the Unit and that funds from this source are being used to replace broken equipment and maintain the quality of the service.

MEETINGS OF THE ELECTRON MICROSCOPE STEERING COMMITTEE

The Electron Microscope Steering Committee is a technical subcommittee of the Equipment Committee, chaired by the dean of the Faculty of Science. It comprises the director of the Unit, five members of academic staff and three members of technical staff. The current members are Associate Professor H.P. Linder (Botany), Professor J.J. Gurney (Geological Sciences), Professor B.B. Rawdon (Anatomy and Cell Biology), Professor J.A. Thomson (Microbiology), Dr R.D. Knutsen (Materials Engineering), Mr D.A. Gerneke (EM Unit), Mr R.S. Rickard (Geological Sciences) and Mr P.D.G. Richards (Anatomy and Cell Biology). In addition Associate Professor R.B. Tait (Mechanical Engineering) has been co-opted onto the Committee.

Meetings of the Electron Microscope Steering Committee were held on 24 May 1995 and 20 November 1995. At both meetings progress made in implementing the Unit’s goals was reviewed. The Committee approved the proposals for the image digitizing service, the image archive project and the applications for equipment to be funded by ITEC and by the Equipment Committee.

USE OF THE UNIT

Services provided by the Unit during 1995 are listed in Table 1.

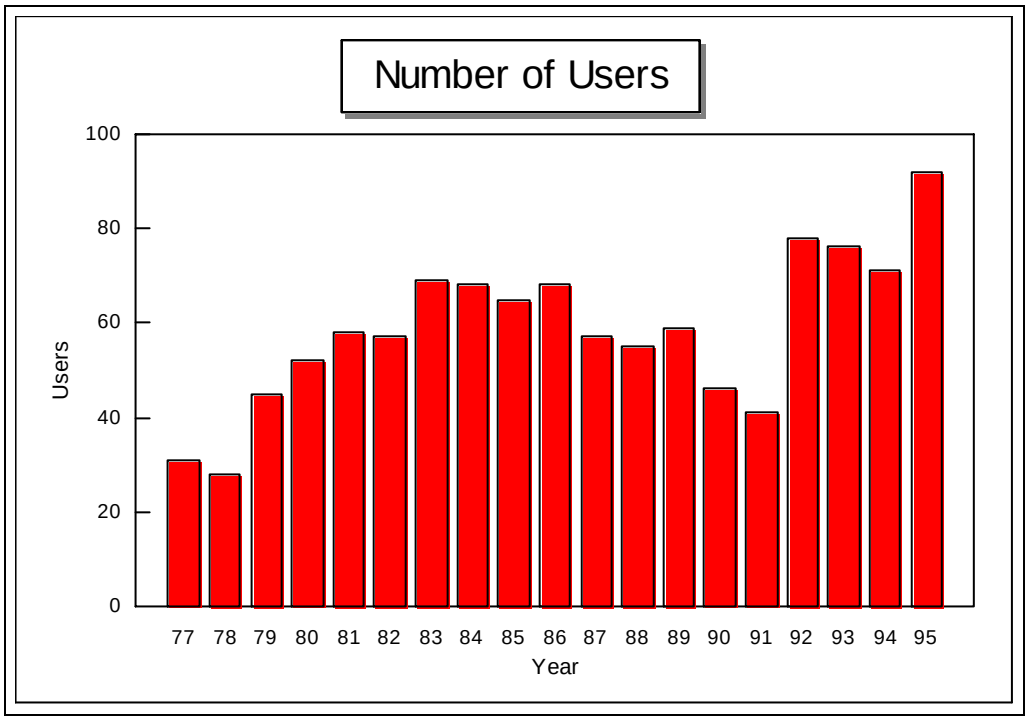

Figure1: Number of users per year since 1977.

Figure 1 shows that the number of users rose to 92 in 1995. There was an increase in the number of projects originating from other Universities, government departments and commercial/industrial firms. Almost all of this interest was due to the facilities offered by the S440 although some interest was shown in our cryo-ultramicrotomy facilities.
The names and departments of the users are listed in Table 7.

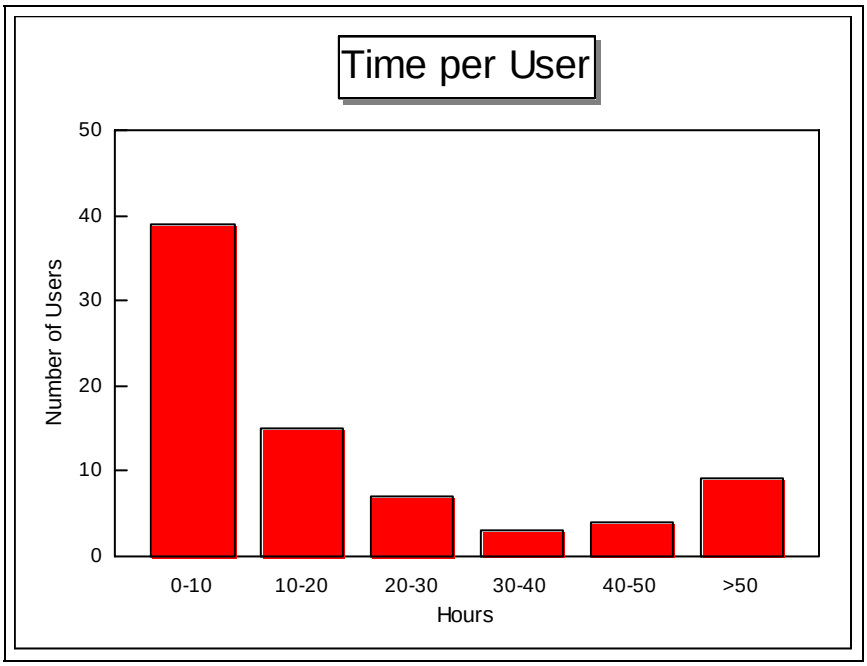

Figure 2: Usage pattern. The graph shows the time users spent viewing samples, either alone or assisted on any one of the electron microscopes.

The usage pattern, which has not changed from previous years, shows that the largest number of users made use of the Unit facilities for a comparatively short time. There is very little point in investing time in training these people and therefore they make considerable demands on the Unit staff. This graph illustrates the continued high demand for a samples in-results out pattern of usage. Further evidence of this demand is that Mr Jaffer logged 748 hours (almost 2 full days a week) preparing samples for users. At times users were forced to wait 4-6 weeks for an appointment with Mr Gerneke to operate the S440 for them. Towards the end of the year a number of users were competent operators of the S440 and the demand for staff operators declined.

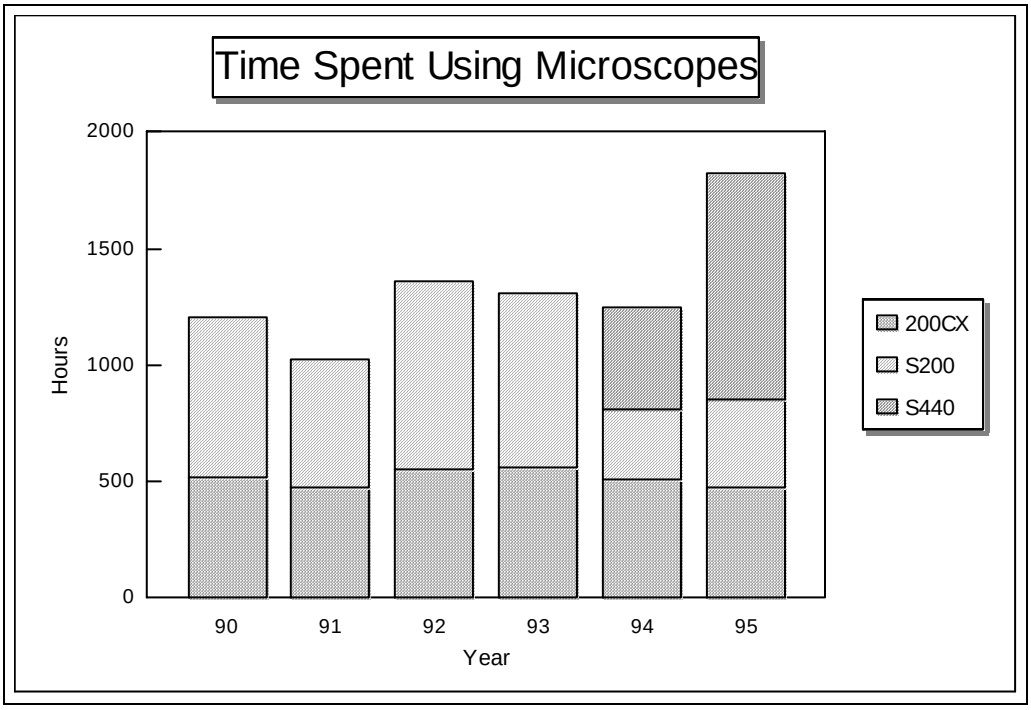

Figure 3: Time spent using the Unit's microscopes since 1990.

Total time spent using the Unit's microscopes soared to 1825 hours in 1995. More than half of this time (975 hours) was spent using the S440 which brought into service at the end of June 1994.
Some work that could potentially have been done on the S200 was done on the S440 instead because the S200 continued to display intermittent faults which made users reluctant to use it. Although the total time spent using the 200CX was similar to that in previous years, the number of users remained high at 25 users.

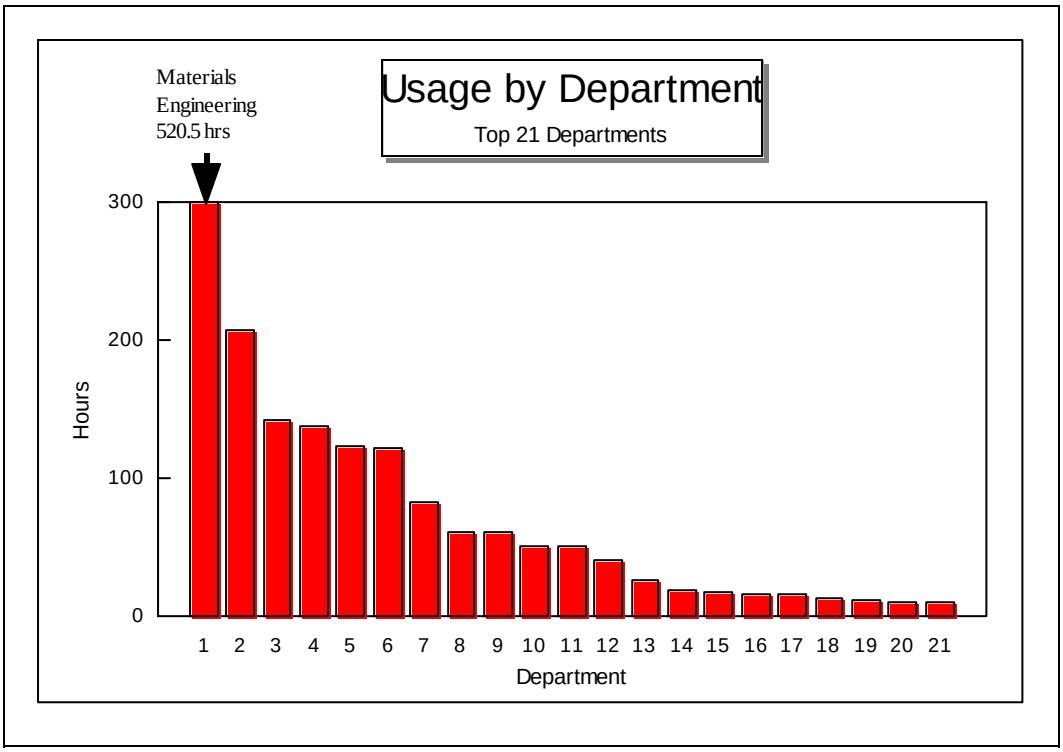

Figure 4: Microscope usage by department. The key is as follows:

1 Materials Engineering	8 Energy Research Institute	15 Mechanical Engineering
2 EMU - User training	9 Chemistry	16 NAC
3 Chemical Engineering	10 Geology (UND)	17 Cardiothoracic Surgery
4 Zoology	11 Commercial Users	18 Biochemistry
5 Botany	12 Archaeology	19 UWC
6 Geological Sciences	13 National Botanical Institute	20 Pharmacology
7 Microbiology	14 Anatomy and Cell Biology	21 Chemical Engineering (US)

1 The largest part of the Materials Engineering use was due to a single project which involved mapping the texture of stainless steel on the S440.

2 EM Unit training was the second largest user. Much of this time was spent instructing users in the use of the new equipment. The cost of this was charged to the Departmental Grant.

3 The total number of academic/government user departments has increased from 19 to 25.

TEACHING

USER COURSES

SEM training courses were held from 13/3/1995 to 17/3/1995, for 4 new SEM users and from 10/7/1995 to 14/7/1995 for 2 new users.

The four or five day intensive course aimed at honours and post graduate students, "Introduction to Microscopy for Biologists", was held three times and attended by a total of 20 students and one staff member.

9/2/1995-14/2/1995	8 Zoology students
20/3/1995-24/3/1995	4 Chemical Engineering students
18/4/1995-24/4/1994	8 Biochemistry students and 1 Chemical Engineering staff member

INDIVIDUAL TRAINING

Thirteen new users were trained to operate the 200CX, eight were trained to operate the S440, one to operate the S200 and nine to operate the microtome.

SCHOOL VISITS

Twenty-two standard eight pupils from Bishops visited the Unit for a lecture and demonstration on 1 February and a group from St Joseph's College visited the Unit on 14 June.

LECTURES

Mr Jaffer delivered four lectures and a practical on "Virus Structure and Electron Microscopy" as a component of Microbiology 303S from 14-17 August.

TEM COURSE

Mr Steve Chapman, an internatioanally renowned teacher of electron microscopy, delivered a course on transmission electron microscopy in the Unit from 26-28 June. It was organized by Anaspec cc and attended by 8 participants from UCT, UWC and UPE .

ENVIRONMENTAL GEOCHEMISTRY

Mr Gerneke held a four day practical workshop in element analysis for the Environmental Geochemistry honours course run by Prof J. Willis in the Unit.

EQUIPMENT

CAMBRIDGE S200 SEM AND KEVEX 7000 EDX

The S200 was again used at well below its former rate for most of the year. In spite of the rebuilding and repair that took place in 1994 the instrument continued to display occasional faults which manifested themselves as lines on the photographs. The fault is currently believed to be due to switches that have worn out. Unfortunately switches of the type required are obsolete and any substitution will require some re-engineering. This is the second time that we have encountered faults in a component that is unobtainable through conventional sources and it is this kind of obsolescence that may impose limits on the practicable lifetime of the instrument.

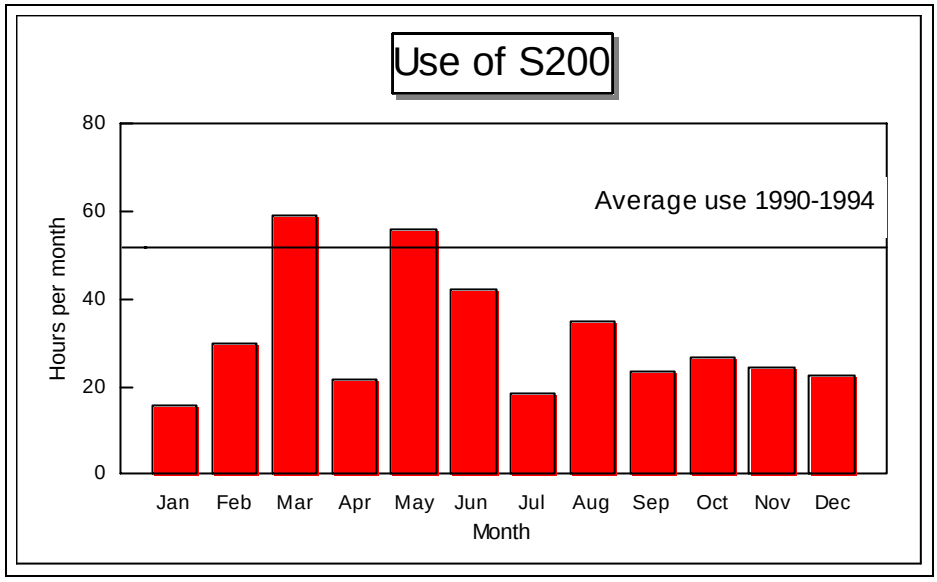

Figure 5: Use of the Cambridge S200 SEM

The Kevex detector was used successfully. A circuit board was replaced by one of those obtained from NAMPAK in 1994.

JEOL 200CX TEM

Use of the TEM again fell slightly during the year.

No serious breakdowns were recorded on this instrument during the year, however there are problems of beam stability during the "warm-up" period which last about five hours. The specific causes of these problems remain unkown but several potential problem areas are being monitored.

The AstroCam 4100 CCD camera was installed on this microscope in order to create a facility for direct digital imaging. This did not work and was ultimately returned to the manufacturer for modification.

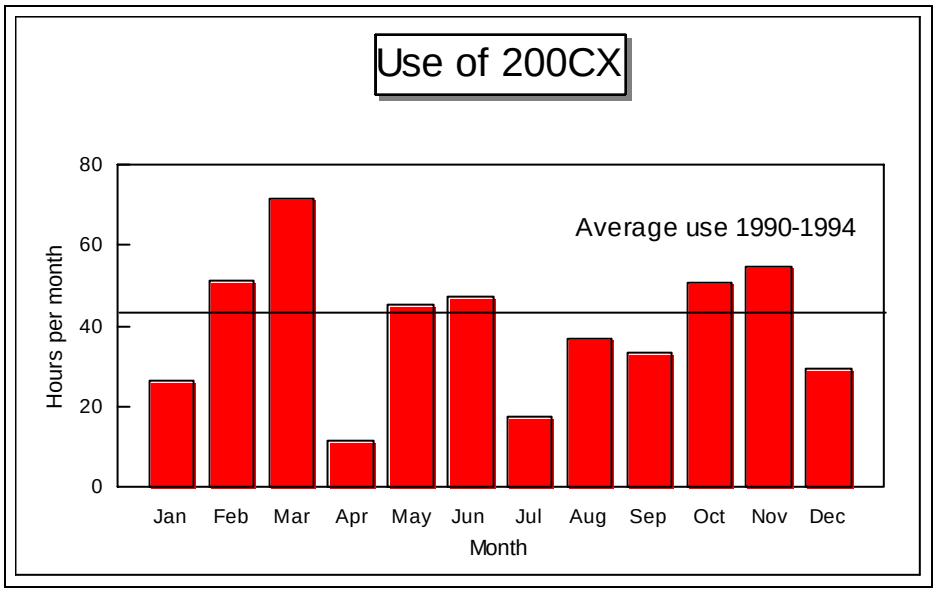

Figure 6: Use of the Jeol 200CX TEM

LEICA STEREOSCAN S440

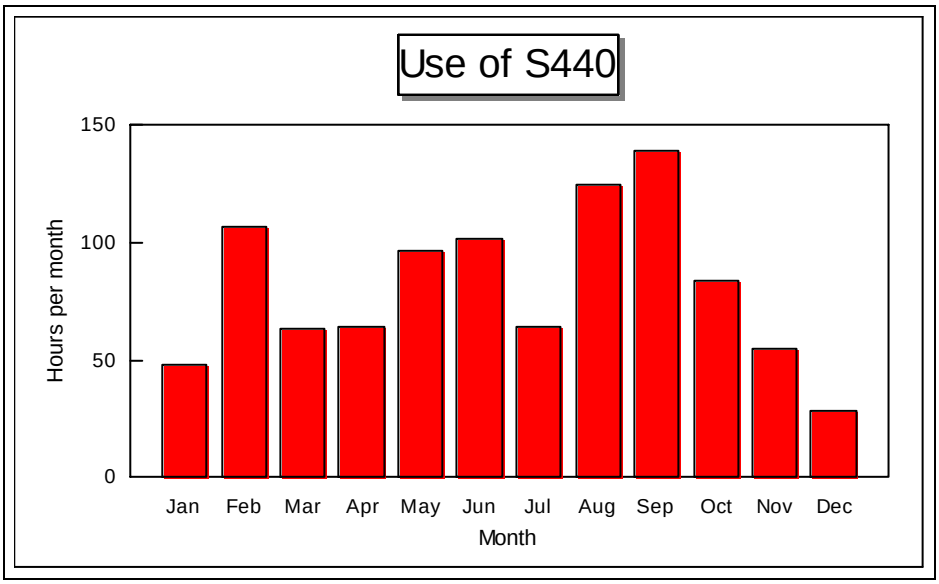

Figure 7: Use of the Leica S440 SEM

The facilities offered by this instrument are unique in the country and therfore the high usage was anticipated. Use of the instrument follows the academic year with lower utilization during the vacation periods and over Easter. This is similar for all instruments and there is probably very little that can be done about it. The annual rush to finish honours projects in Science and Engineering contributes to the high September load. Note that the total use of this instrument made during 1995 is the highest ever made of any single instrument in the Unit. This must indicate that it is applicable and appropriate to the needs of the University.

OTHER EQUIPMENT

COMPUTERS

A computer funded entirely by ITEC was purchased to control the AstroCam CCD camera. A second powerful computer, funded equally by the FRD core programme and ITEC was purchased in order to

store, process and display images as well as act as a development platform for image processing algorithms.

MICROTOME

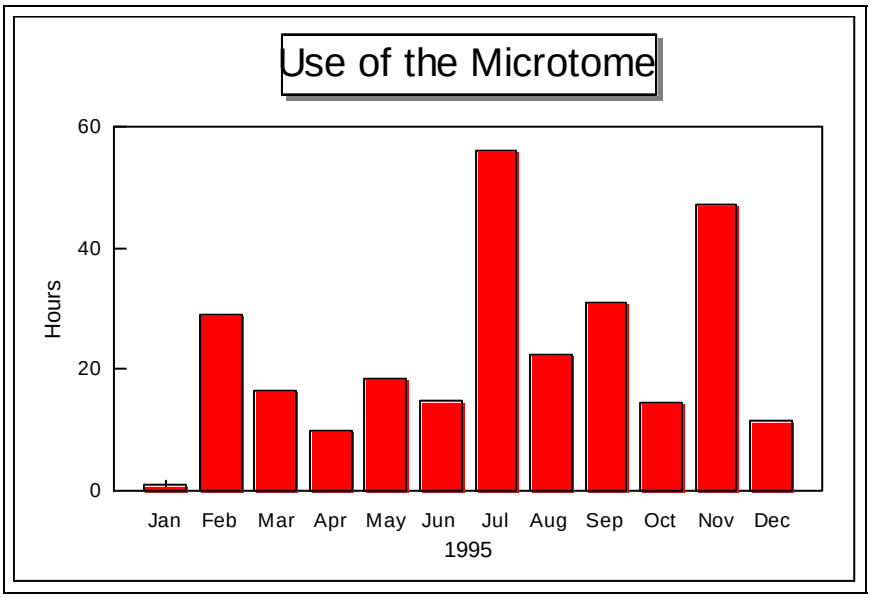

Figure 8: Use of the Leica FS Ultramicrotome

There has been a resurgence of interest in projects involving microtomy since the installation of the new ultramicrotome in May 1994. Statistics on the use of the microtome were not kept previously.
The full potential of the instrument remains to be exploited. In order to position the Unit to support an instrument of this kind Mr Jaffer was underwent training at the University of Natal (Pietermaritzburg) under the supervision of Dr Edith Elliot during May 1995.

FINANCE

Details of the Unit's accounts are presented in Tables 2, 3, 4, 5 and 6.

RESEARCH ACTIVITY

Research was generally carried out in collaboration with other departments and laboratories.
The Director devoted time to the three research projects described below and to the supervision of two PhD students (Mr Jaffer and Mr Reavis) and one MSc student (Mr Nicolls). Mr Nicolls completed his project and has submitted his thesis for examination.

Electron Tomographic studies of the chromatin fibre:
B.T. Sewell and M.A. Jaffer.
Chromatin in the cell nucleus is compacted through a series of folding events. The first of these foldings is the formation of nucleosomes. This is well understood. The nucleosomes are then formed into fibres which have a diameter of about 30 nm. The structure of the fibres remains unknown. Electron tomography is a method which could lead to the structure determination of the fibre at the level of resolution necessary for understanding of its folding.

Computer analysis of gel electrophoretograms:
B.T. Sewell, S.C. Reavis (Provincial Laboratory for Tissue Immunology).
This project involves the development of a computer system for the analysis of gel electrophoretograms. Although many of the algorithms are of general application the primary objective is the development of a system for the automatic analysis of the tandem repeat VNTR DNA polymorphism for paternity testing.

Autofocus Algorithms in the Scanning Electron Microscope
B.T. Sewell, G de Jager and F.C. Nicolls (Department of Electrical Engineering)
Accurate and rapid automatic focusing of the scanning electron microscope would simplify the operation of the microscope for novice users and enable an experienced user to achieve more. The only published work in the area makes use of a large number of scans of the same area and chooses the one which has the best focus. The goal of this project is to design and implement an algorithm which will be able to

predict focus from a small number of scans. The project is being undertaken as part of our partnership agreement with Leica, Cambridge

Development of a system for the analysis and recording of electron backscattered diffraction patterns
R.D. Knutsen, N.J. Wittridge, D.A. Gerneke and B.T. Sewell
Electron backscattered diffraction patterns can easily be used to determine the orientation of crystallites, particularly those in a polycrystalline material. The arrangements of the crystallites, or microtexture, is important in determining the mechanical properties of steel and aluminium sheets. We have built a system for recording these patterns and semi-automatically deterimining the orientation of the crystallites. Microtextures have been mapped using the system.

Studies on otoliths
M.E. Waldron and D.A. Gerneke
Banding in otoliths from mackerel *(Trachurus trachurus)* can be used to determine the age of the fish. The bands are laid down daily but details of their origin are not fully understood. Elemental analysis and cathodoluminescence studies of the bands have been undertaken in order to gain some understanding of this.

PUBLICATIONS

Publications, for 1995, that resulted from research in which the EM Unit staff have been directly involved are listed:-

Conference Proceedings

Jaffer, M.A. and Sewell, B.T. (1995), "The internal structure of isolated chromatin fibres", 13th Congress of the SA Biochemical Society, Bloemfontein, 2-5 April

Sewell, B.T. (1995), "Software for the revision of Std 9-10 Physical Science", Internet & Educational Computing Conference, Cape Town, 28-29 September

Published Conference Proceedings

Gerneke, D.A, Sewell, B.T, Gartz, V.H. and Frimmel, H.E.(1995), "The technique of cathodoluminescence applied to Witwatersrand quartz using a Leica S440 and Oxford MonoCL". Proc. Electron Micros. Soc. Southern Afr. **25**, 5.

Gerneke D.A. , Lipinski M.R., Durholtz M.D, Waldron M.E, Oosthuizen W.H., Erasmus, J. and Sewell, B.T. (1995) "The visualization of growth increments". Proc. Electron Micros. Soc. Southern Afr. **25**, 72.

Sewell, B.T. and Jaffer, M.A. (1995) "Is a slow-scan CCD camera a viable alternative to film?". Proc. Electron Microsc. Soc. Southern Afr., **25**, 6.

Von Wechmar, M.B., Purves, M., Jaffer, M.A. (1995) "New insights into the biology of tobacco necrosis virus indicate a complex epidemiology requiring novel control strategies", Proc. Sixth International Plant Virus Epidemiology Symposium - Jerusalem.

Published Paper

Delpierre, G.R. and Sewell, B.T. (1995) "Designing for the Real World: Physical Science Courseware for South African Schools", Spectrum, 33(4), 18-20.

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.

Adams, S.A., Kelly, S.L., Kirsh, R.E., Robson, S.C. and Shephard, E.G. (1995) "Role of neutrophil membrane proteases in fibrin degradation", Blood Coagulation and Fibrinolysis, **6**, 693-702

Bruyns, P. and Meve, U. (1995) "The generic position of Carallumna dodsonia", Edinburgh J. Bot, 52, 195-203.

Bruyns, P. (1995) “A re-assessment of the genera Tridentea Haw. and Tromotriche Haw. S. Afr. J. Bot. 61, 180-208.

Matthews, I., and Cook, P.A. (1995) “Diatom diet of Abalone post-larvae (Haliotis midae) and the effect of pre-grazing the diatom overstorey”, Mar. Freshwater Res., 46, 545-548.

Parthasarathy, M., Garcia-Lario, D., de Martino, D., Pottasch, S.R., Kilkenny, D., Martinez, P., Sahu, K.C., Reddy, B.E. and Sewell, B.T. (1995), Astron. Astrophys., 300, L25-L28.

Waldron, M.E. (1995) “Evidence of reduced growth rates of anchovy recruits off South Africa in 1989 and 1991”, S. Afr. J. mar. Sci., 15, 263-267.

OTHER MATTERS

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 1995 were Membratek, Lubilon, Plessey, Scientific Services, Pinelands Environmental Technology, Patterson and Cook Consulting Engineers, Halliburton and Atlantis Diesel Engines. Revenue from this source rose substantially from R7 861 in 1994 to R18 689.

PROPOSAL FOR AN IMAGE DIGITIZING FACILITY TO BE ESTABLISHED IN 1996

The Unit has in the past received many requests from users for access to a light microscope with digital image capture facilities or alternatively for the digitization of existing light and electron microscope images at high resolution. Also several light microscopists are currently considering adding digital image capture facilities to their own microscopes.

The proposed facility will enable users to photograph their specimens on film and subsequently digitize the film. Although this is not the same as direct digital image capture it is considerably cheaper than providing these facilities wherever needed and for most purposes should suffice. There are also large slide collections in the Departments of Archaeology and History of Art that are being damaged by improper storage and require digital archiving. The Departments of Electrical Engineering and Surveying have also made proposals for the use of such a facility.

An under-utilized darkroom in the Unit will be converted to house the facility which will be largely operated by the users.

VISITORS TO THE UNIT

Professor T.L. Blundell visited the Unit on 2 April and gave a workshop science policy organized by the FRD. Dr P. Wright of Oxford Instruments was in the Unit from 13-15 September during which time he checked the performance of the MonoCL cathodoluminescence spectrometer manufactured by his company and instructed Unit staff in its use. His travel expenses were paid for by Wirsam and stay in Cape Town was paid for by the Unit.

IMAGE ANALYSIS SERVICE

The Joyce-Loebl image analyser suffered a significant decline in use during 1995 although at least two projects were completed using this instrument. There are two reasons for the decline in use: (1) several departments now have their own (superior) facilities (2) The system is restricted in the types of image it can analyse and many of the projects involving those kind of images have been done. Image analysis has become an intrisic part of many EM studies and some consideration will have to be given to upgrading or replacing this instrument.

SUMMARY

1995 was a productive and successful year for the Unit, in particular, the new equipment was well used and proved beneficial. We have, at times experienced stress because of the high demand for our services but it is hoped that large users will incresingly become self sufficient.

I wish to express my sincere thanks for all the support the Unit has received from Prof. V C Moran, as the Chairman of the Electron Microscope Steering Committee, and the committee members who played an active role in the continued functioning of the Unit.

Prepared by: Associate Professor B.T. Sewell
Director
21 March 1996

TABLE 1

Services Offered by the Unit during 1993

Service	Comment
Access to 200CX TEM	Used by 25 staff and students.
Access to S440 SEM	Very heavily used.
Access to S200 SEM	Not as well used as in previous years. Work was transferred to the S440.
Training on 200CX	Thirteen users were trained in 1995
Training on S440 SEM	Eight new users were trained in 1995
Training on S200	Two courses
Access to Ultracut S Ultramicrotome	Well used
Training on Ultracut S	Seven people were trained
Sectioning of blocks supplied by the user	Well used
Embedding of biological specimens	Well used
Sputter Coating of specimens supplied by user	Very popular service
Critical point drying of specimens supplied by the user	Very popular service
Access to darkroom facilities	Well used by a small number of users. Many potential users would rather have their darkroom work done for them.
Printing of EM films	Service used to capacity
Preparation of slides of electron micrographs for lecture purposes	Well used
Access to optical microscopy facilities	Use is increasing
Access to Image Analysis (GENIAS)	Use hs declined. Used for teaching image analysis.
Access to Image Processing and Analysis (SEMPER)	Not used.
Element analysis by EDS	There is considerable demand for this service on the new Kevex Sigma system.
"Introduction to EM for Biologists"	This course was held three times.
Access to specimen polisher	Well used
Access to high vacuum coating plant and accessories	Adequately used
Store of EM consumables	Used by all our users
Access to prep lab	Used for the final stages of preparation only.
Collection of books and journals on microscopy	The books are well used during our courses.
Access to microdensitometry facilities	Used by the unit for calibration purposed in 1995.
Vacuum Leak Detection	Used by Materials Engineering and Physics departments
Production of CD ROMS	Over 25 were produced

TABLE 2

Equipment Expenditure

Funded by the Equipment Committee	
Turbo Pump converter kit for EM109	R 79 020.86
TOTAL	R 79 020.86
Funded by ITEC	
PC to control CCD camera	R 13 654.00
Image processing computer and software	R 26 750.00
TOTAL	R40 404.00

TABLE 3

External Services Entity

Opening Balance of Funds	R 14 747.04
Income	
Miscellaneous	R 12 203.64
Internal Recoveries	R 3 867.00
Consulting Fee	R 119.09
Hire of Equipment	R 2 500.00
TOTAL	R 18 689.73
Expenditure	
Airfares	R 3 915.82
Equipment Registered Assets	R 819.00
Hire of Vehicles	R 467.40
Materials and Consumables	R 42.05
Minor Equipment under R100	R 2 798.82
Petrol Purchases	R 55.39
Subscriptions	R 441.01
Sundry Expenses	R 190.56
Travel and Subsistence	R 1 388.14
TOTAL	R 10 117.89
Closing Balance 1995	R 19 870.46

TABLE 4

Departmental Grant

Opening Balance of Funds	R 2 171.36
Income	
Annual Grant	R 35 000.00
TOTAL	R 35 000.00
Expenditure	
Cleaning Materials	R 361.48
Computer Consumables	R 1 421.16
Gas - General	R 7 346.39
Equipment Registered Assets	R 2 899.89
Laundry	R 312.69
Maintenance Department Charges	R 525.00
Materials and Consumables	R 9 379.51
Petrol	R 50.00
Printing / Photocopy	R 845.85
UCT Printing Department	R 949.00
Postage and Telegrams	R 667.20
Repairs and Maintenance General	R 5 548.87
Stationery	R 2 618.72
Subscriptions	R 60.00
Sundry Expenses	R 475.19
Telephone Calls	R 3 617.23
Transport	R 2 416.80
Travel & Subsistence	R 20.00
Telephone Installation Costs	R 349.98
Hire of Equipment	R 2 475.00
TOTAL	R 41 989.98
Closing Balance 1995	R 4 818.62**Db**

TABLE 5

Consumables Store

Opening Balance of Funds	R 5 199.84
Income	
Miscellaneous	R 3 962.32
Other	R 38.10
Internal Recoveries	R 16 952.54
TOTAL	R 20 952.96
Expenditure	
Materials and Consumables	R 16 230.51
Stationery	R 150.90
TOTAL	R 16 381.41
Closing Balance of Funds 1995	R 9 771.39

TABLE 6
Maintenance

Opening Balance of Funds	R 34 068.02
Income	
Computer Software	R 515.00
Hire of Equipment	R 7 680.00
Miscellaneous Income	R 832.76
Internal Recoveries	R 33 642.50
TOTAL	R 42 670.26
Expenditure	
Materials and Consumables	R 4 056.56
Equipment (Registered Assets)	R 4 828.25
Minor Equipment below R100	R 85.00
Transfer to investment account	R 50 000.00
TOTAL	R 58 969.81
Closing Balance of Funds 1995	R 17 768.47

TABLE 7

User List

Anatomy	Khati, S.	Hons
	Kidson, S.	Staff
	Richards, P.	Staff
Archaeology	Manning, L.	Hons
	Miller, D.	Staff
Atlantic Diesel Engines	Hunt, J.	
Botany	Dakora, S.	Staff
	Farrant, J.	Staff
	Johnson, S.	Post Doc
	Kruger, L.	Hons
	Klak, C.	MSc
	Newton, R.	Staff
	van Rensburg, S.	MSc
Cardiothoracic Surgery	Zhang, Y.	Staff
Chemical Engineering	Cohen, B.	MSc
	Illing, S.	PhD
	Johnson, L.	MSc
	Moosa S	PhD
	O' Connor, C.	Staff
	Petrik L	Staff
	Scholtz N	PhD
Chemistry	Bretherton, T.	PhD
	Koch K	Staff
	Nassimbeni, L.	Staff
	Rodgers A	Staff
	Zeng, R.	PhD
Civil Engineering	Heckroodt, R.O.	Staff
Energy Research Institute	Schaberg, P.	Staff
	Wicking-Baird, M.	Staff
Geological Sciences	Bezuidenhout, N.	MSc
	Frimmel, H.	Staff
	Gartz, V.	MSc
	Klump, J.	BSc
	Menzies, A.	MSc
	Minter, L.	Staff
	van Heerden, L.	Post Doc
	Willis, J.	Staff
National Accelerator Centre	de Waal, H.	PhD
Lubilon	Fisher D	Cons
Materials Engineering	Ball, A.	Staff
	Burgess, A.	BSc
	Dumbel, P.	BSc
	Howard R	PhD
	Jungbacke N	MSc
	Knutsen R	Staff

	Lang C	Staff
	Mills D	Phd
	Ming V	PhD
	Vismer S	MSc
	Williams G	MSc
	Wittridge N	PhD
Mathematics	Bruyns P	Staff
Mechanical Engineering	Magagula, M.	Hons
	Tait R	Staff
Membratek	Stroewald, H.	
Microbiology	de Villiers, D.	Staff
	Chen, W.	PhD
	Hansen-Wester, L.	Staff
	Jaffray, A.	MSc
	Petersen, Y.	Hons
	Quobela, M.	Staff
	Thomson, J.	Staff
	von Wechmar B.	Staff
NAC	Pineda C	Staff
	Przybylowicz W.	Staff
	Przybylowicz J.	Staff
NBI	Kurzweil H	Staff
	Manning, J.	Staff
Patterson & Cooke	Patterson, A.	
Pharmacology	Saliba, K.	PhD
	Smith, P.	Staff
Physics	Comrie C	Staff
Pinelands Environmental Technology	Batt, J.	
Plessey	Vincent, J	
Protrain	Chapman, S	
Scientific Services	Zweistra, P.	
SFRI	Lipinski, M.	Staff
University of Port Elizabeth (Physics)	Neethling, J.	Staff
University of Stellenbosch (Chemistry)	van Jaarsveld, J.	MSc
UWC (Orthodontics)	Reid, R	Staff
UWC (Pharmacology)	Carlie, G.	MSc
Zoology	Arendse, L.	BSc(Hons)
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