ANU ELECTRON MICROSCOPY UNIT

1999 Annual Report

CONTENTS

The University Electron Microscopy Unit is a central facility, established in 1989, which provides access to electron microscopy and related techniques to staff and students from all areas of the ANU. It has seven electron microscopes (four scanning EMs and three transmission EMs), a good deal of ancillary equipment, basic light microscopes and a variety of equipment for digital image acquisition and processing. A full description of the operation of the facility is given in a handout for users available from the unit, and through the web page **http://www.anu.edu.au/EMU**

The objectives of the Unit as set out in its establishment paper (2498/1988) and endorsed by a review in 1993:
"The purpose of the unit is to provide an efficient service in scanning and transmission electron microscopy to the University community at large and to users external to the University, where appropriate. This service shall include provision for access to modern EM equipment, service for occasional users, training in EM methods for regular users and consultation on applications of EM. The Unit is encouraged to provide leadership in the development and implementation of new EM equipment and methodology. It is an objective of the University to maintain the standard of the facility at a level commensurate with the University's heavy commitment to research and to the major research objectives within the programs of the Schools and Faculties".

1. OVERVIEW OF THE YEAR

The high level of use of the unit was maintained in 1999 despite a temporary reduction in staff in the last half of the year. A 3% reduction in operating grant was more than offset by a small increase in external earnings and greater contributions from RSBS and other areas of funds for specific purposes. Staff and many users of the Unit were heavily involved in preparations for the biennial conference of the Australian Electron Microscopy Society.

2. RESEARCH AND TEACHING ACHIEVEMENTS

Research

During 1999 there have been considerable improvements in the facilities made available for research projects.
The upgrading of the ANU's medium voltage TEM equipment obtained as the result of a successful RIEF bid in 1997 has been pretty well completed. A new 300kV Philips CM300 was successfully installed in RSES, and work completed on the refurbished and upgraded Philips 430 that was relocated to the RSBS site in 1998. Both instruments have low element energy-dispersive X-ray analysis capability and high sensitivity 1024 x 1024 12 bit CCD cameras.

A very popular introduction this year has been a cooled high resolution colour CCD camera for light microscopy, which has made acquisition and processing of many images faster and less expensive. The camera, and a Macintosh G3 computer to upgrade the

adaptation of the Robinson low-kV backscattered electron detector with the addition of secondary electron detection capability. It allows, for instance, imaging of the surface of liquid oils. The detector was brought with EMU funds and a contribution from RSES.

The cold stage of the high resolution field emission SEM been upgraded to full functionality, with temperature control in the transfer chamber.

Analytical mapping functions on the JEOL 6400 scanning electron microscope have been boosted by a Cameo "chemical imaging" accessory to the Oxford ISIS energy dispersive X-ray analysis system, which allows combinations of elements to be traced.

A CCD microspectrophotometer has now been adapted for cathodoluminescence spectrography on an SEM (Vowles, Stowe). The spectrometer may also be used on a light microscope, or as a free-standing detector. Continuing work within the Unit on the development of techniques or instrumentation includes projects on microwave fixation for TEM and field emission SEM (Shen, Stowe), and a forescattered electron detector for the JEOL 6400 SEM (Vowles, Brink).

Number of ANUEMU Users 1989-1999

YEAR	RSBS	OTHER IAS	FACULTIES	OTHER	TOTAL
1989	25	21	42	19	107
1990	29	29	55	21	134
1991	55	40	73	22	190
1992	42	47	67	26	182
1993	46	73	68	30	217
1994	43	85	60	36	224
1995	63	88	66	37	254
1996	84	94	86	30	294
1997	64	88	63	35	255
1998	64	76	87	30	257
1999	68	74	89	35	266

(Undergraduate courses and other student groups are counted as one user)

The numbers of users are shown as an indication of the pattern of use of the Unit, which has been roughly constant for some time following a steep increase in the first few years of operation. The number of publications recorded that have used the Unit's resources has followed a similar pattern, but is still rising. Details of the distribution of equipment use across departments and schools, and changes in that distribution over time, are shown in the Appendices.

Teaching

Staff or students intending to use the EMU facilities are given individual training in the operation of the instruments they need. Theoretical background and an introduction to a wider range of microscopic techniques are available through a series of 1 to 3-day workshops aimed primarily at postgraduate students, held in the first semester with the aid of staff from RSBS, RSES, RSC, RSPhysSE and Geology.

Postgraduate students are drawn from all over the university. The unit is also regularly used for part of undergraduate courses and for Honours projects, mainly by FEIT, BOZO, BAMBI, the Geology and Forestry departments, and by the University of Canberra (National Centre for Cultural Heritage Science Studies).

In 1999 for the first time the EMU also organised a nationally advertised 3-day advanced workshop in SEM with Mr Steve Chapman of Protrain Ltd. The workshop, taking advantage of the excellent range of SEMs available in the unit, had a very positive reaction from its small number of participants. The intention is to extend the catchment area next year.

3. PUBLICATIONS.

Publications 1989-1999

(Not including abstracts, theses or papers in press. **NB For statistical and reporting purposes items are NOT in addition to those listed in Departmental and School reports**)

YEAR	RSBS	OTHER	TOTAL
1989	5	7	12
1990	13	12	25
1991	11	14	25
1992	11	20	30
1993	4	31	34
1994	9	50	59
1995	9	46	55
1996	18	42	60
1997	4	64	68
1998	15	58	73
1999(collected to date)	6	59	65

1998 Papers not included in 1998 Report:

Aleinikoff, J.N., Muhs, D.N., and Fanning, C.M. (1998) Isotopic evidence for the sources of late Wisconsin (Peoria) loess, Colorado and Nebraska: implications for paleoclimate: In Busacca, A.J. (ed.), Dust Aerosols, Loess Soils and Global Change. Washington State University College of Agriculture and Home Economics, Miscellaneous Publication No. MISC0190, Pullman, WA, p. 124-127.

Craig VSJ, Ninham BW, Pashley RM (1998) Study of the long-range hydrophoboc attraction in concentrated salt solutions and its implications for electrostatic models. Langmuir 14:3326-3332

Lu W, Baldwin KG, Hoogerland MD, Buckman SJ,.Senden TJ, Sheridan TE, Boswell RW, (1998) Sharp edged silicon structures generated using atom lithography with metastable helium atoms J. Vac. Sci. Technol. 16 (6), 3846 - 3849.

McCourt S, Armstrong RA (1998). SHRIMP U-Pb zircon geochronology of granites from the Central Zone, Limpopo Belt, southern Africa: Implications for the age of the Limpopo Orogeny. South African Journal of Geology 101: 329-338.

Oliver GJH, Johnson SP, Williams IS, Herd DA (1998) Relict 1.4Ga oceanic crust in the Zambesi valley,

northern Zimbabwe: Evidence for Mesoproterozoic supercontinental fragmentation. Geology 26: 571-573
Sutherland, F.L., Hoskin, P.W.O, Fanning, C.M. and Coenraads, R.R. (1998) Models of corundum origin from alkali basaltic terrains: a reappraisal. Contributions to Mineralogy and Petrology, 133, 356-372.

1999 Publications using the unit (* authorship includes unit staff.)

1.Aleinikoff JN, Muhs DR, Sauer RR, Fanning CM. (1999) Late Quaternary loess in northeastern Colorado, II: Pb isotopic evidence for the variability of loess sources. Geological Society of America Bulletin, 111, 1876-1883
2. Bangert B, Stollhofen H, Lorenz V, Armstrong R (1999) The geochronology and significance of ash fallout tuffs in the Permo- Carboniferous Dwyka Group of southern Namibia and South Africa. Journal African Earth Sciences, 29-1, 33-49.
3.Bolger J A, Montross C,. Rode AV.(1999) Shock waves in basalt rock generated with high-powered lasers in confined-geometry. J App Phys 86:5461-5466
4.Bowring SA, Williams IS (1999) Priscoan (4.00-4.03 Ga) orthogneisses from northwestern Canada. Contrib Mineral petrol 134:3-16
5.Campbell KSW, Barwick RE (1999) Dipnoan fishes from the Late Devonian Gogo formation of Western Australia, Rec WA Museum. Suppl 57:107-138
6. Chen Y, Fitz Gerald J, Williams JS Bulcock S (1999) Synthesis of boron nitride nanotubes at low temperatures using reactive ball milling. Chemical Physics Letters, 299:.260-264.
7. Chen Y, Fitz Gerald J, Chadderton LT, Chaffron L (1999) Nanoporous Carbon Produced by Ball Milling. Applied Physics Letters, 74:2782-2784.
8. Chen Y, Chadderton LT, Fitz Gerald J, Williams JS (1999) A Solid State Process for Formation of Boron Nitride Nanotubes. Applied Physics Letters, 74:2960-2962.
9. Chen Y, Fitz Gerald J, Chadderton LT, Chaffron L (1999) Investigation of nanoporous carbon powders produced by high energy ball milling and formation of carbon nanotubes during subsequent annealing. J. Metastable and Nanocrystalline Materials. 2: 375-380.
10. Chen Y, Fitz Gerald J, Williams JS, Willis P (1999) Mechanochemical Synthesis of Boron Nitride Nanotubes. J. Metastable and Nanocrystalline Materials, 2: 173-178.
11. Chen,Y. Williams J.S,. Campbell S.J and Wang G.M.(1999) Increased Dissolution of Ilmenite Induced by High-Energy Ball Milling., Materials Science and Engineering A, 271:. 485-490.
12.Craig VSJ, Ninham BW, Pashley RM (1999) Direct measurement of the hydrophobic attraction: the effects of dissolved gas. Approach rate and neutron irradiation. Langmuir 15:1562-1569
13.Dall RG., Hoogerland MD,. Baldwin KGH, S.J. Buckman (1999) Evanescent light wave-guiding of metastable helium atoms through hollow optical fibres. Journal of Optics B 1 (4), 396 - 401
14.Drysdale RN (1999) The sedimentological significance of hydropsychid caddis-fly larvae(Order:Trichoptera) in a travertine-depositing stream: Louie Creek, NorthWest Queensland, Australia. J Sedimentary Res 69:145-150
15.Evans JR (1999) Leaf anatomy enables more equal access to light and CO2 between chloroplasts. New Phytologist 143:93-104
16.Evans JR. Loreto F. Acquisition and diffusion of CO2 in higher plant leaves. *In* (RC Leegood, TD Sharkey and S von Caemmerer, eds) 'Photosynthesis: Physiology and Metabolism', Kluwer Academic Publishers, The Netherlands pp321-351
17.Foden J, Sandiford M, Dougherty-Page J, Williams I (1999) Geochemistry and Geochronology of the Rathjen Gneiss: implications for the early tectonic evolution of the Delamerian Orogen. Aust J Earth Sciences 46:377-389
18.Gamaly EG, Rode A V, Luther-Davies B (1999). Ultrafast Ablation with High-Pulse-Rate Lasers. Part I: Theoretical Considerations, J. Appl. Phys.85(8), 4213-4221
19.Gamble JA, Wysoczanski RJ, Meighan IG. (1999) Constraints on the age of the British Volcanic Province from ion microprobe U-Pb (SHRIMP) ages for acid igneous rocks from NE Ireland. Journal of the Geological Society of London, 156, 291-299
20.Geslin JK, Link PK, Fanning CM (1999) High-precision provenance determination using detrital-zircon ages and petrography of Quaternary sands on the eastern Snake River Plain, Idaho. Geology, 27, 295-298.
21.Goodge JW, Fanning CM. (1999) 2.5 b.y. of punctuated Earth history as recorded in a single rock. Geology, 27, 1007-1010
22.Hardham, A.R. (1999) Cell Biology of *Phytophthora cinnamomi.* In: Patch Deaths in Tropical Queensland Rainforests: association and impact of Phytophthora cinnamomi and other soil borne organisms, pp. 27-31. Edited by P.A. Galek. CRC for Tropical Rainforest Ecology and Management,Cairns.
23.Hodzic A, Kalyanasundarum S, Lowe A, Stachurski ZH (1999) The microdroplet test: experimental and finite element analysis of the dependence of failure mode on droplet shape .Composite Interfaces 6: 375-389
24.
25.Husheer SLG, Thompson JG, Melnitchenko A (1999) Cristobalite-related phases in the $KAlO_2$-$KAlSiO_4$

26.system. J Solid State Chem 147:264-630
27.Jacobs J, Thomas R J, Armstrong R A, Henjes-Kunst F (1999). Age and thermal evolution of the Mesoproterozoic Cape Meredith Complex, West Falkland. Journal of the Geological Society, London, 156, 917-928
28.Johnson SE, Tate MC, Fanning CM (1999) New geologic mapping and SHRIMP U-Pb zircon data in the Peninsular Ranges batholith, Baja California, Mexico: Evidence for a suture? Geology, 27, 743-746.
29.Kerr A, Welham NJ, Willis PE (1999) Low temperature mechanochemical formation of titanium carbonitride, Nanostructured Materials, 11:233-239
30.Larson SA, Cornell DH, Armstrong RA, (1999). Emplacement ages and metamorphic overprinting of granitoids in the Sveconorwegian Province in Värmland, Sweden – an ion microprobe study. Norsk Geologisk Tidsskrift, 79, 87-95.
31.Mahoney BJ, Mustrad PS, Haggart JW, Friedman RM, Fanning CM, McNicoll VJ. (1999) Archean zircons in Cretaceous starta of the western Canadian Cordilera: the "Baja B.C." hypothesis fails a "crucial test". Geology, 27, 195-198.
32.McCourt S, Armstrong, R.A. Early Proterozoic orogeny in the Central Zone of the Limpopo Belt - a discussion. S.A. Journal Geol 101:
33.Mitchell H.J, Hardham, A.R. (1999) Characterisation of the water expulsion vacuole in *Phytophthora nicotianae* zoospores. Protoplasma 206:118-130.
34.Nesbitt RW, Pascual E, Fanning CM, Toscano M, Sáez R, Almodóvar G.R. (1999) U-Pb dating of stockwork zircons from the eastern Iberian Pyrite Belt. Journal of the Geological Society of London, 156, 7-10.
35.Peucat JJ, Ménot RP, Monnier O, Fanning CM (1999) The Terre Adélie basement in the East-Antarctica Shield: geological and isotopic evidence for a major 1.7 Ga thermal event; comparison with the Gawler Craton in South Australia. Precambrian Research, 94, 205-224.
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38.Robb LJ, Armstrong R. Waters DJ, (1999). The history of granulite-facies metamorphism and crustal growth from single zircon U-Pb geochronology: Namaqualand, South Africa. Journal of Petrology, 40, 1747-1770.
39.Rode AV, Luther-Davies B, Gamaly EG, (1999) Ultrafast Ablation with High-Pulse-Rate Lasers. Part II: Experiments on Laser Deposition of Amorphous Carbon Films, J. Appl. Phys., 85(8), 4222-4230
40. Rode A V, Gamaly EG, Elliman RG,. Kheifets A S, Luther-Davies B (1999) Cluster-assembled amorphous carbon nano-foam synthesised by high-pulse-rate laser ablation, in: Electronic Properties of Novel
41.Materials Science and technology of molecular nanostructures, Eds.: H. Kuzmany, J. Fink, M. Mehring, and S. Roth, AIP Conference Proceedings 486, American Institute of Physics, Melville, New York, 1999, p. 196-199.
42.Rubatto D, Gebauer D (1999) Eo/Oligocene (35 Ma) high-pressure metamorphism in the Monte Rosa nappe (Western Alps): implications for paleogeography, Schweizerische Mineralogische and Petrographische Mitteilungen 79, 353-362
43.Schaltegger U, Fanning CM, Günther D, Maurin JC, Schulmann K, Gebauer D (1999) Growth, annealing and recrystallization of zircon and preservation of monazite in high-grade metamorphism: conventional and in-situ U-Pb isotope, cathodoluminescence and microchemical evidence. Contributions to Mineralogy and Petrology, 134, 186-201
44.* Stange G, Stowe S (1999) Carbon-dioxide sensing structures in terrestrial arthropods. Microscopy Research & Technique. 47:416-427
45.Tabira Y, Withers RL (1999) The determination of an unknown oxygen atom position in rare earth zirconate pyrochlores by a 111 systematic row CBED technique. Phil.Mag.A 79, 1335-1346
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47.Tate MC, Norman MD, Johnson SE, Fanning CM, Anderson, JL (1999) Generation of tonailte and trondhjemite by subvolcanic fractionation and partial melting in the Zarza Intrusive Complex, western Peninsula Ranges Batholith, northwestern Mexico. Journal of Petrology, 40, 983-1010.
48.Thomas R.J, Cornell DH, Armstrong RA (1999). Provenance age and metamorphic history of the Quha Formation, Natal Metamorphic Province, a U-Pb zircon SHRIMP study. South African Journal of Geology, 102(1), 83-88.
49.Thompson JG, Rae AD, Bliznyuk N, Withers RL (1999) Ordering of Ce^{III}/Ce^{IV} and interstitial oxygens in $CeTaO_{4+x}$ (x 0.17) superstructure. J Solid State Chem 144:240-246

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53.Troitzsch U, Ellis DJ, Thompson J, FitzGerald J (1999) Crystal structural changes in titanite along the join TiO-AlF. European J Mineralogy 11: 955-965
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55.Weber KJ, Blakers AW, Catchpole KR(1999) The Epilift Technique for Si Solar Cells. Applied Physics A (Materials Science Processing). 69(2):195-199
56.Weber KJ, Catchpole KR(1999) Surface Morphology of Silicon Layers Grown on Patterned Silicon Substrates by Liquid Phase Epitaxy. J Crystal Growth 204, 453
57.C.M. Weiller (1999). *Leptecophylla*, a new genus for species formerly included in *Cyathodes* (Epacridaceae). Muelleria 12(2): 195-214.
58.Welham NJ (1999) Ambient temperature formation of (Ta,Nb)C and (Ta,Nb)N. ,Journal of Materials Science, 34: 21-27
59.Welham NJ (1999) Room temperature reduction of scheelite ($CaWO_4$), Journal of Materials Research, 14:619-627
60.Welham NJ (1999) Non thermal production of tungsten from scheelite. Materials Science and Technology, 15:456-458
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66.Withers RL, Proffen Th,.Welberry TR (1999) Inter-sublattice ordering correlations and the geometrical locus approach to localized diffuse scattering. Phil.Mag.A 79, 753-762
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69.

In Press (EMU staff only)

Heady RD, Evans PD. Callitroid (Callitrisoid) Thickening in *Callitris*. IAWA J.

Conference Presentations (EMU staff only)

Heady RD Ecological wood anatomy of *Callitris* Vent. (Cupressaceae).Microscopy New Zealand Conference, Rotorua, February 1999
Shen Rl, Stowe SJ. Fixation of plant material for TEM in a domestic microwave oven. Microscopy New Zealand Conference, Rotorua, February 1999 (Poster)
Stowe SJ, Vowles D. The relationship between SE, BSE and CL signal in a "controlled pressure" SEM: studies using the Robinson combined BSE/SE detector and a CCD-based cathodoluminescence spectrometer in a Hitachi S2250 NSEM. Microscopy and Microanalysis 1999, Portland, OR. August 1999 (Late breaking poster)

4. PERSONNEL STATISTICS
(for statistical purposes, staff particulars are included in the RSBS Annual Report)

Staff:
Sally Stowe, MSc Hons(Auck), PhD (Facility Coordinator)
Frank Brink, BAppPhys (SA) MSc(LaTrobe)
Roger Heady, BAppSc(CCAE), GradDipElec(CCAE), GradDipResMan(CCAE), PhD
David Llewellyn, DipEng(Bruce TAFE)
Ruolan (Lily) Shen, DipTCM(Guangzhou)
David Vowles, DipApplPhys(WAIT) (to July)

5. FINANCE
(Note that the ANUEMU finances are handled and reported within the RSBS cost/administrative centre)

In 1999 the ANUEMU received an operating grant of $407,000 to cover salaries and on-costs, operating expenses and minor equipment. Of this approximately 87% was spent on salary-related costs. Additional income in 1999, from ANU and external sources, totalled c.$58,000 (External sources.....$26,000, ANU non-tied contributions..... $4,100, contributions towards specific equipment from ANU user areas $28,000. Directly contributed consumables and staff development costs not included). More detailed accounts of expenditure are contained in the minutes of the EM Advisory Committee.

Nominal costings to School or Departmental level are prepared on request. There have been no significant cost overruns since the last major revision of the ANUEMU budget in 1990. The Unit has been able to run very efficiently because its block funding is sufficient to allow forward planning of basic functions, in a situation where the pattern of use across campus and across different equipment types may shift markedly from year to year.

Income opportunities.
Sources of funds for major items of equipment are the EM Reserve, Major Equipment Committee and more recently the ARC. Minor equipment (below about $100K) has normally been bought from combinations of the operating grant, external earnings and contributions from users.

External sources of funds.
- The principal source of external funds generated within the EM Unit is SEM use by government organisations (in 1999 mainly AGSO, AFP and CSIRO, for a total of $17, 775). Regular external users generally operate the microscopes themselves, and are effectively integrated with the normal operation of the unit. Given sufficient demand there would be some scope for increased activity here, at the cost of increased booking delays for ANU users. There is spare time available on TEMs, but at this point little demand.
- Commercial sources. A source of income initiated in 1997 is the sale of value-added EM-related laboratory supplies. ($2570 in 1999). Other income is derived from an analysis service, managed through ANUTECH, for airborne particles and other OHS-related samples from building sites($2295 in 1999).

There is the possibility of seeking, through ANUTECH, to increase work done for commercial firms. However major work in this area would impact heavily on the microscope

and staff time available to assist users, which are already limiting factors, and demand in Canberra is not high.

ž There is some scope for raising more money internally and externally through workshop charges, but for relatively small amounts. Apart from their basic educational role, the main value of such workshops lies in publicising the facilities of the unit.

The most appropriate and cost-effective role for the EMU in bringing funds into the ANU may be in providing supporting infrastructure for academic endeavours that have commercial or external government backing. However there is an increasingly evident need for a mechanism to provide the EMU with some remuneration for the services provided for such projects.

6. ORGANISATION

The ANUEMU is a central facility serving both the IAS and the Faculties and currently performing about equal amounts of biological and physical sciences work. The Unit is housed within RSBS and uses its administrative and support structures. The Director of RSBS, together with the EM Advisory Committee, has overall responsibility for its operation.

The Advisory Committee as at the end of 1999 consisted of:

Prof. D.H. Green, RSES (Director of a non-biological research school) (Chair)
Prof.J.Hearn (RSBS Director - *ex officio*)
Prof. J. Pickett-Heaps, School of Botany, Univ. of Melbourne (external advisor)
Dr S. Stowe, ANU EMU Facility Coordinator (*ex officio*)
Dr J. Fitz Gerald, RSES (Materials Sciences Advisor)
Dr A. Lowe, Engineering Dept, FEIT (Faculties Representative)
Dr E. Ball, RSBS (co-opted member)
Dr R. Elliman, RSPhysSE (co-opted member).

Formal input from users comes from regular written surveys of all ANU EMU users and a number of other interested parties (such as major users of other EM facilities on campus) conducted by the Unit to canvas requirements for equipment and various organisational matters. From time to time items related to other microscopy facilities in the ANU or indeed the ACT are included.

Since the administrative superstructure for the Unit is provided by RSBS, internal administrative costs are very low. There is no reception or administrative support position as such. Staff resources spent on all aspects of administration are around two-thirds of the Facility Coordinator's time and about 20% of a full-time position spread over three other staff members.

Changes in the work environment

Changes in the work environment this year have been a continuation of trends evident for the last few years - an increase in the use of digital imaging techniques, and continued pressure on staff time. A delayed appointment following a voluntary redundancy halfway through the year has meant that staff resources have been stretched very thinly indeed. Despite this the usage level of only one of the major equipment groups (light microscopy) was down, while SEM use has been roughly constant, TEM use has increased slightly, reflecting the materials science users of the 300kV Philips 430 TEM brought into the EMU last year (600hours), and PC usage continues on an upward trend (see appendix ii). While development and maintenance work and the support given to user projects has certainly suffered to some extent,

in the long run the EMU will benefit from the new appointment, strengthening expertise in the biological and cryo-preparation areas, while still providing support for analytical work. Overall the position in regard to staffing is little changed. The potential of the unit is still severely limited by staff levels much lower than in comparable Australian units.

7. COLLABORATION AND OUTREACH.

The nature of the relationship or interaction between The Faculties and the Institute of Advanced Studies.

The ANUEMU is a resource shared by the Faculties and the Institute of Advanced Studies, and is often a focus of interaction between them. As shown in the Appendices, use of the EMU is reasonably well spread across the science-based Faculties departments and Research Schools, with the exception of the Faculties Department of Physics. Cross campus accessibility of materials science preparation equipment, for historical reasons not well represented within the ANUEMU, has been considerably facilitated by support provided to extra-departmental users of equipment in Geology and RSPhysSE by David Llewellyn, an ANUEMU staff member.

Other staff activities: Frank Brink has started a PhD on crystal structure of meta-oxy-fluorides, supervised by John Thompson and Ray Withers, RSC. Roger Heady is a Departmental Visitor with the Department of Forestry, working on wood structure and as a tutor. Sally Stowe is a Visiting Fellow in the Developmental Neurobiology group, RSBS, and in 1999 worked with Gert Stange (Visual Sciences, RSBS) on a review of land arthropod carbon dioxide receptors.
The annual workshop series arranged by ANUEMU involves considerable input from other areas, primarily RSES, RSBS, RSPhysSE, RSC and Geology.

Nature and Extent of Collaboration with other Australian and Overseas Universities or Bodies.
The ANU EMU will provide facilities to staff and students of other Australian universities on the same basis as ANU users. In practice many visitors are affiliated with ANU departments, and do not appear as external users on our records. In 1999 there were 7 users from the University of Canberra and 8 from other universities. The University of Canberra (National Centre for Cultural Heritage Science Studies, NCCHSS) uses the ANUEMU for a section of an undergraduate course and a number of honours projects, and we have cooperative links with their Raman Microscope Unit. Non-university users paying for microscope time include AGSO, CSIRO, Australian Federal Police and the Royal Australian Mint. Non-ANU users (not counting visitors associated with ANU departments, or AGSO users based in RSES) accounted for 12% of all users, the same proportion as last year.

Activities of individual staff members: during 1999 Roger Heady taught SEM as part of the Conservation of Cultural Materials undergraduate course at UC, David Llewellyn taught part of an electron microscopy course at CIT. Sally Stowe was an invited participant at the first ESEM Roadmap symposium (Leura, February 1999).
Apart from conference presentations already listed, Frank Brink, Sally Stowe and David Vowles attended the 5th biennial symposium of the Australian Microbeam Analysis Society (AMAS) in Sydney February. David Llewellyn attended a workshop on Focused Ion Beam technique associated with the same symposium, and visited a CNRS laboratory at the

University of Orsay, France.

Outreach Activities.
The ANUEMU is always a popular part of the National Science Summer School visit to RSBS in January, and Work Experience students in user departments frequently spend time in the Unit. Images provided by the Unit were used in a display by Museum Victoria.

Dr SJ Stowe
for the ANU EM Advisory Committee

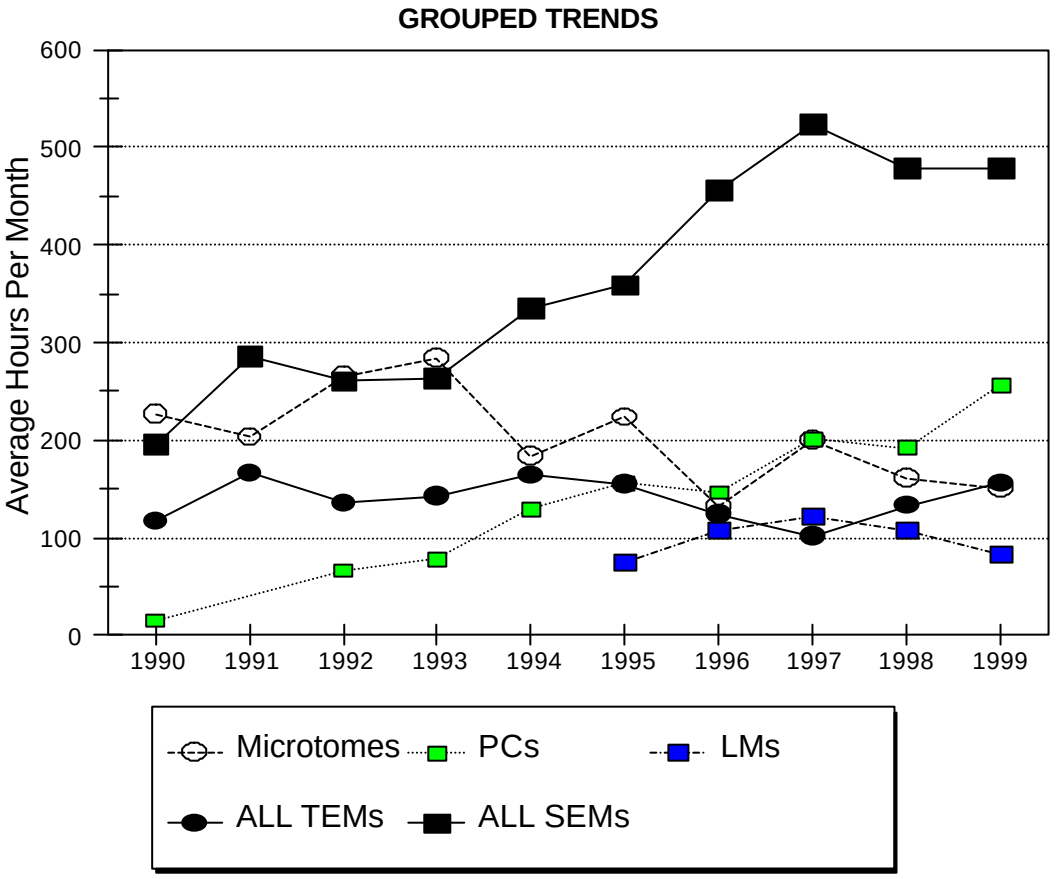
APPENDICES

(i) DISTRIBUTION OF ANUEMU EQUIPMENT USE IN 1999

EQUIPMENT USE (HOURS)

Dept. (no. of users)	microtomes	PCs	LMs	TEMs	SEMs
Non-ANU (34)	24	21	4	14	138
BAMBI(8)	14	61	17	93	
BOZO(10)	148	39	5	81	128
FEIT(25)	435	596	168	217	314
Forestry(9)	38	130	31	4	448
Geology(33)	26	55		125	1101
Archaeology & Anthro(4)					192
School of Art(1)					9
JCSMR(5)		250	253	3	8
RSBS(68)	822	1750	547	606	645
RSC(7)		23		233	125
RSES(35)		2	1	17	1482
RSPAS(6)		2			128
RSPhysSE(21)		27	20	342	318
TOTAL(ANU)	1483	2935	1042	1721	4898

(ii) TRENDS IN ANUEMU EQUIPMENT USE 1990-1999



(iii) DISTRIBUTION OF ANUEMU ELECTRON MICROSCOPE USE 1990-1999