

## Inauguration of the EBL Facility

On Monday 16 July the Rt. Hon. Mrs. Shirley Williams pressed a button inside the Clean Room at the Rutherford Laboratory to inaugurate the SRC's Electron Beam Lithography Facility (EBLF). Mrs Williams was accompanied by her daughter, Rebecca, and Lady Dainton. The event was eagerly observed through windows and on closed-circuit television by about 80 invited guests.

### Opening Ceremony

At a ceremony prior to the inauguration Mrs Williams was welcomed by Professor Sir Geoffrey Allen and Dr Godfrey Stafford. Mrs Williams expressed her special interest in the project, which was approved in 1977 when she was Secretary of State for Education and Science. She spoke of two of the UK's major assets - the excellent standard of its higher educational system and that the country maintained a high level of attraction for people of great ability to go into scientific research. However she felt that we must strive for a better working relationship between industry and science in order to take full advantage of the great discoveries; she complimented the SRC on its determined efforts to bridge this gap.

Dr Stafford presented Mrs Williams with a gift of mask plates (described below), which had been fabricated at the Facility, and photographically enlarged views of the masks.

The facility at Rutherford Laboratory provides a mask-making service to Universities and Polytechnics. It is one of five centres supported by the SRC's Engineering Board for producing microelectronic devices. The other centres, which each specialise in some aspect of integrated circuit fabrication, are at the Universities of Edinburgh, Sheffield, Southampton and Surrey. Researchers in Universities and Polytechnics therefore now have access to a service that can produce prototype microcircuits on silicon and other semiconductor devices to their own designs.



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The principal equipment of the EBL facility is the electron beam pattern generator EBMF-2, manufactured by Cambridge Scientific Instruments (Bulletin 6, 1978) and delivered to the Laboratory in March 1979. Since then, the machine has undergone rigorous acceptance testing in order to demonstrate writing accuracy to approximately 0.1 micron.

Above: Mrs Shirley Williams, dressed in light blue protective clothing, during her inauguration of the EBL Facility

Below: Dr Godfrey Stafford presents Mrs Williams with an EBL memento during her visit.

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## The Presentation Gift

The desire to present a gift to Mrs Williams provided a challenge to produce a piece of work indicative of the capability of the EBL Facility. Strenuous efforts were made to debug the suite of programs linking the computer-aided mask designs available at the Prime 400 computer of the Interactive Computing Facility, via two PDP-11 computers at the EBL Facility and thence to the EBMF-2 machine.

The presentation piece chosen consisted of two standard chrome-on-glass mask plates arranged back-to-back. The first plate contained the words,

"Presented to the Rt. Hon. Mrs Shirley Williams at the Inauguration of the Electron Beam Lithography Facility at Rutherford Laboratory - 16 July 1979"

and a visually attractive chip design selected from those available to the EBL Facility. This pattern appears several times on the plate at approximately twice full size (ie 8mm x 8mm). The message text was terminated with a full stop which was itself a 1mm x 1mm version of the same chip mask! The SRC logo, also incorporated into the design, provided an interesting test of the design software and data processing programs.

The second plate contained the same pattern written to the size 36mm by 36mm, which allowed some details of the design to be seen without requiring a microscope. The writing procedure also simulated the generation of "reticule" plates, which are required for optical step-and-repeat printers in common use in the silicon integrated circuit industry.

The ancillary equipment used to support the EBMF-2 had been commissioned earlier (Bulletin 7, 1979), and the presentation piece offered a rare opportunity to process a design through all stages of mask manufacture. Initially the chrome plate was covered with a new experimental resist using a spin-coating machine. After pattern exposure, the plates were inserted into an electron beam developing machine where the exposed resist was developed out, thereby revealing the unwanted chromium.

The plates were then placed in an ion-beam etching machine, where a collimated beam of argon ions (500eV) "milled" away the exposed chromium at about 0.04 micron per minute. The etching process effectively sand-blasts on an atomic scale, in which the chromium layer is only 0.1 micron thick compared with the resist thickness of 0.5 micron. Careful control of the etching time revealed a well-resolved chromium pattern, producing a linewidth of approximately



Professor Sir Geoffrey Allen and Dr Godfrey Stafford welcome Lady Barbara Dainton and Mrs Shirley Williams in an exhibition area near the EBL Facility.



Professor Eric Ash (Chairman of the EBL Advisory Committee) in discussion with Mr Ron Lawes (EBLF Project Leader), Mr Tony Egginton (Director of Engineering and Science, SRC) and Professor John Brown (Chairman of the SRC's Engineering Board).

1 micron for the "full stop" pattern. As a final touch, the text was coated with 0.2 micron thickness of gold using the r.f. sputter coater.

*The presentation of such a gift confirmed that the Electron Beam Lithography Facility is now truly open for business!*

suitable substrate, build up tens of thousands of electronic components on a single wafer or chip. The standard chip material is silicon which can be readily doped by controlled amounts of, for example, boron or phosphorus to make layers of either "n" or "p" type material.

Silicon processing will be carried out at the Universities of Edinburgh and Southampton which have special equipment for processing silicon circuits, including furnaces in which the dopant levels can be controlled to build up the layers required and chemical etching facilities to form the patterns which make up a complex circuit. Accurate alignment machines are needed to ensure that each mask used in the build-up process is precisely located relative to others in the set. Most devices use at least

## Role of the EBL Facility

The Electron Beam Lithography Facility at Rutherford Laboratory will provide high precision mask sets for use in the manufacture of microcircuits for Universities and Polytechnics research projects. These masks define the intricate geometrical patterns which, when projected sequentially on a



5 or 6 masking stages, and some as many as 13. Absolute cleanliness is essential throughout all steps in the manufacture to minimise defects.

An extremely accurate way of controlling doping levels has been evolved using ion implantation and most modern circuits use at least one implant in their manufacture. The SRC is supporting Surrey University to expand existing facilities and build up a centre of excellence in the technique which involves ionising the dopant and accelerating the ions to an accurately known energy before they impinge on the substrate to produce the required carrier concentrations.

There are other materials in addition to silicon which have properties of particular interest. Sheffield University has received SRC funding to provide a central facility in epitaxial crystal growing of materials such as gallium arsenide and indium phosphide. These and other associated materials are widely used in integrated optics and solar cells.

The output mask sets from the EBL Facility will therefore be used in conjunction with facilities at the Universities of Edinburgh, Sheffield, Southampton and Surrey and also in UK industry in order to complete the manufacture of microcircuits. The EBL Facility will also be used for other micro-engineering projects and enquiries have already been received from astronomers, high energy physicists, metrologists, laser physicists, biologists and many others.

We thank Ron Lawes (EBLF Project Leader) and Bill Turner (SRC Co-ordinator of the University Device Fabrication Centres) for information contained in this report.

## OVERSEAS Visits

J Maharana to Erice, Sicily, from 31 July to 11 August to attend Summer School.  
C J Batty to ILL and CERN from 1-17 August for discussions.  
A Astbury to CERN from 3-18 August to work on Prop. 204/UAI.  
S A Creak to DESY from 6-8 August for accommodation administration.  
D Clarke to DESY from 7-17 August to work on JADE Experiment.  
D H Saxon to DESY from 7-21 August to work on Tasso Experiment.  
H Hadley and R J Rice to Wuppertal University from 7-8 August for meeting on GIRL Collaboration.  
D Evans to USA from 8-25 August to attend International Cryogenic Materials Conference and visit laboratories, universities and industrial organisations.  
A Raven to USA from 11-18 August to attend Gordon Conference on Laser Interaction with Matter.  
J C Thompson to CERN from 13-25 August to work on NA2 Experiment.  
R G Evans to Paris from 28 August to 8 September to attend CECAM Workshop.

## Academic Successes

Congratulations to Arthur Chilvers of Instrumentation Division who has been awarded a BSc (CNAAB) in Electrical and Electronic Engineering following day release study at Oxford Polytechnic.

Our best wishes also to the following Student Engineers who have all gained Upper Second Class Honours in Engineering:

David Clarke in Electrical Engineering at Cambridge. Alwyn Howes in Mechanical Engineering at Surrey. Alex Stansfield in Electrical Engineering at Bristol. Peter Williams in Mechanical Engineering at Leeds.

## Polarised Target Workshop

### POLARISED TARGET WORKSHOP

An international Workshop will be held at The Cosener's House, Abingdon, from 1-5 October 1979.

The purpose of the Workshop is to bring together those who are involved in the use, development and construction of polarised targets, and specialists from those fields of research in solid state physics and chemistry which are relevant in the production of suitable polarisable materials.

The meeting is sponsored by the Rutherford Laboratory in conjunction with the International Organising Committee for Symposia on High Energy Physics with Polarised Beams and Polarised Targets.

Further information is available from the local committee:

S F J Cox	Rutherford Laboratory
G R Court	Oliver Lodge Lab.,
	Liverpool University,
	PO Box 147, L69 3BX.
T O Niinikoski	CERN

## Death Benefit Scheme

DID YOU KNOW the Laboratory operates a fund to provide an immediate cash payment to your nominee without any fuss or formality. At present the benefit amounts to £75 per death. Higher membership could mean higher benefit.

WHY NOT JOIN? It only costs 60p; because the finances are in a healthy state, subscriptions are currently suspended but could be re-introduced at the discretion of the Management Committee and would be 10p per month or 1p per week.

Application forms are available from Mrs S Fones, Personnel Group, R20.

## Film Badge Notice

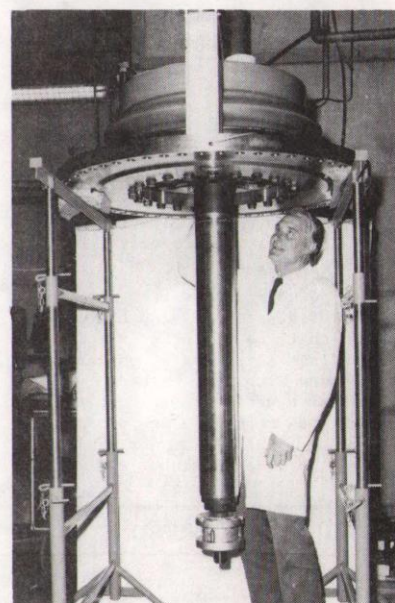
It is Period 8, colour strip GREEN. Please check that you are wearing the correct film and all old ones are returned.

Next Film Change - Monday 13 August.

## RCBC Progress

Previous issues of the *Bulletin* have recorded various milestones in the development of the plastic piston and bellows assembly for the Rapid Cycling Bubble Chamber (RCBC), destined for use in the particle physics programme at the CERN SPS.

A further milestone was recently passed when the assembly underwent a successful fatigue test at CERN, completing over 5 million cycles under conditions more arduous than are likely to be achieved in operation. Aspects of the assembly which were fully tested included the bellows (*Bulletin* 17, 1978), the plastic piston (*Bulletin* 8, 1979), various epoxide resin bonded joints between the bellows, piston and chamber body, and the attachment of a full size operating shaft to the piston. After the required number of cycles at low temperature the assembly successfully withstood a pressure test of 1.25 mpa (12.5 atmospheres).



Ken Quinton alongside the piston-bellows assembly during tests at CERN. (Photo CERN)

The assembly is now being returned to Rutherford Laboratory, where it will be prepared for installation in the chamber later in the year.

## Sales to Employees

Sales of scrap metal/plastics as set out in RLN 12/73 will be made on 10 and 24 August at the scrap compound, rear of R40 from 1200-1230 hrs.

## Undelivered Mail

Several letters addressed to Tony Weidberg, ex Neutrino Dept, Fermilab, are awaiting collection at the Personnel Group, Room 70, R20.





## Au Revoir Pat!

Friday 13 July - an unlucky day for the friends and colleagues of Pat Junkison who was leaving the Rutherford Lab. for a new career - in Motherhood!

Quite a crowd was assembled in the Coffee Lounge to wish Pat well and to witness the presentation to her, by Geoff Manning, of a carriage alarm clock, a memento of the happy time she had spent with us.

At one point in her career, he recollected, she had been heard to remark that she was underworked. In the last seven years, whilst she had worked with him, he had never given her cause for that complaint. Now she was to have a new boss; he warned her that her duties would be even more onerous, but comforted

her with the thought that it was the first twenty years that were the worst!

In reply, Pat said that she hadn't been so nervous since the day she was married, that she was not often stuck for words, but she could only say how much she had enjoyed her time at the Rutherford. However she was looking forward to her new life. "To personal friends," she said, "you know where I am. To acquaintances and colleagues - 'So long - it's been good to know you'."

*Pat has sent us the following note:*

"Leaving Rutherford after 6½ years, I take with me memories of nice people and an interesting place to work, plus the carriage clock to which so many people contributed. To those concerned my special thanks and to one and all 'Farewell'."

## Christian Fellowship

All are warmly invited to attend the following meetings on Thursdays in the R2 Conference Room at 12.30pm led by:

- 2 Aug - Chris Biddlecombe
- 9 Aug - Ray Powell
- 16 Aug - Meyrick Wyard
- 23 Aug - Dennis Williams
- 30 Aug - Robert Harrison
- 6 Sep - Jim Sinclair from AERE

## National Savings

Monthly cycle No 22 Certificates will be available for collection at the Cash Office, Building R20, from 1st August 1979 onwards.

## Horticultural Society

FLOWER GARDEN OF THE YEAR, AND BEST KEPT GARDEN OF THE YEAR COMPETITION will be judged shortly. If you would like to compete send your name and address to Mrs W Dance, H7.12, AERE by Friday 3 August. You could win the Schonland Trophy or a Diploma in Horticulture and a fl gift voucher.

FLOWER SHOW this year will be held on 13 & 14 September in the upstairs hall of the Social Club at AERE. Schedules are available from Mrs Dance.

You do not have to be a member of the Society to enter either competition or show. Enter these dates in your diary and start your preparations now!

## Crib

The Lunch Time Crib League has reached the half way stage (some teams are lagging behind with their fixtures).

As can be seen from the League position the Sparks have a two-point lead over Webb's Wonders and Wheeler's Jokers, but with another 8 games to play it's very wide open. The Concorde seem to be grounded at the bottom.

Captain	Team Name	P	W	L	Pts
Craske	Sparks	8	6	2	12
Webb	Wonders	7	5	2	10
Wheeler	Jokers	8	5	3	10
Holsman	All-Stars	8	4	4	8
Childs	IRAS	8	3	5	6
Grant	Saints	5	3	2	6
Grindrod	Workers	5	3	2	6
Lubbock	All-Sorts	7	2	5	4
Apsey	Concorde	6	1	5	2

Leading Team: Peter Craske, Reg Atkinson & John Ellis

Chasing Teams: Harry Webb, Ray Smith & Frank Castle  
Brian Wheeler, Jack Marshall & Dave Kent

## Cricket

The Club entered two teams in the Harwell Evening League this season; one from Atlas and one from the rest of Rutherford. The competition is one of 18 overs a side and, although Atlas didn't fare too well, the Laboratory side reached the semi-finals of the competition.

We have had some big scores against the Harwell sides, including 147 for 3 and 133 for 3, with John Culley 84 not out (seems he doesn't only play well at Chiswick) and Eddie Smith 70 not out. Jimmy Denly also batted up to his high standard throughout.

The semi-final was played on Monday 16 July against MDD from Harwell. The scores were tied at the end of 18 overs:

MDD	73-8
Rutherford	73-7

After much discussion the game was replayed on Wednesday 18 July. Unfortunately Rutherford lost:

Rutherford	101-3 (Dennis Stock 48 not out)
MDD	119-6

Thanks for the support of all who played in the competition - well played!

(Report by Roger Taylor)



RUTHERFORD LABORATORY

# BULLETIN

Deadline for Insertions

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# Training 1979-80

Employees of the Rutherford Laboratory may now apply for training concessions for courses at local colleges and application forms for this purpose are available from Local Admin Offices. Prospectuses and timetables for local colleges are being distributed to Local Admin Offices and the Libraries as they become available. The Training Officer, Mr T F Gubbins, will be available to advise prospective students (except during the period 17-31 August) and appointments may be made on Ext 266.

## TEC Courses

ONC courses in Science and Engineering and City and Guilds Technicians courses (except stages T5/6 for C & G courses) have now been replaced by courses run under the auspices of the Technician Education Council. TEC Higher Certificate courses in Science and Engineering are being introduced by local colleges this year. These changes affect existing students only under exceptional circumstances, such as break in study or excessive number of repeats. All new students will enter TEC courses this year, except that courses for computer staff will be delayed because they are to be run jointly by TEC and the Business Education Council. TEC courses include 'analytical' and 'practical' groups of units which are broadly equivalent to ONC/HNC and C & G courses respectively.

## BEC Courses

ONC courses in Business Studies and in Public Administration are now being phased out and this year new students will enter the first year of the Business Education Council Ordinary National Certificate course. The courses are organised under four Boards covering Business Studies, Financial Sector Studies, Distribution Studies and Public Administration and Public Sector Studies, but courses associated with all these Boards will not necessarily be run by all colleges. BEC Higher National Certificate courses will be introduced by colleges at the appropriate time.

## Enrolment

Prospective students should note the following arrangements for enrolments:-

OXFORD POLYTECHNIC  
Departments of Science and Engineering

Enrolment on first day of class but note special arrangements for some TEC Engineering students (see Department timetables).

NEHBURY COLLEGE OF FURTHER EDUCATION  
Department of Technical Studies

New students should enrol on Tuesday, 4 September, 10am - 8pm.  
On-going students may enrol on first day of class.

ABINGDON COLLEGE OF FURTHER EDUCATION )  
All Departments )

OXFORD COLLEGE OF FURTHER EDUCATION )  
All Departments )

Students may enrol at the Harwell Education Centre, Bldg 455, AERE,  
10am - 12noon, on Thursday, 6 September.

The following students must enrol at the college in person at the times shown in the prospectus:-

Those who wish to attend other Colleges or other Departments of the above Colleges.

Those who wish to attend Abingdon and Oxford Colleges of Further Education and are unable to attend enrolment at AERE.

## Harwell, SRC & CSC Courses

HARWELL EDUCATION CENTRE COURSES

Copies of the 1979/80 AERE Course booklet are expected shortly and they will be widely distributed in the Laboratory as well as being available in DAO's Offices, the Libraries and Training Section. Applications from Rutherford Laboratory staff to attend AERE courses must be made on Form N552 (yellow) to Training Section, Building R20, and not direct to AERE, although enquiries may be made to the telephone extensions mentioned in the booklet.

SRC MANAGEMENT COURSES

The current SRC/ARC course booklet gives details of courses up to December 1979. A booklet covering calendar year 1980 is to be published during the autumn and copies will be distributed as for the AERE booklet.

CIVIL SERVICE COLLEGE COURSES

Civil Service College course booklets will be distributed to appropriate Group Leaders as they become available. They can also be seen in the Libraries and Training Section.