SERC BULLETIN
SCIENCE & ENGINEERING RESEARCH COUNCIL
Volume 2 Number 5 Summer 1982

In this issue

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Cover picture: *Loading a 356mm square photograph into the COSMOS machine. The photographic plate is placed on an x, y carriage of precision 0.5 micron in each axis. Above the carriage are two high resolution scanning systems. Each scanner projects a light beam on to the photograph and the amount of transmitted light is a measure of the density at each point on the photograph.* *See article on page 10.*

Council members visit CERN

Photo: CERN

The SERC Council held its January meeting at CERN and combined this with a visit to some of the facilities on the CERN site. The CERN laboratory is situated near Geneva, and straddles the Franco-Swiss frontier. The UK has been a member of the organisation since its foundation, in 1954, to allow European physicists access to research facilities that few countries would be able to fund alone. CERN today provides research facilities for about 1700 physicists, the majority of whom are from the 12 member-states.

In the course of the visit, Council members were able to meet British members of the CERN staff and visitors from UK universities, and to see a selection of the equipment and facilities on the site. Points of interest included the 'accumulator' ring (a device to store antiprotons) that is at the heart of a new programme of experiments based on proton-antiproton collisions, and a major experiment in which Birmingham University, Queen Mary College, London, and RAL are collaborating with groups from institutions in France, Germany, Austria and Italy.

The visitors were also able to see prototype items of equipment to be used in LEP, the Large Electron-Positron collider project that received formal approval from all member-states in December 1981, and to visit a mock-up of a section of the 26-km circumference LEP tunnel.

Appointment of Chief Scientist

The Council is pleased to note that Dr R B Nicholson, FRS, has been appointed Chief Scientist to the Central Policy Review Staff. Although this means he has had to resign his membership of the Council, of which he has been a member since 1978, it is hoped he will retain his close links with SERC.

The Science and Engineering Research Council is one of five Councils funded through the Department of Education and Science. Its primary purpose is to sustain standards of education and research in the universities through the provision of grants and studentships and by the facilities which its own establishments provide for university research.
The SERC Bulletin summarises topics concerned with the policy, programmes and reports of the SERC.

All publications described are available from the appropriate department of the Council, free, except where otherwise stated. The SERC's Annual Report (available from HMSO bookshops) gives a full statement of current Council policies together with appendices on grants, awards, membership of committees and financial expenditure.

Enquiries and comments are welcome and should be addressed to the editor, Miss J Russell, at the Science and Engineering Research Council, Polaris House, North Star Avenue, Swindon SN2 1ET. Tel Swindon (0793) 26222.

ISSN 0262-7671

Council commentary

Congratulations to the following members of Council on the honours they have received:

Knight Bachelor: J Lewis; A M Muir Wood
CBE: P A B Hughes

Dr J L Gowans, CBE, FRS, the Medical Research Council Assessor to Council, also received a Knighthood.

Studentships

The Engineering Board continues to give strong encouragement to the support of postgraduate taught MSc courses which are an important means for providing the specialised vocational training needed to equip engineering graduates for industry and as conversion courses for science graduates. Council responded positively, therefore, to a proposal that the Engineering Board should have the freedom to convert 40 research studentships into 45 advanced course studentships from within the 1982 quota of awards for engineering. An additional 15 advanced course studentships were also allocated to the new Biotechnology Directorate, thereby doubling the number of such awards on offer in biotechnology. The future of the Collaborative Training Award Scheme (CTA) was reviewed and Council agreed to recommend to the Department of Education and Science that the Scheme should continue in its present form for a further two years. Although the take-up of awards has recently fallen from the peak of 27 established in 1979/80, members felt that CTA was even more relevant to present-day circumstances than to those which existed in 1977 when the Scheme was created. It was agreed that greater efforts were needed to publicise CTA and that the Council's Regional Brokers could play a leading role in this connection.

Financial matters

By late January, expenditure forecasts for 1981/82 indicated that the provisions for international contributions were likely to be fully spent. Although some savings had been predicted earlier in the year, with the agreement of DES and Treasury, these were used to advance part of the final instalment due in respect of the initial capital cost of the Institut Laue Langevin in Grenoble, thereby relieving some pressure on Council's funds for 1982/83.

During the final quarter of 1981/82, the Council continued to monitor its projected expenditure closely and it appeared in January that research grant spending would fall short of its target and hence plans were made at that time to bring forward the purchase of items from 1982/83, including the first stage of the replacement of the IBM 360/195 computers at the Rutherford Appleton Laboratory. During March the rate of submission of research grant claims accelerated and it was, therefore, unnecessary to incur additional commitments for 1981/82. The Council would be considering what action it should take in 1982 regarding the RAL computer replacements at its May meeting.

Council has now received details of its allocation for 1982/83 which in total is £234,402,000. Not all of these funds are consolidated within Council's main guidelines, there being special additions for micro-electronics and biotechnology totalling £2,592,000 plus a recent injection of £660,000 for research grants. The latter arose as a result of the Secretary of State's recommendation to the ABRC that some funds previously allocated to the SSRC should be re-directed to the support of the natural sciences in universities. Although substantial cuts seemed probable at one time, the Science Vote was once again protected in the Government's expenditure review.

Astronomy, space and radio

Council noted the annual reports of the international organisations to which it subscribes through the Astronomy, Space and Radio Board and approved SERC's contributions to each of them for the coming year. The organisations concerned were the European Space Agency, the Anglo-Australian Telescope Board, the European Incoherent Scatter Scientific Association and the South African Astronomical Observatory.

The capital construction costs for the La Palma 4.2 metre telescope have been revised to bring them to current price levels and Council approval was given to a new figure of £12,850,000. The increases since May 1980 are entirely attributable to UK and Spanish inflation and, relative to the indexation of the ASR Board's funds, the project has risen in cost by only about £400,000.

Central computing

In January the Council considered a proposal from its Central Computing Committee concerning the future provision of vector processing capacity for academic research. At present this is restricted to the specialised service available through the Cray 1S-500 computer installed at Daresbury, time being hired on this machine under a contract which expires in June 1983. However, the Computer Board has recently decided that the computing requirements of its national centres over the next decade can best be met by the installation of vector processors.

This development opened up the possibility, therefore, that the Board could in due course assimilate the existing SERC workload on its own general-purpose machines. It was recommended that this transition be achieved by the Council and the Computer Board acting in concert to exercise SERC's purchase option on the existing Daresbury Cray, largely using Computer Board funds. Under these arrangements, which were accepted by Council, the Cray will remain at Daresbury until the second quarter of 1983 when it will be transferred to the University of London Computer Centre.

Discussions are in progress between officials of the Council, the Computer Board and the national centres to ensure that the transfer of responsibilities is as smooth as possible and provides the continuity of service which existing research programmes require.

Working party on postgraduate education

The report of a Working Party chaired by Sir Peter Swinnerton-Dyer, FRS, commissioned in 1979 by the Advisory Board for the Research Councils to look into postgraduate education, was published in April.* Sir Peter is Master of St Catherine's College, Cambridge, and is a member of SERC's Postgraduate Training Committee.

The report urges a more rigorous approach to research training in the main scientific disciplines, including an improvement in submission rates for PhD theses (for the results of a SERC survey on this subject, see page 24).

Among the Working Party's recommendations are:

- a thorough review every four years or so by each research council of its award allocations and postgraduate policies;
- better representation on research council committees by 'user' representatives in industry and commerce;
- monitoring of thesis completion rates and the imposition of 'sanctions' by the research councils against institutions with poor submission rates;
- greater contact between supervisors and students; staff influence on the choice of students' research topics; assessment of students' suitability to continue at the end of their first postgraduate year.

A draft of the report was referred to SERC in December when Council agreed to consider it in depth after consulting its Boards and relevant committees. With this consultation complete, Council is returning to the report in June.

** Advisory Board for the Research Councils: Report of the Working Party on Postgraduate Education,* Cmnd 8537 HMSO £7

Daresbury – a lively scientific centre

PROFESSOR LESLIE GREEN became Director of SERC's Daresbury Laboratory in July 1981. A leading authority on the structure of nuclei, he is on secondment from the University of Liverpool where he was Pro-Vice-Chancellor and head of the Department of Physics. *SERC Bulletin* asked him how he sees his new office.

SERC Bulletin: *Daresbury Laboratory accommodates two major facilities – the Nuclear Structure Facility and the Synchrotron Radiation Source – as well as theory and computational services: to what extent do you feel their roles are complementary or do they remain separate? How do you feel the Laboratory fits into the SERC structure?*

Professor Green: The Nuclear Structure Facility and the Synchrotron Radiation Source do not have a great deal in common in their scientific programmes but they do have similar requirements in the services needed for project construction, development and exploitation.

With the recent commissioning of the SRS, and the imminent prospect of NSF utilisation, the Laboratory's attention is now firmly focused on building closer ties with our new user communities. We are sure that close collaboration between our colleagues in the universities and our own theoretical, experimental and computational scientists, will result in a lively scientific centre in line with SERC's declared aims of support to university research and to collaboration with other institutions, both within and outside SERC, and in industry.

SB: *What do you feel Daresbury's relationship should be with research groups in universities and polytechnics?*

LLG: Our role is to provide and operate the large advanced facilities which no single university group could hope to install and fully utilise on its own – and provide the technology and support in experimental skills required for their exploitation. It is difficult to see how the SRS or the NSF could have been designed, built and operated in a university department but projects of this type are very necessary if British science is to remain competitive. We also need to provide theoretical and computational support for the experimental programmes. For example, a great deal of good experimental data are already coming from the SRS and many of the experimental groups have no recourse to theorists in their area of interest in their own universities. The current financial pressures on university departments will make it more difficult for them to mount new lines of research and to maintain the momentum of their research. The presence of central facilities with coherent research communities will, I hope, help to maintain research morale.

SB: *How do you view this trend towards the national 'big science' laboratories for use by the whole British scientific community as opposed to each university having its own smaller facility?*

LLG: For much of the synchrotron radiation community, and to a lesser extent the nuclear structure community, dependence on central facilities for their research is a new way of life. When the Synchrotron Radiation Source and the Nuclear Structure Facility are fully in use, over 90% of the scientists doing research here will be from universities. The laboratory scientists share with the universities all the tasks which are necessary if experiments are to be successful and the university users share the short and long term planning necessary if projects like these are to be successful over the years. So in a very real sense the Laboratory is an extension of the universities.

In large central laboratories there are dangers of inflexibility and loss of freedom for rapid response to new ideas, but we have to be aware of these and do our best to remove them.

Professor Green with Dr W Duncan, Dr J B West, Mr P Moore observing visible synchrotron radiation emerging through a lead-glass window from the primary mirror of the infra-red port. Infra-red radiation is used in experiments on molecular dynamics, semi-conductors and gases.

The environment of advanced technology operating at the research forefront, with all the necessary detailed planning, is a good one in which to train research students and avoids the dangers of isolation which can occur in small departments. The equipment and techniques used in nuclear structure and synchrotron radiation research are such that the research student can still be given responsibility for a large part of an experiment and can become familiar with a broad range of concepts and with advanced equipment.

SB: *How do you see Daresbury's future in the international context?*

LLG: Earlier we discussed Daresbury's role in support of research in UK universities but our role in an international context is also an important one. The Laboratory, of course, maintains active contacts with other centres both by visits and by collaborations. For example, Daresbury scientists have participated in nuclear structure experiments at Brookhaven, Heidelberg, Niels Bohr Institute, Copenhagen, and the Australian National University. Synchrotron radiation experimenters frequently collaborate with LURE, DESY, Frascati and centres in the USA and USSR. Once both projects are fully commissioned we are hopeful that these arrangements will be reciprocated in terms of international collaborations at the Laboratory.

On the international side, the NSF at its full potential will be unique and is complementary to the other leading European heavy ion facilities, GSI and GANIL. There is already Danish involvement in proposals for experiments at the NSF and there are representatives from Germany and France on our programme review panel.

Right now, we have an agreement for Swedish use of the SRS and the Dutch have signified their intention to build a beam line and contribute to its running costs in exchange for access to the SRS; their experimental proposals will naturally be subject to the same review procedures as UK users, but this widening of the SRS community and European involvement is very welcome.

In the longer term, if the European Synchrotron Radiation Facility is built, we believe there is a strong case for siting it at Daresbury. In addition to the availability of staff with ten years' experience of synchrotron radiation here and an experienced machine design team, there would be many advantages from two complementary synchrotron radiation sources on one site. If a European source were built here, the probable direction of development of the Daresbury SRS would be to provide a dedicated ultra-violet source with the ESRF satisfying the need on the x-ray side.

SB: *The NSF: You have been involved with the development of this world class facility for many years; your own group at Liverpool University was one of those to give up its own accelerator so that this new major national facility could be built. How do you see the future of university groups in this field sharing one central facility?*

LLG: Both Liverpool and Manchester have closed down their own accelerators. Both groups realised a long time ago that replacement of their accelerators would be necessary and that it would not be possible except on a national scale. Both groups have been strong supporters of the NSF from an early date and now benefit from having it on their doorstep. However, there is a worry that, being a single beam machine, the NSF will not provide anything like the total beam time needed by the nuclear structure community.

SB: *Nuclear structure physics is an exciting branch of fundamental science in its own right, but can techniques developed in this area have wider applications?*

LLG: Nuclear physics has been, and still is, astonishingly fertile in its spin-off of ideas and techniques, not only in medicine but in nuclear energy and in the many applications of radioactivity to engineering, science and archaeology. Our knowledge of stellar structure and stellar evolution is completely dependent on data from nuclear physics. But this is not, of course, why the Nuclear Structure Facility exists or why young men and women are prepared to devote themselves to the subject. That is the same as any other branch of science, that they find it intellectually exciting and demanding and they hope to discover new and interesting phenomena.

Professor Green

SB: *Synchrotron radiation is a new field for you. What developments do you see in the field?*

LLG: The science at the SRS covers an enormous range from atomic physics to biophysics. It certainly spreads our interests and is very enriching from a personal point of view. It is not a new field for Daresbury, of course, since parasitic use of the synchrotron radiation from NINA was well developed at the time of its closure.

Shortage of funds and manpower at the SRS tends to push us in the direction of initially building experimental stations which provide services for a large number of users at the expense of being able to respond quickly to a good idea from a single user. We have not been able to build up the number of beam lines and experimental stations at anything like the rate we would like, so the additional funds and support coming from non-entitled users are very welcome. The Dutch plans to build and support a beam line with experimental stations, the agreement for Swedish use and the involvement of an industrial consortium will help in providing additional resources for speeding up the development, but equally important is the international and applied broadening of the programme which is very welcome.

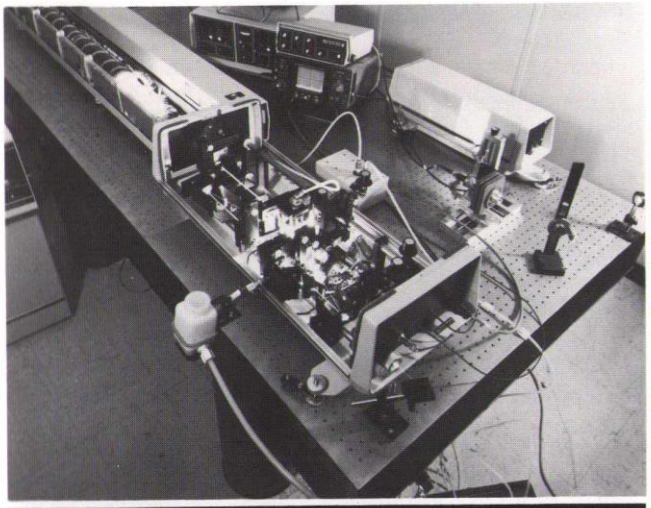
Discussions are well advanced with the Medical Research Council to support biological work at the SRS jointly with SERC. This will enable us to provide better facilities for this work by building the Biology Support Laboratory at an earlier date.

One consequence of the financial constraints which resulted in the long construction time of the SRS is that, in order to remain competitive with overseas sources started much later, we have to plan an upgrade of the Facility quite soon after its start up. Within the last year it has been shown to be technically feasible to reduce the beam size and so improve the brightness of the source by installing additional quadrupole magnets in the lattice. The earliest this improvement can be made is 1984-5. It will involve a shut down of six to eight months but the resulting improvement will make that well worthwhile and by then the users will have had three years' use of the SRS.

Lasers for nuclear structure research

A recent arrival on the experimental equipment scene at Daresbury is a tunable dye laser system. Surprisingly this is not associated with the existing tunable source (Synchrotron Radiation Source) but is for nuclear research using the Nuclear Structure Facility (NSF) currently being commissioned. Lasers have been finding an increasing use in nuclear physics and this new facility will provide an opportunity for UK scientists to participate in an expanding field.

The new lasers will be mainly used to measure hyperfine structure and isotope shifts of radioactive species produced by the NSF tandem. This consists of very precise measurements of atomic transitions in the visible and ultra-violet region, which provide information about nuclear ground state properties. Although atomic spectra are principally determined by the atomic number of the nucleus, small effects can be observed due to the finite nuclear size and electric and magnetic moments. The former causes a shift in the atomic transitions and, if this is measured over a range of isotopes (isotope shift), changes in the nuclear radius can be measured. Nuclear ground state moments give rise to a splitting of the atomic levels (hyperfine structure) and can also be measured.



The laser system prior to installation

Of course measurements of these effects are not new. What is exciting is that new techniques with lasers allow accurate measurements to be made on unstable nuclei. Additionally the method is so sensitive that only a very few atoms are required and nuclei far from the stability line can be studied. The study of these 'exotic' nuclei provides a sensitive test of the way in which neutron and proton forces affect the nuclear shape as one goes away from the most favourable neutron to proton ratios.

The new laser system comprises an actively stabilised ring dye laser pumped by a large argon ion laser. It is capable of producing more than a watt of continuous light output tunable over the complete visible range. Developments to extend this into the ultra-violet parts of the spectrum using frequency doubling crystals will be undertaken. Atomic transitions will be measured using the technique of resonance fluorescence. In this the laser light is tuned across a narrow range centred about the atomic transition. When the laser frequency matches the atomic transition frequency, photons are absorbed by the atoms and the re-emitted light can be observed with photomultipliers. Because of the high output power of the system and its narrow linewidth it is possible to observe, by this technique, the transit of a single atom across the laser beam.

Most of the initial work will also employ the Daresbury isotope separator which is coupled directly to the NSF accelerator. Using this, radioactive species will be separated according to their mass before the atomic transitions are measured. Two on-line techniques will be employed. In one, the ions from the separator are stopped in a hot mirror plate and re-emitted as an atomic beam which is made to intersect the laser beam. In the other, the laser light is shone directly along the beam from the isotope separator; the first colliding beam experiment at Daresbury! Although most of the initial work will concentrate on these types of experiment, many others are possible. One attractive possibility is to use the laser light to align atoms by optical pumping and so produce a polarised nuclear target.

Progress on the new facility is well advanced. A new room adjacent to the NSF experimental areas has been constructed and the lasers will be installed in the near future. Experiments are expected to take place during the first NSF beam time schedule.

X-ray fluorescence analysis with the SRS

Another application of synchrotron radiation was developed earlier this year when Dr K Bowen and Dr S Davies (Warwick University), in collaboration with three visiting Dutch scientists (M Prins, R Vis and A Bos), performed some new experiments with the Synchrotron Radiation Source at Daresbury Laboratory. Utilising a graphite mosaic crystal as a monochromator, they shone an x-ray beam on to their specimen, and measured the emitted fluorescent x-rays with a Si(Li) detector. The fluorescence spectrum showed a number of sharp peaks at x-ray energies characteristic of the elements present in the sample. For example, in a standard bovine liver sample, peaks were obtained corresponding to iron, copper, zinc, calcium and bromine, indicating their presence in various amounts.

This technique of x-ray fluorescence achieves remarkable sensitivity (eg detection of trace elements present in quantities ~ 0.5 parts per million has already been achieved). By comparison with the alternative of proton-bombardment fluorescence excitation, the synchrotron radiation method achieves a superior signal-to-background ratio in the low energy region, and generates far less heating in the sample.

The investigators believe there is a very promising future for x-ray fluorescence analysis with synchrotron radiation. Applications in biological and medical fields, in crystal growth and semiconductor technology, and in studies of coal and fly ash are among those cited. At the SRS, it is planned to develop a 'microprobe' based on the fluorescence technique. In this device an x-ray beam will be focused to a small intense spot on the surface of the specimen, and the specimen scanned using an x-y slide, so as to build up a picture of the distribution of elements over its surface area.

Bubble chamber holography

Particle physicists at the Rutherford Appleton Laboratory are developing the use of holography as a new method of recording the tracks and interactions of particles in bubble chambers. The aim is to be able to look with high resolution over the whole volume of a bubble chamber at the decays of short-lived particles which are produced when high energy particles from an accelerator interact with a proton or neutron in the bubble chamber liquid.

Traditionally, such interactions in bubble chambers have been recorded by conventional photography, and many millions of photographs have been examined worldwide in scanning laboratories over the last 20 years. However, if higher resolution is required in the photographic image, a fundamental limitation is encountered: better resolution is accompanied by a smaller depth of field. This well-known effect, first pointed out by Lord Rayleigh, implies that for instance, for a resolution of 30 μm, the depth of field is reduced to $\sim$ 2mm. Thus the effective volume of the bubble chamber is reduced to a slab only a few millimetres thick, and most of the potentially useful volume is wasted. It also becomes increasingly difficult to steer a beam of particles from an accelerator into a bubble chamber in such a thin beam, and beams of neutral particles such as neutrinos cannot be focused into such a shape.

Holography offers a solution to this problem. Whereas in conventional photography the intensity of light from an object is recorded on the film, in holography both the amplitude and phase of light are preserved by modulating a coherent beam of 'reference' light with light scattered from the object. A laser provides the necessary source of coherent illumination. On replaying the hologram, again with coherent light, the wavefront from the original object is restored and an image can be produced with the required resolution and with essentially no constraints on the relative depths of different parts of the image. This image can then be examined microscopically and features of interest noted and analysed.

The current interest in applying high resolution optics to bubble chambers stems from the properties of the 'new' particles discovered in the last eight years. Until that time it was believed that the spectrum of all particles which experience the nuclear – or strong – force could be explained in terms of a substructure of three different types of quark, while a separate family of particles (the leptons) consisting of the electron, the muon and their associated neutrinos, experienced only the weak and electromagnetic forces. Since then a series of experimental and theoretical discoveries has led to the idea that these different particle types are linked in 'generations' of particles and that further quark and lepton types should exist. Indeed, particles containing two new quark types have been seen in this period, starting with the celebrated 'charmed' particles, and a new lepton, the tau, has been discovered.

The lifetimes of the 'new' particles ($\sim 10^{-13}$ to 10^{-12} secs) are such that, typically, they will decay after travelling only $\sim$ 1 mm from their production point in high energy interactions. Thus by searching for interactions where particles decay after travelling such distances, the new particles can be detected, and their production and decay properties studied. It is here that the interest in using high resolution optics arises: in order to see a well-defined track of length $\sim$ 1 mm, which is usually produced amongst a jet of particles carrying between them the momentum of the incoming particle, it is necessary to have bubbles which are not more than a few tens of microns in size.

Extensive tests have been carried out at RAL to test the viability of the use of holographic optics for several different bubble chambers. In these tests, bubble chamber tracks have been simulated by thin wires or glass fibres, and illumination has been by means of continuous wave lasers, but the geometry was that of the envisaged bubble chamber configuration. Very encouraging results have been obtained; in reconstruction of holograms, resolved images of objects less than 10 μm in size have been observed.

These tests have been matched by an equivalent effort in the application of holography to real bubble chambers. Two small purpose-built rapid cycling bubble chambers have been constructed at CERN, and both have produced holograms in test runs. In working with a real bubble chamber, a pulsed laser is used, and it is flashed at the moment when the bubbles formed by the ionising particles from the interaction have grown to just the required size, 10 to 20 μm. There is also interest in using holography in the 80 cm Rapid Cycling Bubble Chamber which was designed and constructed by RAL for use at CERN and – most ambitious of all – plans are also well advanced for holographic trials in BEBC, the 3.5 m Big European Bubble Chamber. All of these projects have participation and interest from SERC-supported British university groups or from RAL physicists.

Another branch of the development programme at RAL is concerned with the problem of the analysis of holograms once they are taken in experiments. Conventional bubble chamber pictures are analysed by projecting the photograph on to a table or screen and digitising the tracks from interesting interactions in two dimensions. Two changes are needed in order to adapt such a system for measurement of reconstructed holograms: first, the incoherent source of illumination must be replaced by a laser; and second, a further digitising stage must be supplied in order to measure the tracks in the third dimension. A third modification is found to be desirable: instead of projecting on to a table or screen, the holographic image is projected on to a Vidicon tube and displayed on a TV monitor. Since the TV camera provides considerable signal amplification, this method reduces the requirements for laser power, and also offers interesting opportunities for image processing in order to increase the signal to background ratio in the observed picture.

Further information about the application of holography to bubble chambers can be obtained from Dr R L Sekulin at Rutherford Appleton Laboratory.

A Vanguard measuring machine for bubble chamber pictures adapted to project and digitise bubble chamber holograms. The controls allow the operator to drive the machine in three perpendicular directions and position any desired point in the bubble chamber volume under the measuring cross.

Specially promoted programmes ...two profiles

The Engineering Board's system of selective support, through its Specially Promoted Programmes (SPPs), was introduced in the Spring 1981 issue of the *Bulletin* (Vol 2 No 2) and a list given of the coordinator and SERC contact for each programme. Here we bring you the third in a series in which we focus on the progress of each of the SPPs in turn.

Distributed computing systems

A distributed computing system may be defined as one in which a number of autonomous but interacting computers cooperate on a common problem. There are many practical reasons for investigating the properties of such systems. These include:

Performance: distributed computing provides a means of achieving very high speed processing which may be more economical than increasing the speed of single processors.

Reliability: a fully distributed system should be able to tolerate faults caused by either software or hardware.

Clarity: many problems can be simplified if expressed as a set of interconnecting and communicating processes.

Distribution: in areas such as real-time control it is often important that processing power is available where it is needed in order to minimise the amount of data which has to be transmitted.

Cost: the low cost of microprocessors allows certain tasks to be performed more economically on sets of microprocessors than on a single

A coordinated programme

In 1977, a coordinated programme was established to encourage and direct more research in distributed computing. To date, expenditure committed to the programme, mostly in the form of research grants, exceeds £4 million.

The main objective is to seek an understanding of the principles of distributed computing systems and to establish the engineering techniques necessary to implement such systems. Particular emphasis has been placed on achieving results of practical value to UK industry.

All the research projects in the programme address some aspect of the problem of parallelism. The main areas are as follows:

Theory and languages: The creation of a theoretical basis for distributed computing is very important, in particular to support work on language and system design. The problems revolve around establishing adequate methods for representing complex asynchronous systems and the identification, formal definition and mathematical analysis of the properties of such systems. Projects at Edinburgh University are involved with defining a suitable framework to represent concurrent computations and to study the foundations of such computations. Newcastle University has developed a formalism for describing and analysing the synchronic aspects of concurrent processes. Queen's University of Belfast has developed compilers for the programming language Pascal Plus which supports concurrency. Queen Mary College, London is investigating a language and design methodology based on the message passing approach to communications between processes and UMIST has developed a methodology for the design of concurrent programs.

Resource management: Distributed computing systems exacerbate many of the current database problems, such as control of access, consistency and naming, as well as providing a more severe environment for access synchronisation. One approach to these problems is the server, a concentrated resource such as a filestore, which is accessed by, or serves, a community of users. Research on file servers is being carried out at Kent and Cambridge Universities. The other approach is the truly distributed resource. Keele and York Universities are investigating a distributed filestore.

Architecture: A variety of new architectures using multiple computing elements is being evaluated. Cambridge University has developed a wide band digital communication ring to which a number of processors for specific functions may be attached. The 'Cambridge Ring' has already been taken up by UK industry. UMIST has constructed a 16-processor shared memory system on which a number of practical applications are being tested. Sussex has built a system in which work stations based on a shared memory architecture are linked by a wide band communications network.

A major project at Manchester University involves the design and construction of a prototype Data Flow computer system. Data Flow is a new approach to computation, where the parallelism is implicit in the problem specification. Unlike vector and array processors, data flow machines do not depend on a high degree of regularity in the computation of parallel problems. Potential applications are wide and include weather forecasting, signal processing and intelligent systems. Projects at East Anglia, Kent and Imperial College, London, are concerned with applicative and logic languages and their implementation on the Manchester machine.

Coordination

A major factor in the success of the programme has been the existence of an academic coordinator. He acts as a link between SERC and the research community, and is also responsible for maintaining contact between researchers, through workshop meetings, conferences and a monthly mailshot. In this way, duplication of research is minimised and cross-fertilisation effected.

Cooperation and transfer of results between research groups is further encouraged by the adoption of common hardware (ie LSI-11, Cambridge Ring) and software (UNIX) bases. Many groups may now communicate directly through network links.

Links with industry

During the programme's remaining two years, a major effort will be made to transfer these results to industry. As reported in the Spring 1982 *Bulletin* (Vol 2 No 4), SERC has appointed an industrial coordinator, based in industry. His responsibility is to encourage industrial take-up of the results of research sponsored by the programme, and to make researchers aware of industrial needs. He is organising an industrial conference to take place towards the end of the current Information Technology year aimed at increasing industry's awareness of the programme.

For further information on the programme please contact either the academic coordinator, Dr D Duce, at the Rutherford Appleton Laboratory, telephone Abingdon (0235) 21900, or the industrial coordinator, Mr F Chambers, Logica Limited, 64 Newman Street, London W1A 4SE telephone 01-636 5440 (ext 242).

Energy in buildings

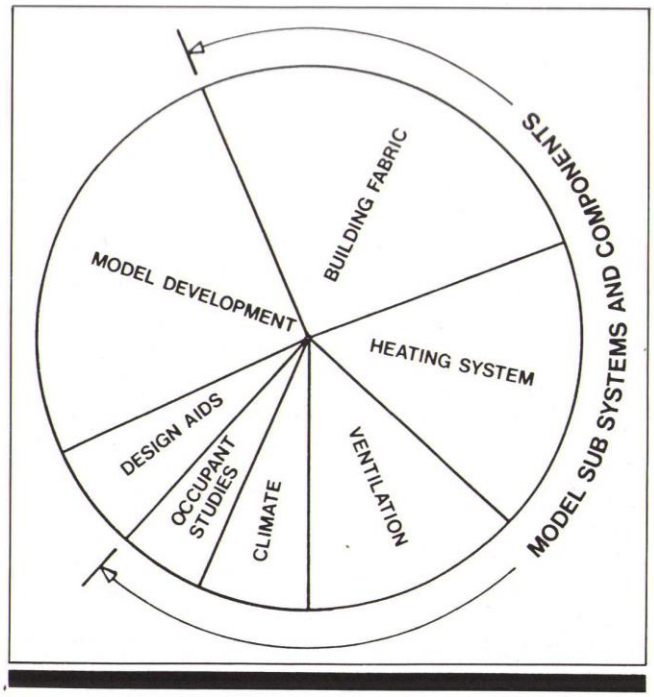
Energy use in buildings represents half of the total amount of prime energy consumed in the UK for all purposes and the importance of buildings in the national energy conservation programme is widely recognised. Nationally, there has been an upsurge in the attention given to research and demonstration projects in this area and it was against this background that the SPP was set up during 1979.

Although the long established 'steady state' methods of analysis could be used to predict the effects of energy conservation measures, it was appreciated that these methods do not fully represent the way in which buildings behave in practice. Buildings, with associated heating and/or cooling plants, control systems and occupants, are subject to changing weather conditions and represent a dynamic and interactive situation. The major aim of the SPP was to increase our understanding of the dynamic thermal response of buildings in order to develop and refine modelling techniques and hence optimise the energy use of buildings.

The SPP currently consists of some 39 research projects with a total commitment of £780,000. One encouraging aspect is the increasing involvement in the SPP of university and polytechnic departments which have not previously been active in the building field. This has served to broaden the base of the research community and every effort is being made to encourage this trend.

The individual projects are related to three main areas of activity:

- ☐ The SPP has been concerned with the improvement and development of existing computer-based simulation models rather than with the development of new models and techniques. For example, Professor P E O'Sullivan at UWIST is extending an existing finite difference research model to housing by incorporating empirical data on ventilation heating system efficiency from the field trials at Abertridwr, South Wales (see *Bulletin* Vol 2 No 4, Spring 1982). Similarly, Professor P Burberry at UMIST has continued with the development of a hybrid model to predict building performance over long periods. One of the aims of this study is to provide design precepts and simple calculation procedures of immediate value to building designers.



Proportional distribution of research budget by subject area

Progress in this area is currently being reviewed. It is anticipated that further support will be given to some of the existing models with the objective of making them available to a wider group of research workers via SERC's Interactive Computing Facility (ICF) network. In parallel with this activity it is proposed to undertake a validation/verificiation study of these models and extend work on the simulation of environmental systems and controls.

- ☐ Although model development is a core activity, the major proportion of funding has been devoted to the experimental and theoretical study of building sub-systems and components. The overall aim of the research is either to improve the quality of the input data to the models or to improve the algorithms used for the solution of particular sub-systems. This has involved research topics over a wide area, ranging from the effect of moisture content on the thermal conductivity of walls to occupants' behaviour in school class-rooms, eg window opening. The SPP will necessarily continue to be involved across this broad front in order to promote model development.

- ☐ Attention has been given to promoting the link between research and industry. Dr A Jones at the Cranfield Institute of Technology has been involved in the implementation of their 'Build' thermal model in a practising design office to examine its usefulness in a design context and the results from this have been encouraging.

  At the University of Cambridge, Dr D Hawkes is concerned with the development of a design guide for low energy primary schools linked to live building projects with county council architects' departments. Attention is being specifically directed to combining a high degree of user control with energy efficiency.

The Coordinator has placed considerable importance on developing links both within the research community and with industry. To this end a number of seminars have been held on well-defined subject areas. These have served not only to aid communication but also to identify specific needs. Consequently, Professor J K Page of Sheffield University is currently assembling a database of 60 years of combined meteorological data. This is to be made available via the ICF network and will be accessible to anyone engaged on SERC-funded research. A further tangible gain is the production of a handbook on the designed conduct of field trials, which consists of the collected experiences of those involved in measuring building performance. This is expected to be of considerable benefit to both new and established research workers.

Dr T J Wiltshire was appointed Programme Coordinator in November 1981 following the retirement of Mr B F Day. Dr W A Smith of the Rutherford Appleton Laboratory will continue to assist the coordinator. The programme is administered by Mr N L Williams, Secretary to the Building Sub-committee, at SERC Central Office, Swindon (ext 2353).

The Building Sub-committee invites grant applications in the research areas outlined, especially where they are clearly related to the needs of industry. The Coordinators will be pleased to discuss any applications in the Energy in Buildings field and applicants should contact either:

Dr T J Wiltshire, School of Architecture, University of Newcastle, telephone Newcastle (0632) 328511 (ext 2012) or

Dr W A Smith at RAL, telephone Abingdon (0235) 21900 (ext 6600).

Measuring machines put UK astronomers light years ahead

Many people are familiar by now with the impressive photographs of the night sky which recent advances in astronomical photography have made possible, using powerful telescopes such as the Anglo-Australian Telescope and the UK Schmidt Telescope on Siding Spring Mountain in New South Wales. However, taking spectacular photographs and carrying out systematic sky surveys are only the first steps in obtaining useful astronomical data. Before astronomers can begin to do science they need to have quantitative measurements of what they see. Since a single photograph can easily contain the images of more than 100,000 stars and galaxies, it is essential to use automatic machines to measure their positions, brightnesses, sizes and shapes.

As a result of several independent developments of such machines during the last few years, astronomers in Britain are now in an unrivalled position to exploit the vast quantities of data being recorded by large optical telescopes. The three major machines in order of development are GALAXY at the Royal Greenwich Observatory, COSMOS at the Royal Observatory, Edinburgh, and the Automatic Plate Measurement (APM) facility at the Institute of Astronomy in Cambridge. Each of these machines is unique and probably more powerful than any similar machine working elsewhere in the world.

Their nearest rivals are the commercial PDS microdensitometers, such as the one at the RGO, which can be more suitable for some types of work but which operate much more slowly and so cannot handle entire Schmidt Telescope photographs.

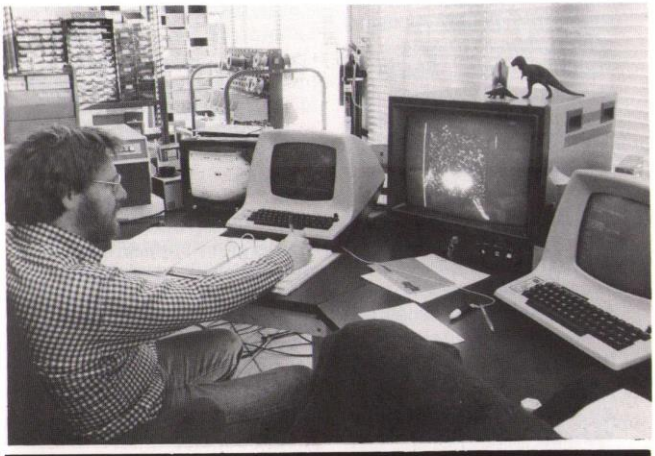
Each of the big machines works in a rather different way, although they share common basic features in that their objectives are to measure the density changes from point to point in an original photographic negative, to detect the presence of stars or galaxies and to measure the properties of these images. This involves shining a very fine beam of light through the photographic plate and measuring how much the light is attenuated by the grains of silver in the images; the blacker the image (and hence the brighter the object), the less light will be transmitted through the plate and detected by the measuring machine.

Scanning across the whole plate involves high-speed small-scale electronically controlled movements of the light beam, combined with large-scale movement of the photographic plate itself on a precisely engineered mechanical carriage. Because the machines work so rapidly and because the quantities of data are so vast (one Schmidt plate, fourteen inches square, contains about a thousand million picture elements or 'pixels'), it is essential that some initial picture processing is done on-line by a very fast computer. Even then, the complete data from one plate can fill several magnetic tapes so that very powerful computers are needed for the analysis of the data. This is where SERC's STARLINK network of VAX computers comes into its own; it is the availability of powerful computing facilities as much as the development of the measuring machines themselves which has suddenly revolutionised the use of large-scale photography in astronomy.

Although the machines share a common aim in extracting data from photographs, they do have significant differences and are used therefore for different types of work. GALAXY uses a scanning cathode ray tube to generate its light beam; once a star image has been located, the spot of light executes a spiral scan to determine the centre and diameter of the image. The diameter of a star on a photograph is a measure of its brightness (*not* of its true diameter, which is very much less and much too small to be detected), so GALAXY generates lists of very accurate star positions and brightnesses but cannot make useful measurements of irregularly shaped or extended objects such as galaxies (despite its name!). Its main programme is the measurement of relatively bright stars on a huge series of several thousand photographs covering the southern hemisphere. These stars will then form a new fundamental reference system for determining the positions of all sorts of other objects such as radio, x-ray and infrared sources.

The COSMOS machine was developed from GALAXY, but incorporates many completely new concepts. It too uses a scanning CRT as its light source, but scans the plate in a raster pattern similar to that used to build up the picture on a domestic television screen. With sophisticated pattern recognition computer software it is therefore able to distinguish between stars and galaxies and to sort out other confusing images such as multiple overlapping stars or photographic flaws. The APM works in a similar fashion but uses a powerful laser beam as its light source and so has the potential to measure photographs more quickly and probably more accurately.

These two very versatile and powerful machines are being used for many exciting research projects, such as searching for new supernovae (exploding stars), probing the structure of the outer parts of our own Milky Way galaxy and finding faint variable stars.



The microdensitometer and control console of the Automated Photographic Measuring System at the Institute of Astronomy, Cambridge. The console consists of a Z-80 microcomputer (far left), a TV monitor which looks at the plate, the control visual display unit, a Lexidata colour graphics display (showing an enhanced picture from the centre of the TV display) and the image processing computer display unit (far right).

Perhaps the most exciting projects are in the field of observational cosmology, in other words looking at the structure of our entire Universe on large scales and at enormous distances. The sort of questions which are now starting to be answered are: what are the largest aggregates of matter in the Universe? Are they clusters of galaxies, superclusters (clusters of clusters), or even larger structures? Does the Universe look the same in all directions? What are the enigmatic quasars, apparently the brightest and most distant objects we can observe? Can we use them as 'standard candles' to investigate very early stages in the life of the Universe?

It must be pointed out that these research projects are not just those of the teams who built and now operate the machines. Each of the big machines is run as a national facility and is available to members of all UK university astronomy groups. Indeed, their use need not be restricted only to astronomical work, and already there have been interesting experiments in measuring other types of photographic material. Anyone who wants more information about the machines and what they can do should contact the machine managers at their respective institutions. A recent SERC internal report on the machines and their capabilities is also available and copies may be obtained from Dr R D Cannon at the Royal Observatory, Edinburgh.

The COSMOS high-speed measuring machine at the Royal Observatory, Edinburgh is designed to extract the information contained in a photograph. At the right is the cabinet containing the basic mechanical assembly and the electro-optical components (see cover picture).

Photographs of size up to 356 mm-square are accepted and placed in an x, y carriage of precision 0.5 micron in each axis. The photograph is scanned by a high resolution light beam and the amount of transmitted light gives a measure of the density at each point on the photograph.

The speed of the machine is such that it can measure and image-analyse a 200 x 200 mm area at 8 micron resolution in 10 hours. The machine can store the information on up to 400,000 images on magnetic tape.

Dynamics Explorer collaborative programme

The NASA Dynamics Explorer satellites 'A' and 'B' are a pair launched on 3 August 1981, into coordinated polar orbits, for the purpose of simultaneously investigating different regions of the Earth's magnetic environment. The satellites provide scientists with a chance to gain an improved understanding about how energy is transported into the Earth's atmosphere and how such phenomena as the auroras are produced. Satellite 'B' is in an orbit close to the Earth – varying between 300 and 800 km in altitude – for investigating the upper layers of the atmosphere and ionosphere, and the way in which the ionosphere interacts with the magnetosphere above.

Dr D Rees, University College London, is co-investigator with Professor P B Hays, University of Michigan, in the Fabry-Perot interferometer experiment on satellite 'B'. The purpose of the experiment is to measure mesospheric and thermospheric winds and temperature. Within a few weeks of launch, the instrument demonstrated its launch specification and took measurements for the first time on a global basis.

To provide an opportunity for normalisation and truth-testing of atmospheric data from different sources, and for simultaneous measurement of a wide range of ionospheric and thermospheric parameters, a collaborative programme of observations was carried out during December 1981, coordinated with overpasses of Northern Scandinavia by satellite 'B'.

The techniques employed in the programme were:

- chemical trails carried up by Petrel rockets;
- ground-based Fabry-Perot interferometers;
- incoherent scatter radar (EISCAT).

Three rocket launches were made during the campaign, two of which were entirely successful. At the times of these flights, the EISCAT and ground-based Fabry-Perot facilities provided additional long-term data concerning the ionosphere and upper atmosphere. As a result of these collaborative investigations, a much clearer picture has emerged of the widespread disturbances which can occur at times of geomagnetic activity in the Earth's environment.

New joint allocation of European time on IUE

Since the launch of the International Ultraviolet Explorer satellite (IUE) in January 1978, the three collaborating agencies – NASA, the European Space Agency (ESA) and SERC – have independently allocated their respective shares of 2/3, 1/6 and 1/6 of the observing time. This distribution broadly reflects their original contributions. SERC, in collaboration with University College London, was responsible for the original design study on which IUE was based and provided the TV cameras which integrate the faint ultra-violet spectra over long exposures prior to transmission to the ground. ESA provided the on-board solar paddles and the ground station in Madrid which all European astronomers visit to make their observations.

IUE continues to operate exceptionally well. Its photometric sensitivity has not changed by more than a few percent over four years. Its lifetime has already exceeded that originally planned and, barring a catastrophic failure, many more years of useful operation can be expected. In the light of this, and in order to achieve a coordinated scientific programme, SERC and ESA have recently agreed to allocate jointly their 1/3 share of the time through a single committee. This will ultimately consist of 1/3 SERC appointees and 2/3 ESA appointees; ratios which broadly reflect the sizes of the UK and continental European user-communities. The joint committee will judge on scientific merit all the European responses to the annual call for proposals.

Now entering its fifth year in orbit, IUE has already inspired three full international symposia, held in London, Tubingen and Washington, with two more (in Madrid and Washington) scheduled for 1982. Altogether, some 300 papers have been published in the proceedings of these conferences and about 250 have appeared in front-rank scientific journals.

Clearly IUE is an outstanding scientific success to which UK astronomers have made a major contribution.

IUE highlights

- The observation, in many cases for the first time, of the ultra-violet spectra of nearly all the primary bodies in the solar system. These include most of the planets, many of their satellites, the Io plasma torus, two comets and several asteroids.
- The detection of several interaction effects between the primary and compact objects in several x-ray binaries including the detection of a gravitational accretion disc in a low-mass system and of an ionisation hole in the primary wind of a high-mass system.
- The most exhaustive analysis yet of any nova (Cyg 1978) which gave chemical abundances and energy estimates consistent with the outburst being caused by thermonuclear runaway in material accreted on to a white dwarf.
- The measurement of mass-loss rates in the winds of luminous stars that are too high to be explained by radiation pressure alone and require evolutionary theories to be re-written for massive stars.
- The study of chromospheric effects over a wide range of spectral type and luminosity in late-type stars; in the case of the pre-main-sequence object T Tau, emission in the Lyman band of molecular hydrogen has been detected from the nearby nebulosity.
- The observation of the ultra-violet spectrum of a quasar showing absorption in the hydrogen Lyman limit at a red shift significantly different from that of the object implying that the absorption is due to the halo of an intervening (but unseen) galaxy.
- The discovery of a hot, extensive halo around our own galaxy; this has implications for the cosmologically important question of the nature of the absorption systems seen in distant quasars.
- The first ultra-violet spectra of BL Lac objects and Seyfert galaxies showing an absence of gas in the former and a remarkable degree of detailed variations in the latter.
- The first ultra-violet observations of the double quasar covering the Lyman lines and giving support to the gravitational lens theory.
- The first ultra-violet observations of a large sample of quasars including the detection, despite IUE's small telescope, of faint ($\sim$ 18 magnitude) high redshift ($Z < 3$) objects.

ESA microgravity programme

On 18 January 1982, the European Space Agency formally announced the start of its programme for scientific research in microgravity. The programme comprises two main areas for study in near-weightless conditions: life sciences to study the effects on living organisms; and material sciences to study the effects on the behaviour of fluids; and crystal growth and metallurgical systems. The three main parts of the programme are:

Biorack – a multi-user experimental facility for investigations in the fields of cell and molecular biology, which is scheduled to fly on the German national Spacelab mission, D1, in early 1986.

Fluid physics module – a multi-user facility designed for the study of phenomena connected with the hydrodynamics of floating liquid zones which is to be flown on the first Spacelab mission in 1983. The module is to be modified for a second flight on the German D1 mission.

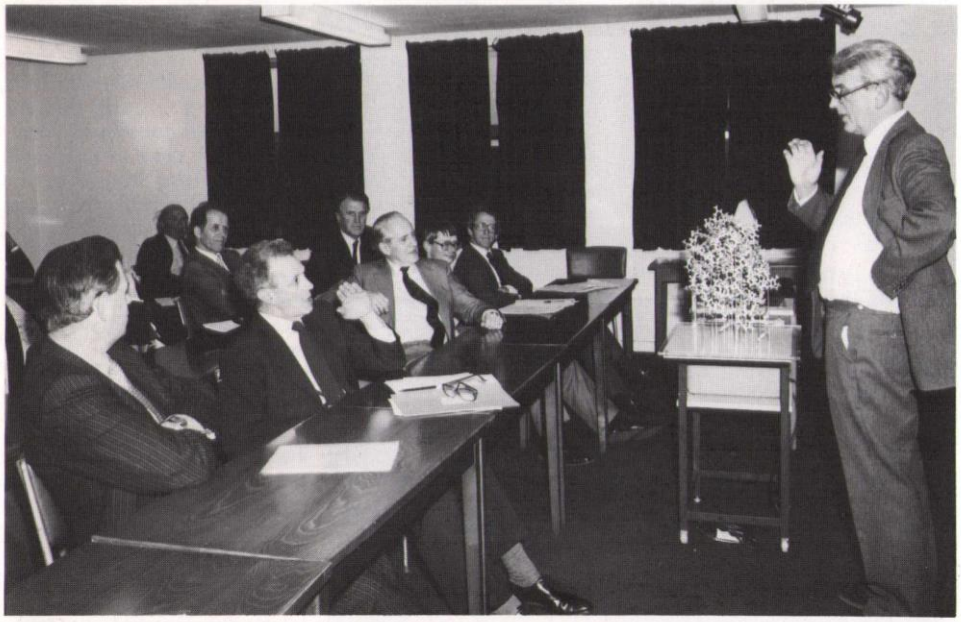
Sounding rockets – for experiments in solidification physics and fluid physics. This is a participation in the German/Swedish TEXUS rocket programme for which British Aerospace is providing its highly successful series of Skylark rockets.

The first phase of the ESA microgravity programme, as presently planned, is due to cover a period of four to five years at a total cost of £20 million (1981 prices) towards which the UK (through the SERC Science Board and the Medical Research Council) is contributing £60,000 per annum – a level intended to give the UK a modest foothold in this field which could be developed if the interest of the scientific community and industry grows and proposals of sufficiently high quality, perhaps with potential commercial benefits, are brought forward.

Future ESA plans for microgravity research envisage payloads on retrievable carriers which can be launched in orbit from the Space Shuttle to operate in free-flying modes, with orbital operation times of up to six months, and be retrieved for re-use. ESA's first retrievable carrier mission is planned for late 1986/early 1987; the ESA Spacelab Programme Board has decided that a microgravity payload should be the primary payload on this flight.

Further information concerning the ESA microgravity programme can be obtained from Mr R F Rissone, SERC Central Office (ext 2320).

Secretary of State visits SERC



Three scientific presentations on aspects of work supported by SERC were made to the Rt Hon Sir Keith Joseph, MP, Secretary of State for Education and Science, in March: computing; astronomy, cosmology and particle physics; and protein crystallography.

Professor Sir David Phillips, FRS, seen here making the latter presentation, referred to the fundamental studies on the structure of enzymes that are increasing our understanding of how they function. In the front row of Sir David's audience at the Rutherford Appleton Laboratory are (left to right): SERC Chairman Professor John Kingman, FRS; Sir Keith Joseph; Mr William Shelton, MP, Under Secretary of State, Education and Science, and DES officials.

The work of the Central Laser Facility

The Central Laser Facility (CLF) at the Rutherford Appleton Laboratory has been in operation for just over five years. During last year the Science Board, within whose field the Facility falls, decided that it would be timely to undertake a broadly-based review of the research programmes carried out using the CLF and of its future potential. A panel under the chairmanship of Dr R N Franklin, Vice-Chancellor of the City University, has completed this review and in January was able to submit to the Board a most favourable report.

The CLF provides a high power neodymium glass laser for university research, mainly into laser-produced plasmas and laser compression, but including other scientific applications where possible. Research is also under way to develop efficient new gas lasers for plasma physics and other applications.

The Panel was impressed by the speed with which the Facility had been constructed and the first scientific results obtained, and with the rapid build-up of activity. A major upgrade and redesign of the system was completed early in 1981, as described in *SERC Bulletin* Vol 2 No 3 (Autumn 1981). The Panel paid tribute to Dr A F Gibson, FRS, under whose leadership at RAL the Facility has been established and developed.

The Panel consulted the CLF user-community in the UK. It found unequivocal support for the Facility and universal acknowledgement that it had provided a valuable stimulus, and brought a national cohesion, to an important area of plasma physics research in British universities. Some members of the community would like to see a strengthening of the experimental programme through closer involvement of university theorists. The users' favourable views were echoed by three senior UK physicists not directly involved in the field, whom the Panel approached for a broad, objective view of the significance of the Facility's contribution to the overall physics scene.

Enthusiastic comments were also received from overseas experts, who considered that the UK community had made scientific contributions of lasting significance in a field of wide international interest. Clearly there is nothing comparable to the CLF anywhere else in the world and it is enviously regarded as a model for those trying to establish something similar.

The UKAEA wrote in support of the work, which it saw as enabling UK scientists to keep a sensitive and informed watch on activities in other countries related to inertially confined fusion.

The Panel also tried to relate its field of review to the broader scene of laboratory plasma physics in the UK. It found that the establishment of the Facility had not significantly altered the total SERC support for in-house university laser-plasma work but that support for non-laser plasma work in the UK had dropped by about a third from 1974 to 1980. The evidence was not that people had diverted to the laser-plasma area, but that the Facility had established a somewhat wider community of successful applicants. The Panel concluded that the Facility provided a major thrust in plasma physics in this country, and one which constituted probably the strongest area of UK university activity in the plasma physics field.

The planned future programme of the Facility identified physics objectives related to unexplored areas of physics where new phenomena could be expected to occur. The plans also recognised the existence of openings to exploit the Facility in directions other than plasma physics, such as atomic and molecular physics, x-ray crystallography, astrophysics, laser physics, photochemistry and biology. The Panel wished new initiatives of this kind to be encouraged.

During the next few years, the programme will seek to exploit the new features of the upgraded glass laser system, and gas laser research and development will continue. In the longer term, the Panel noted strong scientific arguments for developments towards shorter wavelengths and higher intensities.

The Panel concluded that the programme to date had established a substantial place in a competitive field and that there was a strong case for support of a continuing and vigorous long-term programme. The Science Board endorsed those of the report's recommendations which are appropriate for immediate implementation and will take account of the others in planning its programmes in the longer term.

UK wide field camera for ROSAT

The German x-ray astronomy satellite, ROSAT, will carry a UK telescope of novel design. The proposal to fly the instrument, called the Wide Field Camera (WFC), was approved by Council last November. The telescope is intended to complement the principal 0.8 metre aperture x-ray telescope being developed for ROSAT by the Max Planck Institute in Garching, and will view the same fields in an overlapping waveband.

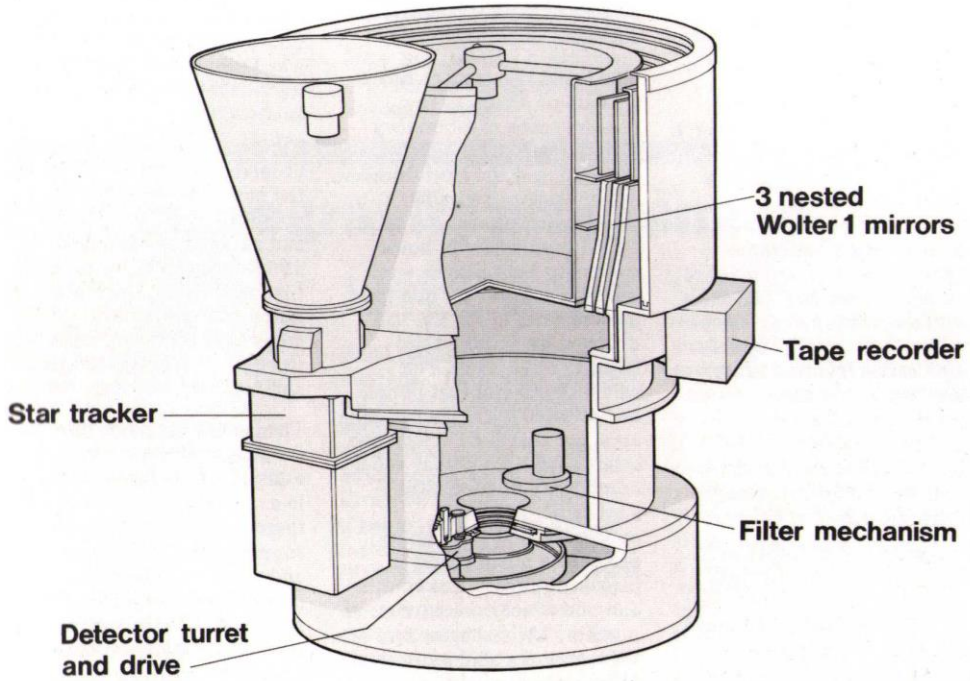
Both instruments employ grazing incidence optics, the great power of which is now being realised in fields as distinct as x-ray microscopy and astronomy. Although somewhat smaller and considerably lighter than the 0.8 metre telescope, the optical design of the WFC allows an overall photon 'grasp' which yields a comparable sensitivity in the band of overlap. The specific waveband covered by the WFC, 50 to 250 Å, reaches well into the extreme ultra-violet (XUV), a largely unexplored region of astronomy – and one that only a few years ago was considered inaccessible because of the opacity of the interstellar medium.

The ROSAT mission will have two main objectives. First, over a six month period, the 0.8 metre telescope will carry out an all-sky survey at a sensitivity comparable to that of the deeper Einstein Observatory maps (which cover only a few square degrees of sky) and more than two orders of magnitude deeper than the current all-sky surveys. Present knowledge of the x-ray sky allows a confident prediction that 10^5 to 10^6 sources, including almost every type of astronomical object, should be detected in the ROSAT x-ray survey. The second phase of the mission, lasting about 2½ years, will allow some 10^4 detailed observations of individual x-ray sources and source fields using the accurate pointing capability of the ROSAT spacecraft. In this non-survey phase the 0.8 metre telescope will be used to obtain detailed x-ray source maps, and spectral and timing data, which will greatly extend current knowledge of the high temperature and relativistic phenomena in situations as diverse as stellar coronae, supernova remnants, compact accreting binaries, galaxy clusters and quasars of extreme redshift. In all these observations the WFC will provide additional and complementary data.

The potential of XUV astronomy has become evident only recently, with the discovery from Copernicus and the data from the International Ultra-violet Explorer satellite that the interstellar gas within $\sim$ 100 parsecs of the solar system is much less dense than the classical picture (of $\sim$ 1 atom/cm^3) derived from radio mapping of the galaxy. The reason for this 'local' void is uncertain, but it may well be the result of a powerful supernova occurring in this region during the past one to two million years (for which there is some astronomical and geophysical evidence). For XUV astronomy these interstellar densities, lower by a hundred-fold or more, dramatically extend the visible horizon. For example, at 100 Å it could be possible to 'see' further than 1000 parsecs (3260 light years) in certain directions: at high galactic latitudes this would extend the XUV horizon into extragalactic space, raising the exciting prospect of detecting the intense XUV radiation theoretically predicted from objects such as the nuclei of quasars and related active galaxies. Clearly, an important bonus of the XUV sky survey will be the direct mapping of the local interstellar density and – in emission – possibly also of the hot, tenuous component of the interstellar gas that traces the passage of pre-historic supernova shocks.

A key feature of the WFC operation is that it will view simultaneously the same area of sky as the main German x-ray telescope on ROSAT. This will effectively double the spectral coverage of the x-ray

Soft X-ray Wide Field Camera (WFC)



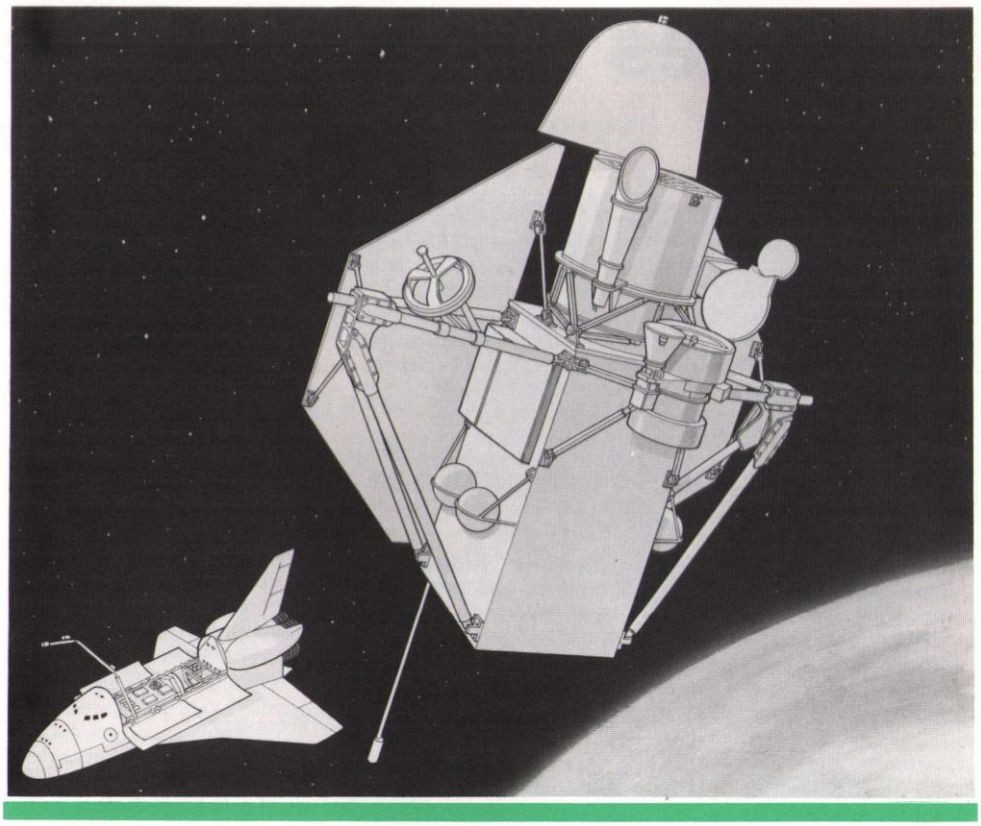
Cut-away view of the UK Wide Field Camera showing its nested array of grazing incidence mirrors.

sources from the 0.8 metre telescope survey, an extension that is likely to be crucial in determining the emission mechanism and (often) the correct astronomical identification of many (especially galactic) x-ray sources. In addition to the wide variety of x-ray sources detected by both instruments, many 'new' sources radiating mainly in the XUV will be discovered in the WFC survey.

Theoretical considerations and results from some early exploratory observations indicate some of the rich variety of objects which should be strong XUV emitters.

From simple consideration of a black body radiator it is evident that the XUV waveband will be 'tuned' to the detection of sources in the temperature domain of 10^4 to 10^6 K, bridging the gap between the surface temperatures of normal (non-degenerate) stars and the 10^7 to 10^8 K plasmas typical of the 'conventional' cosmic x-ray sources. In fact, the first intrinsic cosmic XUV source, detected with a small instrument flown on the Apollo-Soyuz mission in 1975, was later identified with a white dwarf star, HZ 43, having the remarkably high surface temperature of $\sim 10^5$ K. Subsequently six other XUV sources have been reported from Apollo-Soyuz and Voyager-2 observations and from several exploratory small rocket experiments; these sources include three further hot white dwarf stars, two interacting binary systems and the nearby flare star, Proxima Centauri. In addition, observations by the x-ray telescope on board the NASA Einstein Observatory spacecraft have shown strong emissions of soft x-rays to be a surprisingly common feature of stars of a wide variety of spectral types. The ROSAT WFC will extend these brief glimpses of the XUV sky to a survey of the whole celestial sphere and to a sensitivity limit a thousand times below the flux level of HZ 43.

From the present scanty understanding of XUV astronomy, it is clear that the WFC data could have a profound effect on our knowledge of stellar atmospheres, of the space density, evolution and cooling rates of hot white dwarf stars,



An artist's impression of the ROSAT spacecraft after separation from the Shuttle. The UK Wide Field Camera is seen on the near side of the spacecraft.

of shock heating and the importance of nuclear burning on accreting white dwarfs and of the nature and recent history of the local interstellar medium. The XUV 'visibility' of extragalactic space offers, in addition, the possibility of directly observing the suspected hot gaseous haloes of massive galaxies, the 10^5 to 10^6 K diffuse component in galaxy clusters and (perhaps) the intergalactic medium itself, while intense XUV radiation may well arise via the synchrotron process from relativistic jets in objects such as the BL Lacertids. This list, however, is certainly not exhaustive, since it is a 'truism' in astronomy that each new waveband brings a host of surprises. It would indeed be a surprise if this were not so with the opening of the last unexplored waveband in astronomy, the XUV.

K A Pounds

Professor Ken Pounds, FRS, is a Member of Council, Chairman of SERC's Astronomy, Space and Radio Board and Professor of Space Physics and Director of the X-ray Astronomy Group at the University of Leicester.

The WFC is being developed by a consortium led by the X-ray Astronomy Group at Leicester and including Birmingham University, Imperial College, Mullard Space Science Laboratory and the Rutherford Appleton Laboratory. The optical design of the WFC is based on an instrument flown successfully last October on a NASA Astrobee rocket from White Sands, New Mexico, in a collaborative experiment between Leicester and the Space Research Center at MIT. The ROSAT version involves a nested array of grazing incidence mirrors, optimised for use beyond 50 Å. Images of the XUV sky are projected on to a microchannel plate detector, mounted behind a filter wheel selecting different 'colours' in the 50 to 250 Å band, which records the accurate position of each incident photon.

It appears probable that ROSAT, scheduled for launch in 1987, will be the only large x-ray telescope in operation during the latter half of the 1980s. Einstein Observatory operations have recently been terminated and the European EXOSAT x-ray mission is scheduled to run from 1982-84. Therefore the ROSAT data are likely to dominate x-ray astronomy well into the next decade and the mission has recently attracted wide international interest. In particular, NASA is currently seeking a collaborative agreement with Germany in which US astronomers would have a share in the non-survey time on ROSAT and would provide a high resolution image tube for the focal plane assembly of the 0.8 metre telescope. In exchange NASA would undertake to launch ROSAT into the required 56° inclination orbit compatible with the location of the mission ground station at Weilheim in Germany. In the tripartite agreement now being discussed, Germany and the UK will retain sole responsibility for the x-ray and XUV surveys and the three countries will share the non-survey time on both telescopes. The UK observing time will be open to competition from astronomers (and others) throughout the UK community.

Priorities for materials research

The very success of materials scientists as shown by the wealth of materials and methods for processing them now available, has given rise to a feeling that there exist suitable materials for all possible requirements. Continued research on materials, it is implied, is not only pointless but positively detrimental as the discovery of new materials only further complicates the situation.

Needless to say the Engineering Board's Materials Committee does not share this view. It is the responsibility of the materials science community to ensure that British industry gets the most from its raw materials; selects the best material for a particular purpose on the basis of durability, safety and reliability; and develops new and improved materials to meet those requirements more satisfactorily or more economically. However, the Committee is concerned that much of the research it currently supports is disparate, fragmented and unlikely to give rise to radically new or improved materials and processes for their manufacture. Equally, little research is in progress on topics of prime importance to industry, such as the long-term ageing behaviour of materials.

During the past year, therefore, the four subcommittees that report to the Materials Committee have reviewed their portfolios of research and, in consultation with other Committees within SERC and outside agencies, have suggested important areas requiring increased research in the future. The Committee acknowledges that many recent advances have arisen from unsolicited proposals of quality and it is its intention to continue to assess the proposals it considers against the normal criteria of academic excellence and relevance. It has decided, however, that it would selectively encourage and fund proposals of high scientific merit within its priority areas and this decision has been endorsed by the Engineering Board. With today's financial constraints, this implies that for proposals of equal merit, preference will be given to those proposals falling within the Committee's priority areas. Funds will, it is hoped, be available for proposals of exceptional timeliness and merit in all areas within the remit of the Committee. The Committee however encourages all intending applicants to consider undertaking research in the areas identified below.

Non-metallics

- Synthesis and development of new polymer materials for specified industrial applications;
- Structure-property studies of polymers, ceramics and glasses which will relate to new uses in photo-electric, micro-electronic and reprographic devices;
- Behaviour of polymers in service;
- Fundamental problems of polymer compatibility;
- Innovative developments in the understanding of the mechanical properties of polymers;
- Surface phenomena in polymers, ceramics and glasses;
- Structure-property investigations of cements;
- Processing variables in the formation of glasses and ceramics:
- Fundamental understanding of wood, paper and leather.

Metallics

- Novel semiconductors made from purer materials with lower levels of unintended impurities;
- A fundamental understanding of the properties of metals important in processing, ie weldability, machinability, hot-workability etc;
- The behaviour of metallic materials in real engineering situations eg nuclear power stations, high temperature power units, structures confining high pressures, marine structures etc.

Processing

Research falling within the Specially Promoted Programme on Materials and Energy Conservation in the Materials Processing Industries is already selectively funded. However four specific topics have been highlighted as worthy of particular priority:

- Process-specific improvements to save energy and/or materials;
- Development of sensors for process control;
- Recycling of materials, including methods for separating scrap and the development of products which tolerate degraded materials;
- Short circuit routes for existing market requirements eg precision forming.

In the more general processing area the following two topics have been identified:

- Powder processing;
- Surface treatment and coating technology.

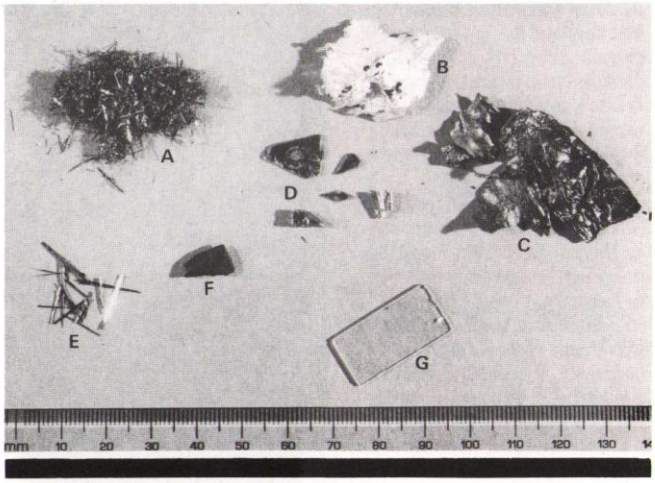
Medical engineering

As an SPP, research within the remit of the Medical Engineering Subcommittee is selectively funded (see Autumn 1981 *Bulletin*, Vol 2 No 3). Within the overall remit of the Subcommittee, priorities have already been identified in biomaterials:

- Development of improved materials, such as polymers, ceramics and metals for use in dentistry, internal prostheses and external aids;
- Study of the physical and chemical structure of biomaterials and the relationship to biocompatibility;
- Studies of adhesion phenomena between living and synthetic materials for dental and internal prostheses applications;
- Correlation between the structure and physical properties of composite dental filling materials;
- Studies and development of novel membrane systems for use as skin replacement and in dialysis.

With the extension of the remit from September 1981 to cover the whole of Medical Engineering, the Subcommittee is giving consideration to priorities outside the biomaterials area. These will be published when available.

The Committee would welcome comments and criticisms of these priority areas. They will be reconsidered periodically and modified and amended as circumstances alter. In the meantime such selectivity does imply that research outside these areas will be examined critically and only those proposals of high scientific merit are likely to be supported.



A selection of materials under investigation at Queen Mary College, London:
A Fibrous polydiacetylene (phenylurethane derivative)
B Amorphous polydiacetylene (octadiynediol)
C Polyacetylene (Shirakawa preparative method)
D Crystal of diacetylene monomer and polymer (toluene sulphonate derivative)
E Polydiacetylene needles (dicarbazole derivative)
F Polypyrrole (conducting polymer prepared electro-chemically; sample supplied by Freiburg University)
G Polymerised Langmuir-Blodgett multilayer

Integrated Graduate Development

Last year SERC launched the Integrated Graduate Development scheme, in order to attract more top quality science and engineering graduates to enter industry and to prepare them for early managerial responsiblity in an engineering function.

Integrated Graduate Development (IGD) involves a planned mix of in-company experience, project work and part-time postgraduate training for new graduate recruits to industry during their initial three years of employment. The first two programmes were announced in the Spring 1981 *Bulletin* (Vol 2 No 2). These were between Cranfield Institute of Technology and Ransome Hoffman Pollard Ltd, and between Warwick University, BL Cars and Lucas Industries.

Since then, considerable interest has been shown in the scheme. The programme at Warwick has been expanded to include recruits from Rolls Royce. The second intake of students at Warwick is now expected to be up to 90 graduates compared with an original number of 60. The target of four experimental programmes has also been reached. The new programmes are significantly different from the initial two in that they involve collaboration between an academic institution and a consortium of companies in a particular industrial sector.

The University of Glasgow's Building Services Research Unit is providing a programme for various companies in the building service industry and similar organisations in the public sector, for example, the Property Services Agency. The second scheme, which is coordinated by the Departmental of Mechanical Engineering at Paisley College of Technology, has been designed for companies in the process plant industry. It was set up with the help of NEDO and will be linked to several Teaching Company programmmes on the same sector.

A wide range of industry has been attracted to the scheme. This will greatly assist the Council in evaluating its potential value and applicability to industry generally.

For further information please contact Dr D P Jones, SERC Central Office, Swindon (ext 2108).

Mr Barry Fowell (left), instructor at the CAD/CAM Unit at Warwick University's Arden House, with two Integrated Graduate Development students obtaining hand-on microprocessor experience.

Cooperative Research Grants in biotechnology

The Biotechnology Directorate has now been established at the Central Office, Swindon and is receiving a number of applications for grants to support both the basic research underpinning biotechnology and applied work.

Cooperation with industry is welcome in association with any SERC grant, and to encourage such cooperation the Council set up the Cooperative Research Grants Scheme (see *Bulletin* Vol 2 No 2 Spring 1981). There are now encouraging signs that industrial companies are willing to cooperate with academic departments through this scheme to support research in biotechnology.

SERC is currently contributing to three programmes in biotechnology under the Cooperative Research Grants Scheme. The Department of Chemical Engineering at UMIST, in collaboration with APV Co Ltd of Crawley, has a research programme under way to study yeast growth and alcohol production utilising solid support particles. At the University College of Swansea, the Department of Chemical Engineering in association with a local firm, Bio-Isolates Ltd, are working on the upgrading of bulk protein separation and fractionation methods.

The third research programme, concerned with methanol oxidation in the methylotrophic bacterium *Methylophilus methylotrophus*, is a joint programme between the Department of Biochemistry at the University of Leicester and ICI Agricultural Division.

The Biotechnology Directorate is currently considering a number of cooperative grant applications covering the whole spectrum of activity from monoclonal antibodies to industrial applications of enzymes. The Directorate wishes to encourage the use of the Cooperative Research Grants Scheme and potential applicants should contact either the Director, Dr W G Potter, or Dr K J Coleman at SERC Central Office, Swindon (ext 2145 or 2279).

A leaflet describing the biotechnology programme may be obtained from the Directorate.

Foundation monitoring on Magnus

The BP Magnus production platform, which becomes operational in 1983, will be one of the UK's largest, most advanced and most northerly platforms. It will also be one of the most comprehensively instrumented steel structures in the North Sea. For the first time, research projects by two academic institutions will be accommodated on the platform. Both projects are jointly supported by BP and by SERC's Marine Technology Directorate (MTD) and will give access to data that will assist future research into subsea working conditions.

The projects form part of a monitoring system to measure foundation performance for a two-year period following the platform's installation. This system will be in addition to the usual types of instrumentation fitted to platforms, for measuring environmental and structural parameters.

The main aim of fitting a foundation monitoring system is to obtain information with which to assess existing design methods, which are currently entirely based on onshore experience and testing. Piling used offshore is very much larger than that onshore and its design may well prove too conservative. Since each of the Magnus platform's four legs will be secured by nine piles measuring 2.13 m in diameter and 110 m long, weighing 350 tonnes and driven 80 m into the sea bed, the additional costs of over-design could be considerable.

BP, as part of a consortium, propose to instrument the foundation system of one leg of the platform. This leg, with its associated group of piles and mud mat, will carry the transducers for the monitoring system; strain gauges, load cells, pressure gauges, accelerometers and settlement gauges will be fitted.

Much of the instrumentation on the system is specially designed. The settlement gauge is being developed at Imperial College of Science and Technology by a team led by Professor J B Burland, with MTD support. The Building Research Establishment will design and manufacture the pressure gauges, and the development and testing of weldable strain gauges is being undertaken by Professor T J Poskitt's team at Queen Mary College, London, also with MTD support. The development of a weldable strain gauge with long-term stability would enable absolute loads to be measured, in addition to the dynamic loads measurable with existing types of weldable gauges, which have a tendancy to drift. Vibrating-wire gauges are very stable for long periods but, as yet, no attempt has been made to fit them to piles. Such gauges would have to withstand the extremely high impact loads which are transmitted through the pile during installation.

Once piling operations cease, the instrumentation will be connected. A statistical analysis of the recorded information will enable comparisons to be made between predicted and actual foundation behaviour. Of particular interest will be: the loads experienced by the pile group for given environmental conditions; the effective capacity of the mud mat; the dynamic stiffness of the pile group; and the axial and lateral capacity of a pile.

The results of the programme will enable existing design methods to be assessed with more accuracy and confidence and may well lead to significant financial savings in the future.

Radio Communications Systems SPP

Radio plays a vital part in information technology and is now being used in linking computer networks at a distance, as well as having an expanding general communication function. Future advances will depend on maximum exploitation of the radio spectrum, which can only accommodate a limited load. Any results that gave more efficient use of the wavebands could be of great commercial importance.

Research in tropospheric radio transmission, radio communication and the associated hardware is supported by the Engineering Board. This is user-oriented work, whereas the Astronomy, Space and Radio Board supports scientific studies of the upper atmosphere using radio waves. One major channel of the Engineering Board's support is via the Departmental Users' Programme, which provides support in radio propagation studies to bodies such as the BBC, British Telecom, Government Communications Headquarters, Home Office and the Ministry of Defence.

After consideration of the propagation work, the Engineering Board's Information Engineering Committee (IEC) decided that there was a need for special stimulation of research on complete radio communications systems and on reception. This led to the setting up of the Radio Communications Systems Specially Promoted Programme (SPP). It is overseen by a panel chaired by Dr Alan Rudge, Managing Director of ERA Technology Limited, Leatherhead, and a member of the IEC's Computing and Communications Sub-committee. Priority areas in the programme include land mobile radio, business systems, satellite communications, maritime services and novel approaches to radio frequency technology and receiver design. Research into general topics having relevance to all these subjects is also of interest; these include spectrum utilisation and shared services. Thus the main theme of the Specially Promoted Programme is the stimulation of research in communications systems and their associated components, leading towards a more effective and efficient use of the electromagnetic spectrum.

Sub-divisions of the programme are terrestrial and satellite radio communications.
Apart from the guidance of the Panel, the programme is to have part-time coordinators. From June, it is intended to have a coordinator from industry in post, responsible for terrestrial radio aspects. Rutherford Appleton Laboratory will provide coordination on satellite communications systems.
In the initial phase, the coordinators will be contacting and visiting academic groups already doing radio communications research, and investigating ways of linking work to common themes. This is important because academic institutions cannot always, in isolation, produce complete systems; individual proposals for components can be evaluated against the background of the systems approach. There are many possibilities for cooperative research with industry and it is hoped that such joint applications will be made to SERC.

Possible participants should note that the aim will be not only to stimulate involvement by established centres of expertise but also to bring in new groups. It will be important to adopt a forward-looking approach in research to plan for systems several years ahead. The present SERC grants commitment on the area, of about £300,000, could perhaps double in a couple of years' time.

Further details of the SPP may be obtained from Mr G J Day, Joint Secretary of the Computing and Communications Sub-committee, SERC Central Office, Swindon (ext 2235).

Trying out Project UNIVERSE

Mr Kenneth Baker, Minister of State for Industry and Information Technology (seated), being shown a pre-demonstration of Project UNIVERSE by Dr G Manning, Director, RAL (left) and Dr D B Thomas, Associate Director, during his tour of RAL in March. Also watching are Professor P Kirstein (UCL) and Professor F R A Hopgood, Head of Computing Division. Data is being sent from the terminal on the left of the picture via a 'Cambridge Ring' Local Area Network to the earth terminal on the roof of the Atlas Centre. From there it is transmitted to the Orbital Test Satellite and received back at the earth terminal before being reinjected into the Cambridge Ring and displayed on the right hand terminal, arriving one quarter of a second later after an 80,000 kilometre trip. With Project UNIVERSE now fully operational, information can be sent in this way to six other sites in the UK at 1 Megabit per second.

SPP in Particulate Technology

A new Specially Promoted Programme in Particulate Technology has been launched by the Engineering Processes Committee of the Engineering Board. The need for promoting solids processing was identified from a report written by Professor H R C Pratt in 1977.

The SPP is a direct response to the technological needs of industry and is particularly pertinent to the processing of chemicals, minerals, pharmaceuticals and food. There will be extensive industrial collaboration throughout the programme.

A large chemical company can have as much as half of its products, by both weight and value, in the form of particulate solids. The high value of products and capital equipment costs in the chemical industry means that even modest improvements in understanding are likely to have a significant economic impact. The programme will focus upon three principal areas of research, namely, particle formation, particle separation and particle handling. The coordination and promotion of the programme will become the concern of a steering group chaired by Professor J Bridgwater (Birmingham University) and a part-time coordinator.

During the first year the programme plans to initiate work on the drying of solids, particle formation and particle growth. Work on particle formation by reduction, solid/solid mixing, liquid/solid mixing, separation of small particles from liquids and slurry processing will follow. The SPP will start in 1983 with a proposed allocation of £1.8 million to be spent over the five succeeding years. It is anticipated that the programme will result in improvements in the design of particles and equipment, and in the monitoring and control of solids processing.

For further information please contact Miss J Williams, Secretary, Chemical Engineering Sub-committee, SERC Central Office (ext 2101).

Coal-burning internal combustion engines

The Coal Technology Sub-committee has recently considered the possibility of an initiative on coal-burning internal combustion engines.

The original internal combustion engine developed by Diesel was fuelled by pulverised coal and work continued, particularly in Germany, on coal-burning diesel engines into the 1930s. However, with the increasing availability of liquid fuels and the associated ease of handling, work on coal-burning diesel engines, which were prone to wear problems, ceased. More recently, following the oil crisis, attention had once again attention has once again using coal as a fuel for internal combustion engines.

The conversion of coal to liquid fuels is possible but would require enormous capital investment in plant. The conversion processes are also thermally inefficient being in the region of 30-40% for refined products (gasolines or diesel fuels).

In view of these considerations, it was agreed that a study of the possibilities of the direct use of coal as a fuel for internal combustion engines would be appropriate. The Sub-committee recognised that there were considerable problems associated with the production and running of such engines, eg fuel injection and wear rates. However, if successful, such an engine could increase coal usage and reduce dependence upon imported oil supplies; there also appeared to be a sizeable market for large, slow-to-medium speed engines both in the UK and abroad.

Given the broad range of topics associated with such a project, the Sub-committee considered that it was necessary to define a specific programme. This would need to take account of relevant previous studies, such as those in Germany in the 1930s, and also recent advances in technology and materials. Mr W Tipler (ex Perkins Engines and Shell) has been appointed a consultant with the specific task of identifying the priorities for research in this area. Mr Tipler has been in contact with many industrialists and academics and his report is now being considered by the Sub-committee.

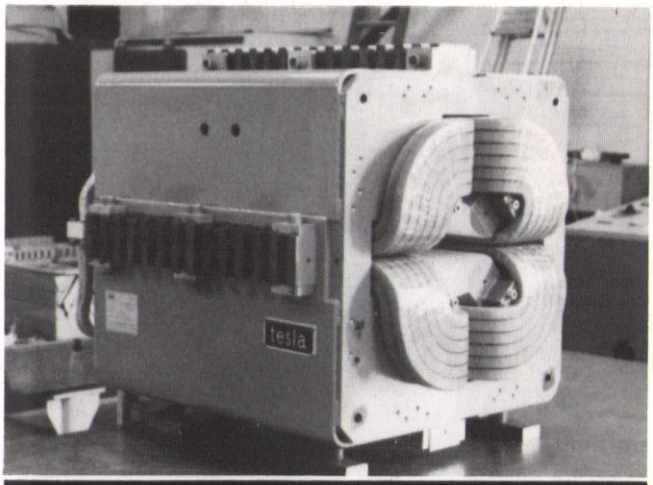
For further information, please contact Mr Guy Richards, Secretary of the Coal Technology Sub-committee, at SERC Central Office, Swindon (ext 2300).

Prototype magnet contract for British firm

Tesla Engineering Limited, a company based in Storrington, Sussex, specialising in work for high energy physics research, has won a contract from CERN, against international competition, for the prototype lattice quadrupole magnet for the proposed new large electron-positron storage ring, LEP.

This magnet is the forerunner of CERN's future requirement for over 500 magnets of this type, each weighing 2.1 tonnes and 1.75 metres long. Two sets of coils are to be provided. One set of coils is from conventional water-cooled aluminium conductor and – something unorthodox in precision magnet design – the other set is constructed in anodised aluminium strip conductor.

The construction of this prototype will enable CERN to determine the design and most economic manufacturing methods as well as the choice between alternative coil types.



The quadrupole magnet with conventional coils manufactured by Tesla for the DESY laboratory in Hamburg, similar to the prototype being made for LEP, but shorter in length.

Diffusion facility at Manchester Polytechnic

A problem often encountered by the polymer industry and by research workers is the extent to which a liquid will penetrate a thick section of a polymer, and how fast.

The Polymer Engineering Directorate and Manchester Polytechnic are beginning to provide answers to such questions by means of a new diffusion technique which utilises radio isotopes. A wide range of polymers – amorphous and crystalline thermoplastics (polycarbonate and polyethylene), thermosetting resins and their glass-reinforced composites and, currently, polyurethane elastomers – have so far been studied. The diffusants used have been water, dilute hydrochloric acid and a range of organic solvents.

In essence, any polymer can be used together with any liquid which may be suitably (and cheaply) radio-labelled – most commonly with tritium or carbon 14. Diffusion from binary mixtures is also relatively easy to evaluate, using dual labelling.

The technique involves first exposing the polymer to the liquids; cutting the exposed samples into layers; then extracting the diffused isotope from each layer and measuring it using liquid scintillation counting. Diffusant concentrations at various points throughout the sample are thus calculated and profiles constructed for any exposure time.

An advantage of the technique is the speedy calculation of diffusion coefficients from short-term data. It is also possible to predict equilibrium conditions readily from such data. Another advantage is that the actual diffusant concentrations are measured, overcoming previous problems caused by the possible simultaneous diffusion of some species out of the polymer. This could be a problem when using conventional gravimetric techniques. These factors are important in deciding whether a given polymer is suitable for use with a particular liquid and for estimating the limiting conditions, the optimum thickness, the maximum temperature of use, etc.

Since extrapolations cannot be made from one system to another, all the studies to date have been carried out by means of very specific short term programmes – a major effort being committed to solve particular problems in the minimum possible time.

The Polymer Engineering Directorate is anxious that maximum use should be made of the facility. For further details please contact Dr J Marshall at Manchester Polytechnic, telephone 061-228 6171.

PED thermal imaging system

An important aspect in many of the research projects supported by the Polymer Engineering Directorate is the heat distribution within a system and the change of temperature as a function of time. To overcome present limitations experienced with the use of thermocouples the Directorate has purchased an infra-red thermal imaging system to enable heat distribution to be visualised in both static and dynamic conditions.

It is expected that the system will be used in studies of cooling in blow moulding and pipe extrusion; areas of wear and thermal generation between V-belts and the pulley; flow in polymer melts; thermal conductance through walls using polymers as insulants; areas of stress and strain in polymers and fatigue in flow and injection moulding. With experience it is expected that more novel uses of the system will emerge. The system has been purchased as a central service facility. It is mobile and open to bids for use from PED grant holders subject to areas of priority identified by the Directorate. The manufacturers have a contract to deliver, install and service the equipment and to train appropriate personnel at the various locations where the equipment will be used.

Enquiries for information on the facility, particularly from PED award holders, should be made to Mrs H E Lennon, PED, 3-5 Charing Cross Road, London WC2H 0HW
Tel: 01-930 9162.

Directory of Directors

In the November 1980 issue of the *Bulletin* (Vol 2 No 1), we gave a round-up of the Council's key personnel at Central Office. Now we present the Directors of SERC's four Establishments and four Directorates.

The Establishments

Daresbury Laboratory

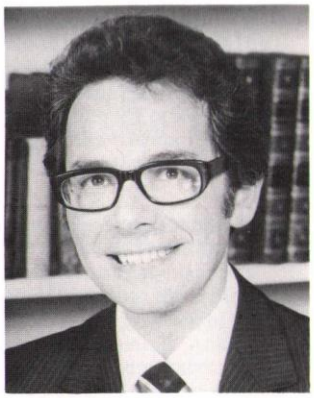
Professor Leslie Green
Appointed July 1981
Profile: page 4 of this issue

Rutherford Appleton Laboratory

Dr Geoffrey Manning
Appointed October 1981
Formerly Director of the Chilton (Rutherford) Site when the Rutherford and Appleton Laboratories merged

Royal Greenwich Observatory

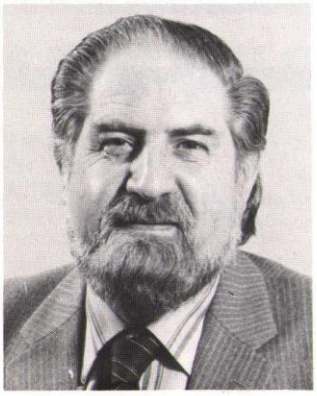
Professor Alec Boksenberg, FRS
Appointed October 1981
Profile: *Bulletin* Vol 2 No 2. Spring 1981



Royal Observatory, Edinburgh

Professor Malcolm Longair
Appointed October 1980
Profile: *Bulletin* Vol 2 No 1, November 1980

The Directorates



Biotechnology

Dr Geoffrey Potter
Appointed November 1981
Formerly Head of SERC's Engineering Division

Marine Technology

Mr Michael Adye
Appointed May 1977
Formerly a General Manager with British Petroleum Ltd

Polymer Engineering

Mr Peter Rice
Appointed October 1981
Formerly Assistant, then Acting, Director of the Directorate

Teaching Company Scheme

Professor Derek Saunders
Professor of Polymer Physics and Engineering, Cranfield Institute of Technology
Appointed October 1981

Studentships 1981/82

1981 report

The number of awards on offer in 1981 was 3240, of which 760 were specifically allocated to the CASE scheme. The total of awards was 360 fewer than in the previous year with most of the reduction in advanced course studentships.

At the Appeals stage almost 800 applicants, including 143 with first class degrees, contended for 157 awards; 58 candidates with first class degrees failed to get an award.

The Engineering Board again adopted a 'first come, first served' procedure in order to encourage the take-up of advanced course studentships. As a result its basic allocation was oversubscribed and the Board made additional funds available so that more awards could be made. The Board will revert to the established procedures for the allocation of awards in dealing with advanced course studentships in 1982, once more imposing a closing date for the receipt of applications.

The demand for CASE was again high. The 760 awards allocated to the scheme were committed by about the end of July. Awards to many of the later nominees were deferred until the 1982/83 financial year.

The table below compares the distribution of studentships taken up on 14 January 1982 with the original target allocations for 1981.

Distribution of 1981 Awards taken up at 14 January 1982 (1981 allocations in brackets)

	Research Studentships						Advanced Course Studentships		TOTAL AWARDS	
	Quota*		CASE		Total					
Quota and CASE allocations										
ASR Board	65	(65)	8	(8)	73	(73)	23	(23)	96	(96)
Engineering Board	433	(435)	304	(300)	737	(735)	418	(374)	1155	(1109)
NP Board	55	(52)	1	(5)	56	(57)	–	(–)	56	(57)
Science Board	780	(769)	434	(430)	1214	(1199)	378	(362)	1592	(1561)
Polytechnics Committee†	21	(21)	–	(–)	21	(21)	12	(12)	33	(33)
Joint SERC/SSRC Committee	37	(37)	11	(15)	48	(52)	64	(55)	112	(107)
Energy Committee	11	(12)	2	(2)	13	(14)	6	(4)	19	(18)
TOTALS: Quota and CASE	1402	(1391)	760	(760)	2162	(2151)	901	(830)	3063	(2981)
Other Schemes										
Instant					84	(89)	121	(140)	205	(229)
Ex-part-time					2	(10)			2	(10)
Collaborative Training Awards					11				11	
Awards Tenable Overseas					16	(20)			16	(20)
GRAND TOTAL					2275	(2270)	1022	(970)	3297	(3240)

*Take-up includes appeals awards. †CASE projects in polytechnics come within the allocation of the relevant Board and awarding Committee

Plans for 1982

A total of 3160 studentships is to be offered in 1982, as compared with 3240 in 1981 and 3600 in 1980. The number of CASE studentships is to be increased by 40, and the number of quota research studentships and advanced course studentships reduced by 60 in each case. Most of the reduction in research studentships will be in the Engineering Board's area; in the case of advanced course awards the reduction in engineering will be proportionately smaller than in other Boards. Twenty-nine advanced course awards have been reserved in 1982 for the field of the newly-formed Biotechnology Directorate. Because of the high demand for 'instant' awards, whose provision allows for quick decisions to be given to applicants in industrial employment, some increase over last year's provision has now been made. The table below sets out the distribution of studentships to be made available in 1982.

Allocation of studentships available in 1982

	Research Studentships			Advanced Course Studentships	TOTAL AWARDS
	Quota	CASE	Total		
Quota and CASE allocations					
ASR Board	64	8	72	20	92
Engineering Board	380	310	690	347	1037
NP Board	51	5	56	–	56
Science Board	748	447	1195	302	1497
Polytechnics Committee †	21	–	21	10	31
Joint SERC/SSRC Committee	35	16	51	46	97
Energy Committee	12	2	14	6	20
Biotechnology Directorate	9	12	21	29	50
TOTALS: Quota and CASE	1320	800	2120	760	2880
Other schemes					
Instant			100	150	250
Ex-part-time			10		10
Collaborative Training Awards					
Awards Tenable Overseas			20		20
GRAND TOTAL			2250	910	3160

†CASE projects in polytechnics come within the allocation of the relevant Board and awarding Committee.

Priorities at the Appeals Stage of awarding Studentships

The 1982 Appeals pool of awards will again be limited to awards not taken up at the quota stage, and to any other awards that can be made available because offers are not taken up. The arrangements for awards at the Appeals stage in 1982 will be that the first goal is to match the original allocations by Boards and Committees as closely as possible, and that the order of priority to be given to Appeals candidates in achieving this will be (1) candidates with first class honours who propose to migrate to take up their awards or who are working in 'special areas' which have been identified by the Council; (2) other first class honours candidates and other qualified candidates working in special areas; (3) other migrants; (4) others suitably qualified who do not propose to migrate.

We expect that competition at the Appeals stage will again be severe, and the Council cannot guarantee that awards will be available for all contenders with first class honours degrees.

Research student and supervisor: a discussion document

SERC has sponsored publication of a discussion document on good supervisory practice. The booklet was issued to institutions in April 1982 with the aim of stimulating all concerned - students, supervisors and administrators - to look afresh at the problems of postgraduate research training and especially at the crucial relationship of student and supervisor.

The document was prepared by a group of senior academics, headed by Sir Derman Christopherson, CBE, FRS, Master of Magdalene College, Cambridge. It considers various aspects of supervison, comments on the need for monitoring and stresses the need for careful planning if the student is to succeed in submitting his or her thesis during the currency of the postgraduate training award.

While the opinions expressed are those of the authors, the Council strongly supports their view that the writing up of results is an integral part of research training. Analysis of PhD submission rates shows that a significant proportion of students have still not submitted a thesis a year after their awards have come to an end (see page 24). SERC supports over 6000 research students with public funds and has a responsibility to ensure that these funds are spent wisely.

The Council therefore hopes that the publication of the discussion document will lead to a better understanding of the demands and constraints of supervision and to an improvement in the submission rate of PhD theses. The Council hopes that those involved in postgraduate research training will let SERC have their views on the document and, in addition, has invited heads of departments when applying for awards to supply copies of any guidance notes they issue on supervisory practice.

Copies of the booklet, *Research student and supervisor: a discussion document on good supervisory practice,* may be obtained from: Secretary's Department (Studentship Policy and Development), SERC Central Office, Swindon (ext 2121).

SERC/OU Continuing Education project

The Council has joined with the Open University in the setting-up of a rolling programme of part-time continuing education courses. SERC is initially committing up to £1.1 million over the next three years to this scheme.

This initiative springs from the Council's awareness of the need to provide opportunities for the re-education of scientists and engineers in employment. Too often such people are unable, for a variety of reasons, to get the 'technological topping-up' increasingly required today. The OU has therefore been commissioned by the Council to produce, under the aegis of a management committee responsible to both bodies, two experimental courses which will be structured and modular and whose specially developed material will take full advantage both of the OU's distance learning techniques and its regional organisation. One course will be in manufacturing and the other in computer applications (including real time monitoring and control systems). In developing course material and in providing tutorial support, extensive use will be made of expertise from industry and from the academic world apart from the OU itself.

The Management Committee, chaired by Mr D H Roberts of GEC, held its first meeting in the Spring; the details below must therefore be regarded as subject to change.

Timescale: It is intended to introduce the modules progressively over about five years, starting in 1984/85 with the aim of keeping pace with those students taking the complete course. All modules, and thus complete courses, should be available by 1988/89.

Courses: The computer applications course is aimed at engineers, scientists and managers who have been some years in industry and who find their work transformed by new computer techniques, especially those triggered by microprocessor developments. The manufacturing course is aimed at middle managers with a scientific or technological background who are in a technological or supervisory role.

A course is regarded as equivalent to a year's full time study and consists of eight to ten modules, each representing 80 to 100 hours of student work. While the courses will have a structural sequence, each module will, as far as possible, be free-standing so that individual modules only might be taken. While little or no use is likely to be made of radio or television, appropriate use will be made of printed texts, supplemented by audio and video tapes together with summer schools.

Qualifications: It is intended that students should receive certificates of qualification for each module successfully completed and a diploma for the full course. Students may also undertake a related project in addition to the diploma course, and if successful, it is hoped that they will receive an MSc-level qualification.

Further information on the programme can be obtained from Mr S G Pitt, SERC Central Office, Swindon (ext 2127).

PhD submission rates

In Spring 1981 (*Bulletin* Vol 2 No 2) we published the results of a preliminary survey of how many research students supported by the Council obtained a PhD. In this issue we provide the results of another survey, this time relating to research students whose awards began in 1977. Institutions were asked to give information on (i) the number of students who had formally submitted a thesis by October 1981 and (ii) the number of students who remained registered for a PhD at that date. The information thus obtained is set out by institution in Table 1 and by SERC subject area in Table 2. These data must, of course, be interpreted with caution. The overall performance of an institution can mask wide differences between departments and, within departments, the results can reflect, for instance, the nature of the research interests and, most importantly, the ability and motivation of individual students.

SERC has always taken the view that its awards are made to provide a training in research and not necessarily for the award of a degree, which is a matter for the student and for the institution. Nevertheless, the Council is strongly of the view that the writing up of results in a coherent account is an integral and important part of research training, and considers that submission of a thesis provides an effective measure of whether this part of the student's training has been satisfactorily accomplished. The Council considers that these data show that there is considerable room for improvement in the present situation.

Table 1 — PhD submission rates etc by institution

	No of students registered	Number submitting by 1.10.81	No still registered at 1.10.81
Universities			
Aston	84	35	24
Bath	33	12	13
Birmingham	73	40	25
Bradford	40	14	20
Bristol	60	31	27
Brunel	17	10	6
Cambridge	145	98	41
City	18	5	5
Cranfield Institute of Technology	14	4	7
Durham	33	16	15
East Anglia	24	11	12
Essex	13	4	3
Exeter	16	6	8
Hull	27	14	12
Keele	7	5	2
Kent	25	11	13
Lancaster	23	11	11
Leeds	85	34	39
Leicester	33	15	16
Liverpool	50	23	24
London:			
Bedford	12	5	5
Birkbeck	7	4	1
Chelsea	16	11	2
Imperial	124	73	34
Kings	35	15	16
Queen Elizabeth	17	4	11
Queen Mary	30	12	14
Royal Holloway	17	5	11
University	50	26	3
Westfield	11	4	5
Other institutions	20	9	8
Loughborough	32	9	19
Manchester	106	60	28
UMIST	47	14	15
Newcastle	56	27	19
Nottingham	62	42	13
Open	6	2	2
Oxford	140	90	35
Reading	35	11	16
Salford	25	17	1
Sheffield	57	24	31
Southampton	62	28	22
Surrey	28	12	10
Sussex	52	27	18
Warwick	40	15	16
York	25	11	12
University of Wales:			
Aberystwyth	24	11	9
Bangor	22	4	17
Cardiff	28	9	16
Swansea	27	9	14
UWIST	16	4	11
Welsh National School of Medicine	1	1	0
Aberdeen	20	9	7
Dundee	11	4	3
Edinburgh	50	26	17
Glasgow	46	33	7
Heriot-Watt	23	15	2
St Andrews	14	4	7
Stirling	15	4	9
Strathclyde	35	19	14
Ulster	1	0	1
Total Universities	2265	1108	824
Total Polytechnics*	94	23	50
Other Institutions*	12	5	3
Grand Total	2371	1136	877

*The numbers of students at polytechnics and other institutions were generally too low to make individual detail meaningful

Table 2 — PhD submission rates etc by SERC Board

	No of students registered in 1977	Number submitting by 1.10.81	Still registered at 1.10.81
Science Board:	1378	733	478
Biological Sciences	520	258	187
Chemistry	507	318	145
Mathematics	149	80	46
Physics & Neutron Beam	202	77	100
Engineering Board	755	307	311
Astronomy, Space & Radio Board	74	37	27
Nuclear Physics Board	62	41	15
SERC/SSRC Committee	66	8	29
Other	36	10	17
Total	2371	1136	877

Fellowships

Senior Fellowships 1982

This scheme enables a very small number of younger tenured academic staff of exceptional calibre to devote themselves full-time to research, free from the restrictions imposed by their normal duties, for periods of up to five years. From among the 29 applications this year the Council decided to offer two Senior Fellowship awards, each for five years, to:

Dr R J Cashmore (aged 37), University of Oxford, for study of $e^+ e^-$ annihilation with the PETRA and LEP storage rings. He will be taking a major role in the construction and organisation of a LEP experiment at CERN.

Dr L G Valiant (aged 33), University of Edinburgh, for research into Fundamental Resource Measures in Computation.

Special Replacement Scheme

The Special Replacement Scheme, launched in 1980 (*Bulletin* Vol 2 No 1 November 1980) is now well established. Under the scheme, a university or polytechnic gives a tenured appointment to a promising young scientist or engineer, thus enabling a senior worker to spend more time on research. The net cost of the scheme is underwritten by SERC. In the scheme's first year of operation, the Council's Fellowship Panel considered 33 proposals and made 18 awards – three more than had been envisaged, because of the high quality of the proposals received.

During the first half of the current academic year 14 proposals were submitted to the Fellowship Panel and nine applications were due to be considered at the Panel's May meeting. The Council hopes that the momentum of the first year of the scheme will be maintained.

Proposals under this scheme should be submitted on Form SRS1. Further information and copies of the form may be obtained from Mr C D Evans, SERC Central Office, Swindon (ext 2173).

Up to the end of March 1982, the following awards had been made:

Queen's University of Belfast	Professor B Crossland	Mechanical and Industrial Engineering
University of Bradford	Dr J C Williams	Chemical Engineering
University of Bristol	Professor D H Everett	Physical Chemistry
University of Edinburgh	Professor F F Bonsall	Mathematics
University of Edinburgh	Professor P H Davis	Botany
University of Essex	Professor M Gordon	Chemistry
University of Exeter	Dr J R Drabble	Physics
University of Glasgow	Dr R B Greer Dr A McNaught	Physiology
University of Hull	Professor G W Gray	Chemistry
University of Kent	Professor J G Powles	Physics
University of Leeds	Professor A W Goldie	Mathematics
University of Leicester	Mr C H Haywood	Physics
University of Leicester	Professor M Symons	Chemistry
University of Liverpool	Dr D J Ryley	Mechanical Engineering
Imperial College of Science & Technology, London	Dr J W Bray	Mineral Resources Engineering
Imperial College of Science & Technology, London	Professor E H Brown	Civil Engineering
University College, London	Professor R L F Boyd	Physics & Astronomy
University College, London	Professor Patricia H Clarke	Biochemistry and Chemical and Biochemical Engineering
University of Manchester	Professor J H Baxendale	Chemistry
University of Sheffield	Dr J R Guest	Microbiology
University of Southampton	Professor R Butterfield	Civil Engineering
University of Southampton	Professor P O A L Davies	Institute of Sound and Vibration Research
University of Southampton	Professor P E Doak	Institute of Sound and Vibration Research
University of Strathclyde	Professor J M Harvey	Mechanics of Materials
University of Sussex	Professor C Eaborn	Chemistry
University of Warwick	Professor S K Bhattacharyya	Manufacturing Engineering

Collaborative Training Awards

Are you interested in short-term research awards? The Collaborative Training Awards scheme (CTA), introduced in 1978 on a trial basis, provides for research awards of up to 12 to 15 months' duration. While based on Co-operative Awards in Science and Engineering (CASE) and using much the same administrative arrangements, the wider range of activities allowable under CTA (for example, design studies and problem solving in the manufacturing field) is intended to lead to greater participation by industry in postgraduate training. The shorter duration is considered to have particular appeal to small and medium-sized firms.

As with CASE, the industrial partner contributes towards the student's expenses outside the university and is required to make a contribution in cash or in kind equivalent to the research training support grant provided by SERC.

Over 70 awards have already been taken up and those involved – academics, industrialists and students – feel they have been of real benefit. DES has recently agreed to extend the trial period to the end of the academic year 1983/84.

Participation by industry may be encouraged by linking/converting the CTA to an industrial studentship thereby providing the employer with an economic way for his employee to receive postgraduate training while assisting the employer on a research task.

Further details may be obtained from Mr S D Greig, SD/PTSS, SERC Central Office, Swindon (ext 2216).

Short courses round-up

• CERN school of physics

The 1982 CERN School of Physics will be held at Cambridge from 5 to 18 September. The School is intended for young European experimental high-energy physicists (PhD students) and it includes lecture courses on gauge theories, quantum chromodynamics and grand unification theories. Further information is available from Miss D A Caton, Conference Secretariat, CERN, 1211 Geneva 23, Switzerland.

• Theoretical particle physics summer school

The 11th British Summer School in theoretical particle physics will be held at Cambridge from 1 to 15 September. The school is intended for PhD students conducting research into theoretical high-energy physics and includes a set of intensive lecture courses, seminars and discussion periods. Further information will be available during the summer term from relevant physics departments.

• High energy physics summer school

The 1982 Experimental High Energy Physics Summer School will be held at the Rutherford Appleton Laboratory from 12 to 25 September. It is intended for research students in the subject who are one year into their PhD studies. The school provides intensive tuition in topics of fundamental importance and current interest in the field of particle physics. Further information will be available during the summer term from relevant physics departments.

•Marine technology

The Marine Technology Directorate's current portfolio contains the following short courses which are due to run in the period June to November 1982:

- ☐ Geophysical signal processing;
- ☐ Inspection, monitoring, maintenance and repair offshore;
- ☐ Introduction to oil well drilling fluids;
- ☐ Laboratory testing of marine soils;
- ☐ Materials selection for offshore applications;
- ☐ Oil and gas production systems;
- ☐ Practical fluid-structure interaction analysis of floating bodies;
- ☐ The benefit of environmental satellites for offshore industries.

The Directorate is also compiling a new portfolio to cover 1982/83. Academics interested in submitting contributions should contact Dr K D Crosbie (telephone 01-930 9162) from whom information on the above courses can also be obtained.

Where microns matter

A 20-minute video cassette on the production of a silicon integrated circuit has been produced by SERC.

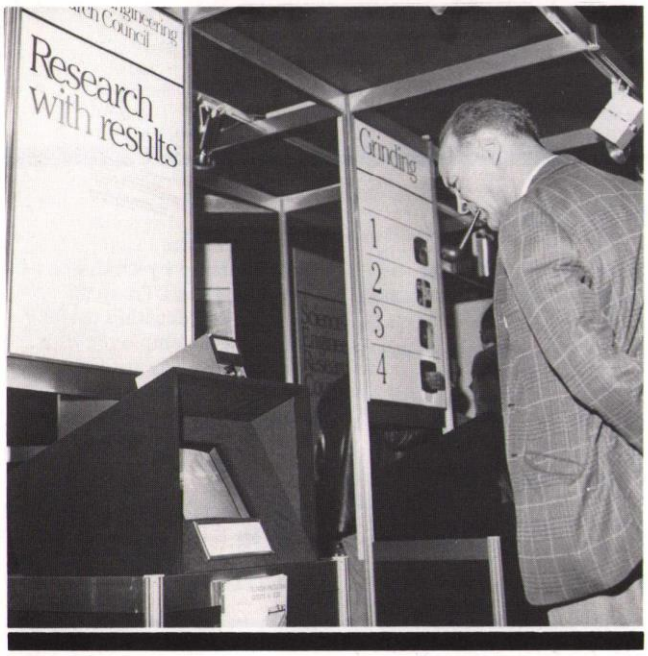
Aimed at final year undergraduate and postgraduate audiences, *Where microns matter* demonstrates how all academic researchers can avail themselves of the latest technology and harness the great potential offered by microelectronics.

The video describes all stages of microcircuit fabrication, from design, including computer aided design, through mask-making (at Rutherford Appleton Laboratory) covering electron beam lithography and ion beam etching, to fabrication (at both Southampton and Edinburgh Universities). It outlines the basic differences between NMOS and bipolar processing, follows an NMOS process, including mask alignment, plasma etching, furnace diffusion, ion implanting and deposition of a metal layer, and shows microscope close-ups of actual circuit elements, using the Nomarski interference technique.

By following a circuit from design, by an MSc student at Edinburgh, through to his inspection of the finished chip, the programme brings out the importance of a designer being aware of the fabrication process. It ends with anticipated future developments in SERC microfabrication technology.

The cassette and accompanying leaflet are available on free loan from Mr Richard Smith, Public Relations Unit, SERC Central Office, Swindon (ext 2254).

Research with results



Two very different exhibition centres have recently been the venues for SERC displays.

During March, London's Olympia was the site of the international engineering exhibition PEP '82. SERC chose this event to show some of the results from the eight years of research into metal grinding and dies and moulds that it has supported. This important area of work has led to significant advances for British industry, advances made possible by the close involvement of researchers with industry. Through the exhibition, more than 200 new contacts were made.

The second display is at Manchester University's observatory at Jodrell Bank. The observatory's permanent exhibition is concerned primarily with their work on radio astronomy. Throughout this summer, however, a display is featuring the wider aspects of SERC-supported work ranging from all of astronomy to science, engineering and nuclear physics. Jodrell Bank is near Macclesfield in Cheshire and is open daily, 2 to 6pm.

Videotapes of SERC-supported research were featured at the PEP '82 Exhibition at Olympia. Copies of these tapes, showing successes in grinding, dies and moulds research, are available on loan from the Public Relations Unit, SERC Central Office, Swindon (ext 2254).

Research grants

Streamlined procedures for small applications

Streamlined procedures for handling small applications for SERC research grants are being introduced on an experimental basis in some of the Council's areas.

Research grant applications requesting up to £10,000 for research in **Mathematics** may for a trial period be submitted at any time, all closing dates for such applications having been abolished from 18 November 1981. Decisions on most of these applications will be taken by specially designated officers of Council, after having obtained the advice of referees. Some of the proposals may still, at the discretion of SERC, be referred to the Mathematics Committee for decision.

Similar arrangements are being introduced by the **Engineering** Board, and universities and polytechnics will be notified when the details have been settled.

These procedures will enable investigators to submit small applications to SERC at any time and are expected to reduce the time taken to consider most of them. The arrangements will be reviewed after a trial period.

Any enquiries about the new procedures should be addressed to the appropriate subject committee secretariat at SERC Central Office, Swindon.

ASR Board short-term visiting fellowship grant scheme

The Astronomy, Space and Radio Board has introduced a trial scheme, complementary to the existing Visiting Fellowship Research Grant Scheme, to enable applications for short-term visitors to be dealt with at short notice.

With effect from 1 April 1982 closing date, investigators who would normally be eligible for research grant support from one of the ASR Board's three science committees may submit an application for travel and subsistence expenses up to £3,000 per annum, to cover a two year programme of short-term visits, only naming the proposed visitors at the time of application where these are already known. The names of other visitors may be submitted to SERC for approval at a later stage, whereupon SERC will normally be able to give a decision within two weeks.

The scheme will be reviewed by SERC after a trial period; investigators who receive research grants under the trial scheme will be expected to contribute to the review.

Details of the scheme are available from Mr R D Cann, Grant Section, ASR Division, SERC, Central Office, Swindon (ext 2359).

Administration of Cooperative Research Grants Scheme

The Cooperative Research Grants Scheme has established itself very effectively since its introduction in 1979 as a vehicle for promoting close collaboration between universities and polytechnics and industry in carrying out research projects. The Council believes that it has now been developed to the point where it can be successfully assimilated by Boards within the committee system.

Accordingly, the Cooperative Research Grants Committee, which has had responsibility for the scheme since it was launched, has been disbanded and responsibility transferred as from 1 April to the Council's Boards and their subject committees. Enquiries about cooperative grants should in future be made to the appropriate subject committee secretariat.

Some new publications from SERC

Particle physics experiments

Copies are available from the Library at the Rutherford Appleton Laboratory of the annual report *Particle physics experiments 1981*. This booklet is a compilation of progress reports on all experiments approved by the Particle Physics Experiments Selection Panel, and records their present state of completion and the results achieved during the year.

Particle physics in the 1980s

The current state of research in particle physics and an outline strategy for the next decade are described in a paper, *The development of particle physics in the 1980s*, presented to Council by the Chairman of the Nuclear Physics Board in January. Copies of the paper are now available from the Particle Physics Secretariat, SERC Central Office, Swindon (ext 2325).

PED publications

Three new titles have recently been issued by the Polymer Engineering Directorate. They are: *The needs for education and training in the British polymer and polymer-using industries; Microprocessors in plastics processing: a review of Interplas '81;* and *Interplas '81: a review of robotic handling devices.*

Copies are available from PED, 3-5 Charing Cross Road, London WC2H 0HW; tel: 01-930 9162.

Materials annual report

Copies of the *Materials Committee Annual Report 1980-81* are available from the Materials Committee Secretariat at SERC Central Office, Swindon (ext 2124).

Research in corrosion

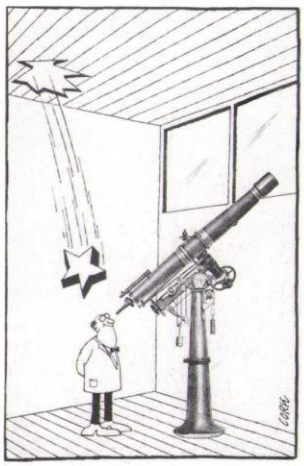
Research in corrosion: a review of projects supported by the Engineering Board of the Science and Engineering Research Council is the third booklet in a series containing short articles illustrating how basic research can be used to solve specific industrial problems by applying the latest scientific techniques.

The booklet covers corrosion in water, process solutions and the atmosphere; marine corrosion; corrosion and mechanical properties; and high temperature corrosion. Copies are available from Engineering Division, SERC Central Office, Swindon (ext 2427).

Major new grant

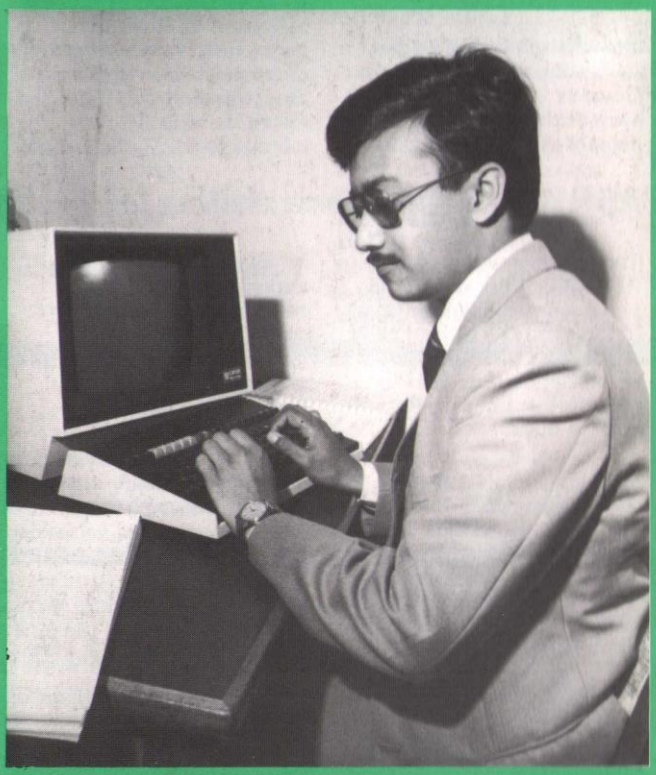
ASTRONOMY, SPACE AND RADIO BOARD

A special revisable grant of up to £859,312 to Professor Willmore and Dr Skinner (Birmingham University) for a Hard X-ray Imaging Experiment on Spacelab 2.



Sandwich course students at RAL

Since 1960 well over 1000 sandwich course students have received industrial experience at the Chilton and Ditton Park sites of RAL. The number receiving training at any time varies: at Chilton in March 1982 there were 62. The disciplines include applied physics, applied chemistry, mathematics, computing, electrical and electronic engineering, mechanical engineering and occasionally business studies, as well as variants on these subjects such as materials technology, physical electronics, control engineering and computer engineering. All but one of the English technological universities and most of the polytechnics, together with the Polytechnic of Wales and Paisley College of Technology, send students from some discipline or other for industrial training. Most students are attending degree sandwich courses but a few HND students are taken from local colleges.



Jamal Rahman is studying Computer Science at Hatfield Polytechnic. During his six months at RAL he will be using the PRIME B computer to write programmes which will help to expand facilities offered by the Administration Database which is used to prepare documents such as the nominal roll and the telephone directory. The database is also used for personnel and accommodation listings.

Christine Rickett is a third year student at Surrey University reading Electrical/Electronic Engineering. At RAL she is working on two projects with the Remote Sounding Group – an airborne radar altimeter scatterometer for measuring directional ocean wave spectra, wind velocity and sea-ice characteristics, and a radiometric study of atmospheric transmission which is part of a feasibility study for a proposed satellite-borne active microwave pressure sounder. She is seen here setting up the tracking antenna of a multi-frequency radiometer. This instrument follows the Sun and measures the relative attenuation by oxygen in the atmosphere of the solar microwave signal. From these data atmospheric pressure can be deduced. Meteorologists would be able to improve their climatic models if a global pressure map were available to them.