SRC BULLETIN

July 1977

Contents

A new neutron source at the Rutherford Laboratory	1
Studentships 1977: the arrangements for CASE and Appeals Studentships	2
New rates for postgraduate students	3
SRC Fellowships	4
Provision of staff posts on research grants	4
CREST-ITG courses in computer science	5
3.8m UK infra-red telescope (UKIRT)	6
Infra-red astronomy satellite (IRAS)	7
Geos	7
New director of Appleton Laboratory	8
RGO permanent exhibition	8
Polymer engineering: the first year	9
Engineering Board programme at the Appleton Laboratory	10
Marine technology director appointed	11
Teaching Company scheme to go ahead	11
Research needs in separation processes	12
Grinding technology	13
CERN Fellowships	13
Farewell to NINA	14
Super proton synchrotron inauguration	17
Director of the Institut Laue-Langevin	17
Central laser facility inauguration	18
Ultra clean facilities at the Rutherford Laboratory	19
High pressure facility	19
1976 Neutron Beam Research Committee Report	19
Major new grants	20
Swindon advance office stage III	20
Closing dates for Advanced Fellowships	20
Closing dates for Senior Fellowships	20

The Science Research Council is one of five Councils funded through the Department of Education and Science. Set up in 1965, SRC's 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.

Details of its support through Research Grants and Postgraduate Awards are contained in its publications known as the Yellow and Green Books respectively.

The SRC also issues panel reports which survey important, topical fields of research and report on both present and proposed developments. Details of all publications are available from the Council's Public Relations Unit at the address given below.

The SRC'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.

This Bulletin summarizes topics concerned with the policy, programmes and reports of the SRC. It is normally published at least twice a year. All reports and publications described are available from the appropriate department of the Council, gratis, except where otherwise stated. A list of the Council's publications may be obtained from the Public Relations Unit, State House (ext 114).

Enquiries and comments are welcome and should be addressed to the editor, I L Arnison at the address below.

Published by the Science Research Council, State House, High Holborn, London, WC1R 4TA (Tel: 01-242-1262). Set in Baskerville and printed by Swindon Press Ltd, Swindon.

A new Neutron Source at the Rutherford Laboratory

Government approval has just been given for the construction of a new facility to provide intense neutron beams at the Council's Rutherford Laboratory. It is planned to serve the needs of University scientists studying the liquid and solid states, including applications in physics, chemistry, biology and materials science. The facility will make use of existing buildings and plant which will be released when the 7 GeV proton accelerator, Nimrod, is closed down in 1978. The new neutron source is based upon a high repetition rate (50 cycles per second), high intensity (2.5×10^{13} protons per pulse) proton synchrotron of 800 MeV energy. The proton beam is incident upon a heavy target to yield intense bursts of neutrons which are slowed to thermal energies by an assembly of reflectors and moderating material. Beams of neutrons emerge through collimating tubes in the thick shielding material surrounding the target assembly. First experiments are planned to begin by the end of 1982.

Thermal neutron scattering is a technique used in an increasingly wide range of disciplines. Nuclear reactors have been the usual source of neutron beams, and for some years now UK scientists numbering approximately 300 have made use of facilities at AERE Harwell, and at Europe's highest flux research reactor at the French-German-UK Institut Laue-Langevin in Grenoble. However, these installations are severely overloaded, and there is little possibility of significantly extending the capability of reactors to satisfy the demands of new experiments. But the pulsed nature of the new source will enable higher *effective* intensities to be realised, and in addition to relieving present demands it is certain to open up new areas of research altogether. Already mentioned are topics as diverse as the magnetic behaviour of materials, the structure of molten metals, and the nature of biological materials under stress, as in muscle contraction.

Design work for the new facility is already in progress, and construction and installation will start following the closure of Nimrod. The estimated capital cost of the basic facility is about £8M spread over approximately five years. In addition, up to £3M will be spent on providing appropriate research equipment. These figures are to be compared with an estimated £30M if the facility were to be built on a new site.

The new Rutherford Laboratory project is at present the most advanced of its kind and is already attracting international interest.

The requirements of the future users of the Facility are being planned and co-ordinated by the Project Scientific Planning Group under the chairmanship of Dr B Fender of Oxford University. For further enquiries contact Dr G Manning (Project Leader) or Dr L C W Hobbis (Facility Utilisation) at the Rutherford Laboratory. Telephone Abingdon 21900 ext 6154 (Dr Manning) and ext 418 (Dr Hobbis).

Studentships 1977: the arrangements for CASE and Appeals Studentships

In the February Bulletin the Council issued a statement of its policy towards postgraduate training and explained its plans for award of studentships in 1977.

Universities and polytechnics may find it useful to have now further information about the arrangements for the award of CASE studentships and ordinary studentships on appeal.

CASE

The Council provided for the award of at least 600 CASE studentships—about 12% more than were taken up in 1976. Once again, the number of CASE projects proposed has exceeded the Council's hopes and expectations, particularly in engineering. About 1,200 CASE projects have already been approved by Boards and 15 which were received shortly before the closing date of 31 May, remain to be considered.

In the Science area over 600 projects have been approved. On the basis of previous take-up of studentships on approved projects the Council expects that the 408 studentships allocated will suffice for the studentships sought in 1977. If the demand should prove larger than expected any remaining applications will be dealt with at the Appeals stage in August.

The Engineering Board has received many more project proposals than in previous years. It has accepted about 550 projects. As announced in the February issue of the Bulletin, the initial allocation for engineering CASE studentships is only 175 but Council is willing if necessary to seek the government's consent for the award of up to 6% (about 200) extra studentships for CASE and other collaborative schemes. Until the extent of the demand for studentships in these 550 engineering projects is known, which will be in late July, the Council will not be in a position to decide on the number of extra studentships for which additional approval is needed. If the demand for studentships in the Engineering Board area is in the proportion to the approved projects that we have come to expect, the possible total of 375 studentships should suffice. The Engineering Board has therefore made arrangements to offer the first 175 CASE awards on criteria which will allow a distribution of these awards in line with the Boards policies for the promotion of postgraduate training. These will take account of the class of degree of the candidate, the priority the Board attaches to the area of work and assessment of the value of the collaborative project as training. It will assist the Board if Departments which have more than one project accepted could list them in priority order. If consideration of any application is to be delayed until August, the Head of Department or academic supervisor and the candidate will be informed. Applications for CASE studentships need not await the degree result, but any award offered will be subject to confirmation that the candidate is academically qualified.

Priority at the appeals stage

Apart from any additional studentships which become available for CASE and other collaborative schemes, the Council expects to be able to make about 200 awards at the appeals stage. This is rather less than in 1976. Studentships will be offered at the appeals stage in such a way as to help the implementation of the Council's postgraduate training policy. Thus priorities will be:

First: to achieve as closely as possible the original allocation made by Council; this was given in the February issue of the SRC Bulletin;

Second: to bring the total for the Instant scheme up to 280;

Third: Equal: (a) candidates for CASE and other collaborative schemes and studentships in Council's "special areas" (Marine Technology, Energy, Polymer Engineering and Manufacturing Technology); and

(b) appellants for ordinary studentships with first class honours degrees (with some preference to those who are migrating to a different institution from that where they took their first degree);

Fourth: Candidates for advanced course studentships with a II(i) honours degree and with some preference for those migrating;

Fifth: Other qualified candidates for ordinary studentships with some preference for those migrating.

The way in which these priorities will work will very much depend on the take-up of allocated quota studentships, the number of applications for studentships on approved CASE projects and on whether the Council will, as it hopes, be able to offer additional studentships for CASE and other collaborative schemes. However, it is hoped that universities and polytechnics will find it useful to have the indication of the Council's intentions set out above.

Any CASE project approved in 1977, which does not attract a studentship this year will automatically be eligible for a studentship in 1978. The Council will consider in the autumn what priority should be given to these CASE projects in 1978.

New rates for postgraduate students

New rates for postgraduate students were announced by the Secretary of State on March 29. They will come into effect from September 1, 1977 for new studentships, and for continuing studentships on October 1, 1977. The existing and new rates are:

(a) **Basic Stipend**	1976/77 £	1977/78 £	Percentage increase %
London	1380	1655	20
Elsewhere	1270	1475	16
Home	925	1075	16

(b) **Additional Allowances**

(i) Postgraduate experience allowances have been increased by about 16% and from October 1977 will range from £160 pa (at age 22) to £650 pa (at age 27 and over).

(ii) Older students allowances have also been increased by 16% to £160 pa (at age 23), £240 (at age 24) and £325 (at age 25 and over).

(iii) Dependants allowances from September 1977 will be broadly in line with supplementary benefit rates:

(a) for spouse or other adult dependant; or
(b) a first child if no adult dependant } £480

(c) for dependent children (other than the first when (b) applies) under age 11 £185; 11 or over but under 17 £325; 17 or over £480.

Disregard of Student's Income

The amount of a student's income which is disregarded in calculating the value of the award is increased from £185 pa to £215 pa (net). In addition, payments from employers (including remuneration for teaching and demonstrating) up to £500 pa will be disregarded. This additional disregard relates to students being trained under the Council's CASE and other collaborative schemes and indicates the importance which the Government attaches to this type of training.

SRC Fellowships

Council has offered two senior fellowships, thirty three advanced fellowships and sixty nine postdoctoral fellowships, tenable from October 1977.

Senior fellowships have been awarded to:

Dr P Day:
Chemistry Department, Oxford University

Professor M Fleischmann:
Chemical Engineering and Technology Department, Southampton University

There were so many candidates (two hundred and fifty one) for the new advanced fellowship scheme, (SRC Bulletin February) that although Council had originally intended to offer only about fifteen such awards, further funds were found in order to offer awards to thirty three candidates. Even so, many good candidates had to be rejected.

However, the Council could not maintain the offer of postdoctoral fellowships tenable at the same level as in 1976. Although the number of applications received (two hundred and twenty seven) was slightly higher, the number had to be reduced to sixty nine instead of seventy five. Within this total, twenty seven awards were tenable overseas.

Provision of staff posts on research grants

Several enquiries have been received concerning SRC's policy on the different grades of staff on research grants. Council's policy is contained in the following extract from the 1975/76 Annual Report:

"Research grants can include support for staff posts to assist the investigator. These posts can be for research assistants who may be scientifically responsible for part of the investigation and also for technicians and other supporting staff. The SRC conditions of grant lay upon the Institution receiving a grant the full responsibility of employer towards the additional staff engaged for the research programme. Except in the case of research assistants, the Council does not attempt to influence the Institution over the period for which the staff are engaged. The only requirement for the engagement of technicians and other supporting staff on research grant funds is that their terms of service should be the same as those for comparable posts in the Institution and that the claim for reimbursement of salary payments should not exceed the provision on the grant.

It has, however, become the practice for SRC committees to limit the tenure of research assistant posts by a single individual to three years. In view of the current difficulties in universities the Council considered whether to change the practice of limiting the tenure of research assistant posts. It decided that the present practice of normally providing for the appointment of research assistant posts within the lecturer scale for up to three years should continue but that, where this would be beneficial scientifically, committees should continue to exercise discretion to enable such appointments to be extended".

CREST—ITG courses in computer science

In January 1974 the EEC Committee on Scientific and Technical Research Policy (PREST) was replaced by the Scientific and Technological Research Committee (CREST), which also took over many of the sub-groups of PREST, including the Informatics Training Group (ITG). With the aim of contributing towards strengthening the European computer industry, the Group was given a mandate to report on the training requirements in computer science within the countries of the EEC, and to prepare a programme of action. Council represents the UK on this group. As a result, the Group initiated a series of short intensive residential courses in different European universities each lasting two to three weeks. The courses are designed to introduce postgraduate students and younger academics to the latest developments in computer science. The three main areas covered are advanced theory, practical computing science, and computer applications in other disciplines and processes. Normally there are fifty to sixty places on each course, half of them being made available on a priority basis to students from Community countries other than that of the host institute.

Initially, CREST-ITG had no funds of its own and courses were financed entirely by the organising countries. This handicapped the Group in its efforts both to develop a balanced programme of courses and to ensure international representation among lecturers and students. Consequently a case was made for support from EEC funds, and the Group has now been granted a budget of 500,000 units of account for the four year period 1977-1980. This is enough for a subsidy of around 35% of the cost of seven courses each year. A balance is planned between the main areas, and countries try to offer courses in which they have the strongest expertise or where the community as a whole may benefit most.

A country wishing to run a course submits to CREST-ITG a title and brief synopsis of objective and outline course content, including the name of the course director, the venue and the approximate dates. This information is considered by the Group early in the year preceding that in which the course is to be held. This early submission of details enables the Group to select a suitable set of courses, with a good balance of subject matter, geographical distribution and timing. When a course has been selected, the course director is invited to submit further details, including the names of the proposed lecturers. These detailed submissions are approved by CREST-ITG in time to permit the director to organise a pre-course meeting of all lecturers. The director is also required to submit a course report, including a list of the students attending. The reports enable the Group to monitor the courses and to ensure that on balance there is adequate interchange of students between member countries. Publication of the material of the courses is encouraged.

The procedure for determining courses for submission to CREST-ITG may vary from country to country. In the UK the initial action comes from the Education and Training Panel of the Computing Science Committee, which selects suitable topics for CREST-ITG consideration and invites an academic expert to submit proposals. For courses held in the UK, Council shares the cost with the EEC and a proportion of places is reserved for students from EEC countries for which fees need not be paid if the sending country has a reciprocal arrangement. Council also pays for UK students whom it currently supports. For courses in other countries, the host country provides similar scholarships and Council pays the expenses for some UK students.

The first two UK courses, which took place in 1976, were on "Data Base Design" at Birkbeck College, under the directorship of

Professor P King, and on "Software Portability" at the University of Kent, under the directorship of Dr P J Brown.

The full programme of courses for 1977 is shown below.

For further information on courses both in the UK and other countries, intending applicants should contact the Computing Science Committee Secretariat at the Swindon Office (ext 114).

14–26 February	Hanover University	Informatics and Medicine
11–22 July	North Staffs Polytechnic	Management Information Systems
3–12 August	Munich Technical University	Operating Systems
22 August–2 September	Dublin, Trinity College	Computer Networks
5–16 September	Swansea, University College	The Microprocessor and its Applications
5–16 December	Toulouse University	Programming Foundations

3.8m UK infra-red telescope (UKIRT)

Three years ago SRC started the construction of a 3.8m infra-red telescope to be installed by arrangement with the University of Hawaii on the summit of Mauna Kea (4200m) on the island of Hawaii. Substantial progress has been made. The building and the lower part of the dome have been erected on the mountain ready to receive the telescope itself, of which the primary mirror is now in the last stages of figuring at Messrs Grubb Parsons Ltd. A recent important milestone has been the erection in the works of Messrs Dunford-Hadfield of the telescope structure for inspection prior to shipment to Hawaii. The telescope will be one of the largest in the world, and the largest purpose-built telescope for observations in the infra-red region of the spectrum.

In the design of all parts of the telescope and its enclosure, consistent efforts have been made to keep costs down. The primary mirror is much thinner and therefore lighter than conventional practice for optical telescopes would suggest, but calculations, in which the Royal Greenwich Observatory (RGO) has collaborated, have shown that flexure can be controlled satisfactorily by attention to the design and positioning of the mirror supports. As a consequence of using a lighter mirror, the telescope structure itself can be made lighter, again reducing costs. The building design has been simplified to be adequate for the need, and the dome is a standard product with only limited handling facilities, so that its diameter, and consequently the size of the building, could be kept to a minimum.

The Royal Observatory, Edinburgh (ROE), which is responsible for the construction phase, is also to be responsible for the operation of the telescope. In addition the Observatory is building common-user instruments to be available soon after the telescope is commissioned in 1978. Throughout the construction project the ROE is being advised on scientific aspects of the telescope and its operation by a committee of infra-red astronomers under the chairmanship of Professor J Ring.

Infra-red astronomy satellite (IRAS)

The SRC is to participate in the IRAS mission for infra-red astronomy, to which the USA (NASA) and the Netherlands Agency for Aerospace Programmes (NIVR) are the major contributors, by providing the ground operations capability based on the Appleton Laboratory. Participation in the mission will give opportunities for UK University scientists to take part in the sky survey, and to use the satellite for observing programmes in the period when survey observations are not being made.

The scientific objective of IRAS is to carry out a survey of the sky at infra-red wavelengths between 8 and 120 microns (μm) at which a ground-based all-sky survey is impossible because of atmospheric absorption. Past experience has shown that whenever a new spectral region has become available for astronomical observations, a sky survey has led to fundamental scientific advances as past optical, radio and X-ray surveys have shown.

The satellite will be placed in a polar orbit at an altitude of about 900 km, and it will carry a 0.6m diameter telescope cooled with helium to a temperature near 10K. It will therefore be equipped with a cryogenic system, charged with liquid helium before launch, and designed to be capable of holding the desired temperature for a period of one year. As the survey proceeds, information on confirmed sources will be released at frequent intervals by means of circulars similar to those issued by the International Astronomical Union (IAU).

Eventually a catalogue of infra-red sources will be published. The scientific programme of the satellite will be under the control of an international scientific team with nine American, six Netherlands and three UK scientists. Many other scientists from the three countries will be associated with the project.

The project will proceed under Memoranda of Understanding between NASA and NIVR, and between NIVR and SRC. These Memoranda define the contributions of the three agencies, which broadly speaking are:

NASA—the launch and the infra-red telescope

NIVR—the satellite

SRC —the ground operations

It is expected that the NIVR/SRC Memorandum will be signed in the near future.

GEOS

The European Space Agency's (ESA's) scientific satellite GEOS was launched on schedule at 10.15 hours GMT on Wednesday, 20 April, from the Eastern Test Range (ETR), Cape Canaveral, Florida. However a malfunction of the US Delta launch vehicle occurred during second and third stage separation, and as a result the launcher failed to place the satellite into the transfer orbit required for subsequent injection into geostationary orbit.

Immediate and successful action was taken by ESA's Space Operations Centre (ESOC) at Darmstadt, Germany, to stabilise the satellite in a temporary transfer orbit. Subsequently ESA officials decided to fire the satellite's apogee boost motor at 07.38 hours GMT on Monday, 25 April, taking the satellite into a 12.06 hour elliptical orbit with an apogee of 38,498 km, perigee of 2,131 km, and inclination of 26.85°.

During the period 27-30 April, the satellite's booms were deployed and experiments switched on, and technologically the satellite is behaving very well. It is evident, however, that the original mission objectives will not now be achieved, and the lifetime of the satellite will be less than was expected in geostationary orbit.

GEOS had been selected as the reference satellite for the 1976-79 International Magnetospheric Study (IMS), a major collaborative geophysical research programme involving scientists from many countries including the UK. There already is considerable pressure from the scientific community for ESA to launch the qualification model of GEOS into a geostationary orbit as soon as possible to fulfill the original scientific objectives and, in particular, to enable the mission to contribute to the IMS. The possibilities of an early re-flight are now being urgently assessed by the Agency.

New Director of Appleton Laboratory

Dr Frederick Horner, formerly Deputy Director of the Appleton Laboratory has been appointed its new Director. He succeeds Dr Saxton, who retired at the end of June.

Dr Horner's career began in the Radio Division of the National Physical Laboratory in 1941. This became a separate organisation after the war and has evolved into the present Appleton Laboratory. Dr Horner became Deputy Director of the Laboratory in 1969.

RGO permanent exhibition

A permanent exhibition covering the history of the Royal Greenwich Observatory, Herstmonceux Castle, telescopes, astronomical instrumentation, time and navigation, astrophysics and astrometry was opened by Mr Patrick Moore at the RGO, Herstmonceux Castle, on Monday, 4 April, before an invited audience of local and county authorities, members of the astronomical community and the press.

The exhibition will normally be open to the general public from Easter week-end until the beginning of October. The hours of opening are:— Monday to Friday 2 pm to 5-30 pm (last admission 4-30 pm) and week-ends/public holidays 10-30 am to 5-30 pm.

The admission charges are: adults 50p, children and OAP's 25p. There is free car parking.

Polymer Engineering: the first year

During its first year of operation, the Polymer Engineering Directorate has been active in new initiatives in both education and research aimed at assisting the polymer fabrication industry. The Directorate has been strengthened by the appointment of Mr Peter Rice as Deputy Director to Dr A A L Challis. Mr Rice is an engineer of wide experience, much of it in the polymer fabrication industry on machine design and building and on the production of polymeric products. He has been, and is active on many technical committees in the Plastics and Rubber Institute and the British Plastics Federation.

The Directorate has prepared an outline plan for the main thrust of its activities during the next 5 years. This has received useful comment from the Engineering Board, BPF and the British Rubber Manufacturers' Association. The plan attempts to concentrate effort into selected areas rather than tackle all the multitude of problems and difficulties that beset the industry. A shortened version of the plan is likely to be published.

The number of graduates now employed in the several thousand companies fabricating plastics is relatively small, and the number of graduate engineers amongst them even smaller. The Directorate has been supported financially by the Rubber and Plastics Processing Industry Training Board and the Engineering Industry Training Board in setting up and supporting a new one-year MSc course in applied polymer engineering at Loughborough University. The course is intended principally for mechanical engineers, the needs of science graduates and materials scientists being already met by several SRC-supported MSc courses in polymer technology that serve as a 'conversion' for them. All now depends on good first-degree engineers taking this course, then demonstrating their effectiveness in the industry, thus establishing a pattern of career and prospects that will sustain and encourage the wider production and employment of polymer engineers.

The second innovation is the launching of four one-week intensive courses in a number of universities and polytechnics. These four courses, taken over a period, will give an overview of plastics processing and properties and are intended for existing senior and middle management of the industry whose knowledge of polymers is usually specialist but often lacking in breadth. The courses will be self-supporting.

The third educational experiment undertaken is the preparation of more adequate data on polymer properties and design procedures. Much of the available data is in a form not easily used by engineers or engineering designers. A number of fellowships are being set up to carry out this work. The University Grants Committee is supporting some further activity in the property and data area which will enable the scope of the information gathering to be extended to include undergraduate engineering courses.

On the research side, a notable feature of the projects approved and being planned is that they all have a company or group of companies associated with them, both in the planning stage and in their conduct. This is seen as an essential requirement if successful research is to be converted into profitable and effective use in the industry. The number of projects now being funded is increasing rapidly, with committed and planned expenditure moving up to the £¾M mark. Three programmes worthy of comment are in mixing, composites and glass-reinforced plastics (GRP).

There is a major programme on mixing, investigating the processes that go on inside the high-powered mixers used to incorporate carbon black into rubber. Extensive work is being planned in the field of composites and the use of highly filled polymers both as materials of potentially superior performance

in certain respects and as a method of saving consumption of polymer. GRP is a material of very wide uses, most of which are fast growing. There are difficulties for the engineering designer using this material arising partly from lack of confidence, from some lack of data and from inadequate non-destructive test methods. Work is in hand to rectify all these omissions.

All the activities of the Polymer Engineering Directorate have been greatly assisted by the advice provided by a number of specialist committees of academics, industrialists and consultants. The service given by many distinguished individuals is gratefully acknowledged.

Engineering Board programme at the Appleton Laboratory

One of the main activities of the Appleton Laboratory is the maintenance of a national research capability in radio-wave propagation studies, much of which is intended to have application to radio communications. The work has in the past been supported by the ASR Board, but in view of its close affinity to activities supported by the Engineering Board through its Electrical and Systems Engineering Committee, Council decided in June last year that the Engineering Board should assume responsibility for this part of the Laboratory's programme.

The Engineering Board sees considerable advantage in harnessing some of the resources of the Laboratory to form an integral part of the programme it wishes to promote in telecommunications. This programme includes communications systems studies—as discussed in the Council's report 'Telecommunications' published in December 1974—as well as propagation research.

In propagation studies, the Engineering Board is seeking ways of bringing the research programmes in the universities and the Laboratory more closely together, of mounting new collaborative programmes, and of using some of the Laboratory's resources in supporting university research. The Board is also anxious to promote work associated with longer-term community needs. A meeting with invited university and polytechnic staff was held recently to discuss these matters, which will be pursued further during the summer.

In communications systems, the Board has for some time been anxious to promote new work of the kind discussed in the 1974 report. Means to achieve this are at present being considered by the Board, and it is hoped to discuss them with the academic community during the summer. It is hoped that the Appleton Laboratory will become increasingly involved with such work in the longer term, although not at the expense of dissipating its considerable expertise in propagation studies built up over many years.

In any event, growing pressure on funds can be expected to increase sharply the need to define priorities for funding, in this as in many other fields. In telecommunications, this is likely to mean firstly, an emphasis on certain aspects of systems studies, and secondly on increasing interdependence and mutual support between the universities and polytechnics and the Appleton Laboratory in propagation studies.

Meanwhile, further information may be obtained from Dr M A Wilkins, State House (Ext 217). Copies of the 'Telecommunications' report may be obtained free from Miss S Holmes, State House (ext 215).

Marine Technology Director appointed

Mr A M Adye has been appointed as the Council's first Director of Marine Technology. The Marine Technology Directorate will aim to increase the involvement of academic institutions in its subject and produce the postgraduate engineers required for the exploitation of sea and sea-bed resources. At the same time it hopes to attract active and continuing industrial collaboration.

The broad strategy of the Directorate's programme will be determined by a management committee with members and assessors from universities, industry and appropriate government departments. Industrial organisations have agreed to contribute financially to the project and have formed a subscribers' association which will nominate three members to the management committee.

Mr Adye, who took up his appointment in May, is on secondment from British Petroleum Limited. He has had a long and varied career in the oil industry and a close association with offshore operations in the North Sea and elsewhere. He was Chairman of the Underwater Engineering Group of the Construction Industry Research and Information Association from 1972 to 1976.

Teaching Company scheme to go ahead

The Science Research Council and the Department of Industry have decided to develop the Teaching Company scheme (announced in SRC Bulletin, January 1976) as a special project for a period of five years, within financial provisions rising to £2 million a year. The cost will be shared equally between the Council and the Department.

The main aims of the scheme are:

to improve manufacturing methods in British firms;

to enable academic departments to make advances in the systematic understanding of manufacturing engineering based on experience of practical industrial problems and

to attract able graduates to careers in manufacturing management.

The scheme operates by establishing a close working relationship between senior staff of one or more academic departments and the management of a collaborating manufacturing firm, a 'teaching company'. The company must be committed to a substantial programme aimed at improving some aspect of its manufacturing, and this programme must be able to draw usefully on academic expertise and manpower.

The Teaching Company scheme enables the academic staff involved to join, part-time, in the programme at the company, supported by young graduates recruited for the purpose, or nominated by the company from its own staff. These graduates work under the joint supervision of company and academic staff. The academic institution must be able to provide supporting course-work to prepare the graduates for their part in the programme and complement their experience during it. The graduates may sometimes register for a higher degree (usually a master's degree by research), if they and their institution wish. SRC and DoI are prepared to support programmes for four years initially, subject to a review of progress towards the end of the second year.

The scheme was developed by a Working Party under the chairmanship of Professor L Maunder OBE (University of Newcastle upon Tyne) following wide discussion on the consultative document 'The Teaching Company' published in 1975 (and now out of print), and experience of initial programmes at five companies, supported by grants totalling over £600,000. These companies are:

CompAir Industrial Ltd, High Wycombe, in co-operation with Professor R H Thornley, University of Aston

Platt Saco Lowell Ltd, Lancashire, with Professor B J Davies, UMIST

GEC Switchgear Ltd, Trafford Park, with Professor A W J Chisholm, University of Salford

TI Matrix Machine Tools Ltd, Coventry, with Professor N A Dudley CBE, University of Birmingham

Herbert Morris Ltd, Loughborough, with Professor R J Sury, Loughborough University of Technology.

Two further programmes have recently been approved, at Lesney Products & Co Ltd, Hackney, in collaboration with Mr J E Proctor, North East London Polytechnic, supported by a grant of £134,900 to the Polytechnic, and at Anderson Strathclyde Ltd, with Professor D S Ross, University of Strathclyde, supported by a grant of £139,000 to the University.

The SRC and DoI are already in touch with several other prospective partnerships who have prepared, or are considering, proposals. They would welcome further enquiries. It is intended that about twenty programmes should be operating by 1982. By that time, SRC and DoI hope that it will be possible to judge whether the scheme should be adopted as a permanent part of engineering research and training in the UK, and if so how it should be supported from public funds.

Further information and advice can be obtained from the SRC's project officer for the scheme, Dr N J Lawrence, at Swindon (ext. 55).

Research needs in separation processes

Earlier this year the Council published a report on R & D needs in separation processes. It gave the results of a survey by Professor H R C Pratt (Melbourne University)—an internationally recognised authority in this field—during his tenure as an SRC Senior Visiting Fellowship at the University of Newcastle.

The Engineering Board's Chemical Engineering and Technology Committee sponsored the survey because an earlier study by the Committee had shown that, of the problems in separation processes identified by industry, about half required long-term research to determine their solution.

The separation processes surveyed by Professor Pratt include countercurrent equilibrium (eg distillation, crystallisation, absorption, exchange), diffusional, mechanical and biochemical methods, and other miscellaneous processes, such as drying, leaching, electrolysis, and osmosis. Detailed recommendations for research and development are presented in the form of a table listing proposed topics under each process, together with priorities.

The CET Committee, wishing to encourage research in this important subject, now invites new applications for research grants. It is hoped to be able to support all meritorious applications received, regardless of the priority ranking given to topics in the Pratt report. This intention will, of course, depend on the level of financial resources made available to the Council.

Copies of the report may be obtained free of charge from Mr P J Bullard, Chemical Engineering and Technology Secretariat, State House (ext 211).

Grinding technology

The Manufacturing Technology Committee is currently supporting a co-ordinated research programme to advance the technology of abrasive machining in the UK in such a way that its further use as an economical production operation is not hampered by lack of technical expertise or information. Recent surveys have indicated that grinding has the highest development potential of all metal-cutting processes.

The first phase of the programme is receiving support of £550,000 and is being carried out in six universities and polytechnics. The economics of grinding is the focal point, the main technical objective being to attain as high rates of metal removed as possible whilst maintaining or even improving upon current values of work surface finish and integrity.

A two-day conference—on "The Industrial Application of Current Research into Abrasive Machining"—was held in December 1976 to review the results of the first two years of the programme. The conference was intended primarily for industrial production engineers and all aspects of the programme were covered. Copies of the proceedings are currently available, at £10 each, from: Dr G Sweeney (Co-ordinator of the SRC Grinding Programme), Machine Tool Industry Research Association, Hulley Road, Macclesfield, Cheshire, SK10 2NE.

CERN Fellowships

Between fifty and seventy CERN Fellowships are awarded each year in the areas of theoretical and experimental sub-nuclear physics, as well as several activities in applied physics, electronics, mathematics, engineering and health physics. They are intended for young post-graduates, often working for, or having just completed, studies for a doctorate. A few appointments are however available for more senior graduates who have had several years post-doctoral experience. (Currently the age limit for Fellows is thirty five years at the time of application). Fellowships are granted for one year initially and are normally extended for a second year. In making its selection CERN gives preference to candidates who have not had the opportunity of previously working at CERN for more than a few months.

CERN also grants Corresponding Fellowships to scientists holding research or teaching posts to help them keep abreast of developments in sub-nuclear physics and related fields. These Fellows visit CERN for three months each year for a period of three years. While Corresponding Fellows are at CERN their parent institutes are expected to continue normal salary payments, while CERN adds an allowance to cover the additional costs of living in Geneva. These appointments are restricted to those scientists who have had previous experience at CERN.

Selection for both types of Fellowships take place twice yearly in January and June and applications should be made through the SRC in October and April. Further information and application forms are available from, Dr W E A Davies, Nuclear Physics Division, State House (ext 371).

Farewell to NINA

The 5 GeV electron synchrotron NINA at Daresbury Laboratory was shut down at midday on 1 April, 1977. When the Science Research Council was founded in 1965 with Sir Harry Melville as the first chairman NINA was at an advanced stage of construction. The first beam was accelerated on 2 December 1966 barely more than three years after work started on the site. This was a remarkable achievement very much to the credit of the Laboratory Director, Alec Merrison, and his team. During 1967 beams were available for setting up the first experiments. These were on wide angle pair (e^+e^-) production (WAPP) by the Daresbury WAPP group, neutral kaon photo-production by the Manchester group, polarisation in electron-proton elastic scattering by a Glasgow/Sheffield collaboration and photoproduction of neutral pions by the Liverpool Group. It was with the WAPP apparatus that the mixing of ρ and ω vector (ie spin 1) mesons was seen for the first time.

This apparatus was subsequently taken over and modified by the Daresbury/Pisa/Frascati collaboration for a series of experiments on electroproduction with a large neutron detector replacing one of the two magnetic spectrometers, the other being retained for the scattered electrons. The Manchester group subsequently set up a beam of neutral kaons and used it to study their three body decay modes and finally their scattering with change exchange. The Glasgow/Sheffield collaboration went on to make measurements of the polarisation of the recoiling nucleon in pion photoproduction and finally to collaborate with the Liverpool Group on a definitive series of experiments on pion photoproduction using a polarised photon beam and a polarised proton target. The Liverpool group had by then progressed from cross section to polarisation measurements using a polarised proton target. For the polarised photon beam an internal diamond target with a very precise remotely controlled orientation mechanism was developed by the Accelerator Group at Daresbury. Regular scheduling of NINA running time began half way through 1967 and in 1968 over 4700 hours were scheduled and an operating efficiency of 73% was achieved. By 1973 the number of scheduled hours had increased to nearly 6000 and the operating efficiency had risen to over 80%. In the remaining years the scheduled hours were limited by financial considerations to an average of 5000 but the operating efficiency rose towards 90%. An efficiency above this level was achieved during the last three months when 1845 hours were scheduled to enable the approved programme to be completed by the closure date.

Testing in the experimental area of the double arm spectrometer for coincidence measurements of electroproduction, with simultaneous registration of the scattered electron and a pion or nucleon in the final state, by the Manchester/Lancaster group started during 1968. The hadron arm for detection of the pion or nucleon was movable in both the horizontal and vertical planes to give azimuthal as well as polar angular dependence. An improved hadron arm with larger acceptance was brought into operation in 1975. This apparatus is an impressive example of the large scale of the equipment needed to study particles of infinitesimal size. Also during 1968 the first measurements of synchrotron radiation from NINA were made. The following year the proposal for a synchrotron radiation facility with two beam ports was formulated and construction started before the end of 1970.

During 1969 data taking started on an experiment by an Anglo-French collaboration (Daresbury / Orsay / Strasbourg) on the backward photoproduction of positively charged pions over the energy range from 0.5 GeV to 3 GeV, covering the pion-nucleon resonance region. The magnetic spectrometer for this experiment was designed and built in France. Also that year a photon tagging system was brought into operation to be used for measurements of total cross sections for high energy photons by the Daresbury/Glasgow/Sheffield collaboration and for the study of backward photoproduction of neutral vector mesons by the Lancaster group. The tagging system used a thin radiator in a low intensity electron beam to generate the photons and a magnet to measure the momentum of the recoiling electrons and hence determine the energy of an interacting photon. There were 64 channels of photon energy with a mean width of about 20 MeV. The total cross section measurements were one of the outstanding successes of the NINA programme and the data remains the standard in the tabulations of particle interactions. By this time there were eight sets of apparatus in the experimental hall which was more than enough for convenience of operation bearing in mind that on an electron synchrotron it is the primary beams of electrons and photons that are mainly required so the opportunities for simultaneous data taking on two experiments are very limited.

A significant event in the summer of 1969 was the appointment of Professor A Donnachie to be head of the Theory Group in association with Manchester University. This group exerted a considerable influence on the experimental programme by the close interaction of its members with the NINA users and in the interpretation of the data from the experiments. It was a clear demonstration of the value that a theory group in a national laboratory can have which is out of all proportion to its cost. Professor Donnachie went on to become head of the High Energy Physics Division at Daresbury and to exert a major personal influence both on the NINA programme and on the programme supported through the Laboratory at CERN, particularly on the SPS.

The experimental programme started in 1967 with bremsstrahlung beams from internal targets. During the following year two extraction systems for electron beams came into operation. In 1970 a servo system was introduced to control the spill of a photon beam from an external target enabling a uniform beam pulse up to 2.5ms long to be obtained giving a duty cycle of over 10%. This kind of system was also applied to the extracted electron beams. Also in 1970 a new injector gun was brought into operation on the 40 MeV linac used as an injector for NINA. This enabled the beam in the linac to be modulated at the radio frequency of NINA (408 MHz) and the bunch separation to be varied as was required by the experiments by the Manchester Group with the neutral kaon beam to give good time-of-flight information for particle identification.

The use of fast data links from experiments to the central computer was a special feature of the exploitation of NINA. These were introduced in 1969 and subsequently became standard for most experiments. A special system was provided for the Synchrotron Radiation Facility shared by the users of the facility. These systems enabled the data to be recorded direct on the disc storage system of the central computer and hence be readily accessible for monitoring of experiments and subsequent analysis. There was also a considerable saving on the peripherals required for the minicomputers used in the experiments.

During 1971 a second photon tagging system was brought into operation on the other extracted beam line. This system covered a photon energy range of 2 GeV in 192 channels. It was intended for the study of multiparticle photoproduction where the energy of the incident photon cannot be determined from the kinematical constraints and has to be measured. The beam was used in a series of experiments by physicists from Daresbury Laboratory and Lancaster and Sheffield Universities. The final arrangement was one of the most complex set up at NINA with a large aperture magnet containing wire chambers for the tracking of charged particles and a wall of lead glass counters for the detection of high energy photons. A total of over 15 million triggers was recorded in the runs with this apparatus.

During 1974 there was a major development on NINA with the introduction of four pairs of quadrupoles into the magnet lattice. These were used under computer control to set and maintain the Q-values, the number of oscil-

lations in the electron orbit for vertical and radial movement, and hence improve the quality and consistency of the beam. Towards the end of the year an improved extraction system was brought into operation on the beam line feeding the second photon tagging system and the following year a similar system came into use on the line feeding the Manchester/Lancaster electroproduction apparatus. Using these systems it was possible for the two experiments to take data simultaneously when the requirements as regards energy were compatible. There was in any case a considerable improvement in the quality of the high intensity extracted beam for the electroproduction programme.

Commissioning of the experimental apparatus on the Synchrotron Radiation Facility started during 1972. At that stage three grating monochromators had been installed for work in the vacuum ultra-violet region of the spectrum by the Universities of Manchester, Reading, Cambridge and Oxford. They were joined the following year by the National Physical Laboratory using a normal incidence monochromator for ultra-violet radiometry. That year also saw the start of the x-ray programme with the installation of a simple crystal monochromator by the group from the University of Strathclyde for work on photoelectron spectroscopy and a bent crystal scanning monochromator by the MRC group from Cambridge for diffraction studies of muscle structure. In 1975 a major programme of ultraviolet photoelectron spectroscopy was started by the Universities of Warwick, Leicester and New Ulster and Daresbury Laboratory. This brought the total number of monochromators installed up to nine. At this stage a modest allocation of main user time for synchrotron radiation users was introduced which was very beneficial to the programme, particularly in the x-ray region. Several new types of experiments in this region were introduced, namely extended x-ray absorption fine structure (EXAFS), small angle scattering with energy dispersion, and topography. A category of minor users was introduced to enable applications involving a small amount of beam time to be processed quickly. This brought in users from several more universities including Durham and Edinburgh. At the time of the NINA shutdown the activity was higher than ever and new minor users appeared during the last few months.

A total of nearly 200 publications have appeared or been submitted which come from the NINA programme and there are many more to come. They are divided approximately in the ratio 2:1 between particle physics and synchrotron radiation. Their content is both experimental and theoretical and includes accelerators, computing and instrumentation. In particle physics the data from NINA has been the major influence in developing the understanding of the structure of nucleons in terms of their constituent quarks thanks to an investment in major sets of apparatus which could be used for precision studies of the response of nucleons to real and virtual photons. In synchrotron radiation Daresbury became one of the leading laboratories in the world and has set the pace for the next generation of synchrotron radiation facilities based on electron storage rings. The important thing is not the lifetime so much as the quality of the life.

Super Proton Synchrotron Inauguration

The inauguration of the 400 GeV proton accelerator, one of the world's largest physics tools, usually known as the SPS (Super Proton Synchrotron) took place at the European Organisation for Nuclear Research (CERN) on 7 May. The occasion was attended by more than 1000 representatives of the member and scientific communities from all over the world.

Construction of the machine has been financed by eleven CERN member states—Austria, Belgium, Denmark, Federal Republic of Germany, France, Italy, the Netherlands, Norway, Sweden, Switzerland and the United Kingdom—at an estimated total cost (spread over an eight-year construction programme which began in 1971) of 1,150 million Swiss Francs (at 1970 prices).

Protons were first accelerated to full energy in the SPS last year and the provision of the full range of the machine's facilities, particularly in the experimental areas, is scheduled for completion at the beginning of 1979. Dr John B Adams, Executive Director of CERN and "father of the SPS" said that it is "The material manifestation of what a united Europe can do if only it is given the chance. The quality of the massive equipment at CERN clearly demonstrates that European scientists and technicians can build the most advanced and sophisticated technical equipment ..... The SPS is the work of an organisation whose member states have a common purpose and the confidence to trust the management to carry it out successfully .....In its way it is a statement about our European Society".

Professor Llewellyn-Smith, of Britain, one of the 'young physicists' for whom the SPS represents the future, pointed out that particle physics involved the study of the infinitely small. He referred to the recent discovery of quarks which are supposed to make up the protons and neutrons of a nucleus. Going further, he pointed out that the beams supplied by the SPS might reveal the structure, or the absence of any deeper structure, inside the quarks. The SPS should also make it possible to progress towards a unified description of the four fundamental forces of Nature.

At the present time, forty three experiments have been approved for the machine and many are now in operation. About nine hundred experimenters from more than one hundred laboratories are taking part in these experiments.

The first of them has just been completed and its results are about to be published by a group of experimenters from the Federal Republic of Germany (Munich), France (Ecole Polytechnique), Britain (Birmingham University), Switzerland (Neuchatel) and CERN.

Director of the Institut Laue-Langevin

Dr John White, a chemist and neutron scientist from Oxford University, has been appointed Director of the Institut Laue-Langevin (ILL) at Grenoble.

The ILL, which celebrates its tenth anniversary this year, is funded jointly by the United Kingdom, France and Germany and is centred around a High Flux Reactor, the

only scientific instrument of its kind in Europe. The reactor produces intense beams of neutrons for use in scientific investigations in solid state physics, chemistry, biology and metallurgy, together with fundamental experiments in nuclear physics.

Approximately seven hundred experiments are carried out annually on the thirty five advanced instruments which are installed on beam tubes around the reactor. About a thousand scientists visit the Institute to participate in these experiments from one hundred and ten laboratories, mainly in the three member countries. In addition, scientists from twenty other countries collaborate in the experimental work carried out.

British participation in the work of the Institute began in 1973 and in 1974 the Science Research Council formally became one of the associates of the ILL which was originally founded by the French and Germans in 1967.

Central laser facility inauguration

The Council's Central Laser Facility which is situated at the Rutherford Laboratory was inaugurated by the Chairman, Sir Sam Edwards, in a ceremony at the Laboratory on Monday, 20 June.

A milestone in the progress of the Facility had been reached some weeks earlier when laser compression was recorded with the first shot of the new two beam laser at a glass micro balloon target.

The Rutherford Laboratory thus became one of only a handful of centres worldwide where such observations have been made. The technically difficult experiment involved focussing the twin laser beams from opposite directions onto a tiny glass balloon of 85 microns diameter and 0.5 microns wall thickness. The laser pulses 100 picoseconds (or 3 cms) long were timed to arrive coincidentally at the target within 20 picoseconds. The target was positioned at the centre of a spherical vacuum chamber and viewed by an array of measuring instruments that have been developed during single beam plane target experiments earlier this year.

One such instrument is an X-ray pinhole microscope which produced a picture of the high temperature target in thermally generated 1 kilovolt X-rays. The image showed strong emission at the two irradiated piles of the sphere and also very localised emission from the centre where the laser driven implosion compressed and heated gas in the glass balloon.

Groups from Universities and Polytechnics wishing to use the Facility should in the first instance contact Dr Paul Williams at the Laboratory.

Applications for Laboratory / University agreements in support of work very closely linked with the Facility should be made directly to the Rutherford Laboratory by the following closing dates: 15 September, 15 December, 1 April.

Applications for other work involving lasers should continue to be made to SRC at State House in the normal way. In the case of any doubt on the method of application please contact Mrs June Hawkins, State House (ext 169).

Ultra-clean facilities at the Rutherford Laboratory

Many of the components of the new High Power Laser at the Rutherford Laboratory are extremely sensitive to contamination by micro particles. In order to make it possible to assemble and maintain the laser components, ultra-clean handling facilities have been set up at the Laboratory.

The clean assembly suite comprises an anteroom which is used for dressing in the clean area protective clothing. This opens into a preliminary clean area 22 m^2 which operates at better than Class 10,000 and contains a sink 1800 mm by 600 mm, a vapour spray degreaser of similar size and a horizontal laminar flow Class 100 work bench. Microscopes and particle count measurement equipment is provided in this area. Connected to the Class 10,000 area is a vertical laminar flow room 5000 mm by 3000 mm which operates at better than Class 100. Special clean clothing and handling facilities are provided.

Although this facility has been set up to maintain laser components, it is possible that use could be made of it by university and polytechnic groups not connected with the laser programme who have a particular requirement for ultra-clean assembly work. Further details of the facility and its availability can be obtained from the Laser Division Project Engineer, Mr J E Boon, at the Rutherford Laboratory.

High pressure facility

The Council has been maintaining a high pressure facility at the laboratories of Standard Telecommunications Limited at Harlow for the past two years, for the benefit of university users.

Demand for use of the facility has risen steadily over this period, and successful programmes have been undertaken in the fields of physics, chemistry and engineering.

Current SRC support extends to April 1978 and the possibility of longer term support is being examined. The specification of the equipment can be obtained from the Secretary of the Physics Committee, State House (ext 390).

Applications for time on the facility should be submitted by the usual closing dates for research grant applications.

1976 Neutron Beam Research Committee Report

The report of the Committee comprises two parts: the first part is of general interest indicating the topics discussed by the Committee during the year and summarising the scientific highlights of current research using neutron beam techniques. The second part, the appendix, is a compendium of individual progress reports submitted by investigators and a detailed report on the Neutron Beam Research Unit. Anyone interested in either document can obtain copies from Miss C J Walter, State House (ext 168).

Major new grants

Astronomy, Space and Radio

i *Solar maximum mission*

Up to £213K over 2½ years to Professor A P Willmore and Dr G M Simnett (Birmingham University) to collaborate with the University of Utrecht in developing a hard X-ray imaging spectrometer for inclusion on NASA's Solar Maximum Mission satellite.

ii *Satellite data handling*

A grant of up to £180K over three years to Professor J T Houghton, Dr C D Rogers and Dr E J Williamson (Oxford University) for updating and renewal of the Oxford satellite data handling and analysis system.

iii *Electrodynamics Explorer*

A grant of up to £185K over 5 years 7 months to Dr D Rees (University College London) to collaborate with the University of Michigan on an interferometer experiment for inclusion in the payload of NASA's Electrodynamic Explorer Satellite Mission.

Closing date for Advanced Fellowships

In order that Boards may have adequate time to select referees and interview candidates, the Council has brought forward the closing date for applications for Advanced Fellowships to 31 October 1977. From 1978 onwards the closing date for applications will be 30 September.

Closing date for Senior Fellowships

The closing date for applications will be 30 November 1977. Applications should be made by letter to the Secretary of the SRC.

Candidates are asked to nominate one referee whom SRC could consult when considering the application.

Swindon advance office stage III

As announced in the SRC Bulletin (February 1977) most sections of the Council's Research and Training Support Section have now been transferred to Swindon. Enquiries should be addressed as follows:

Enquiries about existing Studentships
—Swindon Office

Enquiries about the award of Studentships (questions of elegibility, requests for forms, booklets etc):
—Swindon Office (general enquiry point on ext 143)

Enquiries about Fellowships
—Swindon Office (ext 89)

Enquiries about Research Grants should be made to the appropriate Committee Secretariat. Enquiries about Claims in respect of Research Grants and requests for forms and booklets about them.
—State House (ext 392)

ESTABLISHMENTS OF THE SCIENCE RESEARCH COUNCIL

ROYAL GREENWICH OBSERVATORY
Herstmonceux Castle
Hailsham, Sussex
Director Professor F Graham Smith, FRS
Telephone Herstmonceux (032-181) 3171

ROYAL OBSERVATORY
Blackford Hill
Edinburgh EH9 3HJ
Astronomer Royal for Scotland and Director
Professor V C Reddish, OBE
Telephone Newington (031-667) 3321

APPLETON LABORATORY
Ditton Park
Slough SL3 9JX
Director Dr F Horner
Telephone Slough 44234

RUTHERFORD LABORATORY
Chilton
Didcot, Oxon OX11 0QX
Director Dr G H Stafford CBE
Telephone Abingdon (0235) 21900

DARESBURY LABORATORY
Daresbury
Warrington, Cheshire WA4 4AD
Director Professor A Ashmore
Telephone Warrington (0925) 65000

SRC SWINDON OFFICE
PO Box 18
Swindon SN1 5BW
Telephone Swindon (0793) 26222