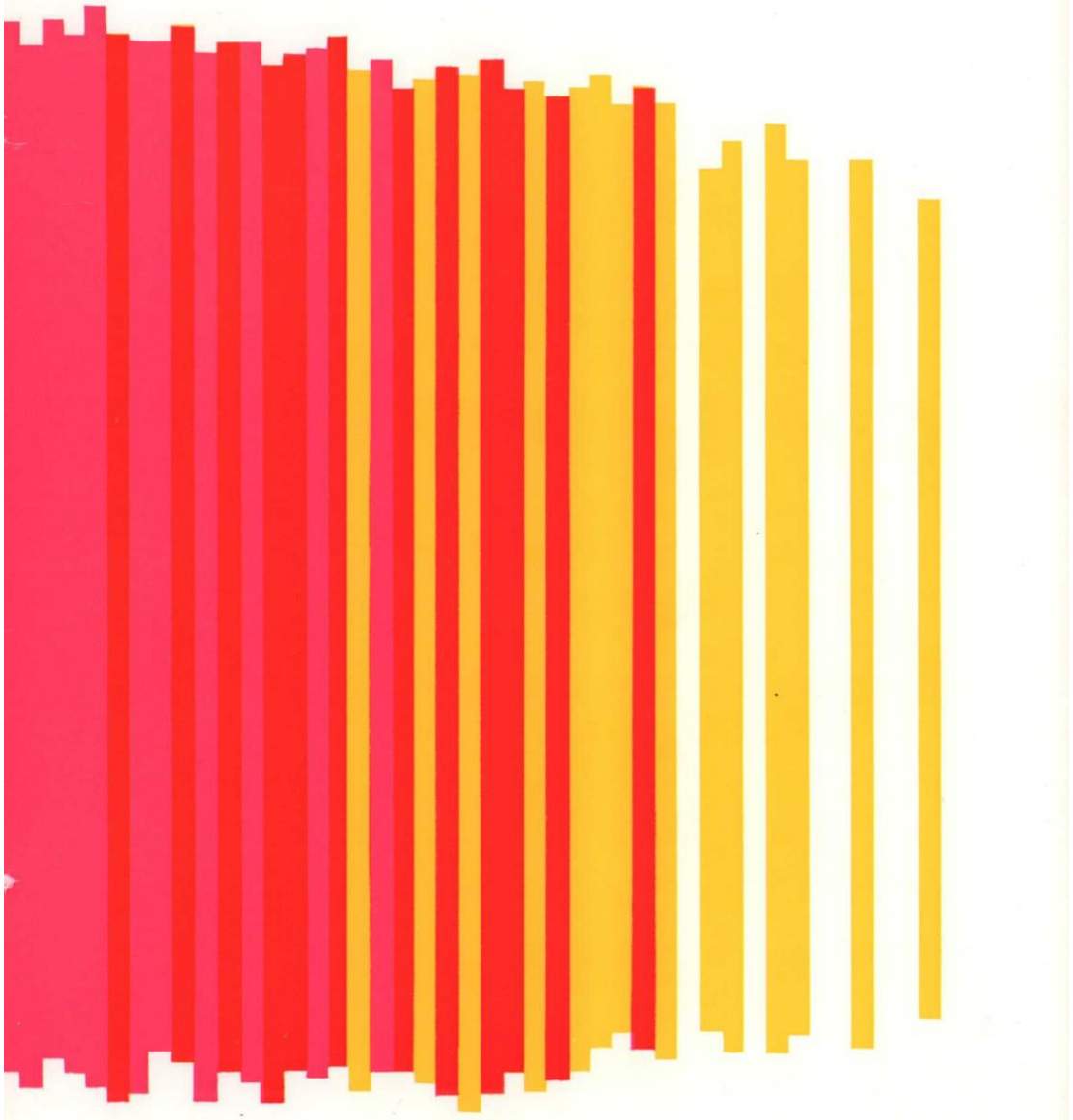
Science Research Council



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.

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

The SRC also issues regular 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.

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The cover design is an artist's impression of energy

Science Research Council

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Introduction

The Science Research Council which was set up in 1965, taking over six national research establishments and the basic research functions of the former Department of Scientific and Industrial Research, is one of the five Research Councils responsible to the Secretary of State for Education and Science (the others are the Agricultural, Medical, Natural Environment, and Social Science Research Councils). The Advisory Board for the Research Councils advises the Secretary of State on the allocation of resources to the Research Councils' programmes of basic research and on their co-ordination with the programmes of applied research for which other Government Departments (eg, Trade, Industry, Environment) are responsible.

The Science Research Council supports basic research in astronomy, the biological sciences, chemistry, engineering, mathematics and physics. The primary purpose of the Council has been stated by the Government in the White Paper *Framework for Research and Development* (Cmnd 5046) as being 'to sustain standards of education and research in the universities', and the Council devotes most of its resources to:

(a) helping university staff to carry out lively and interesting basic research at the forefront of their subjects, either in their own university, or in one of the Council's own research establishments, or if necessary elsewhere;

(b) enabling suitable graduates to receive further training in either methods of research or a specialised branch of science or engineering of importance to British industry.

In 1974/75 the Council will spend on basic research and post-graduate training about £83 million, voted by Parliament.

The Council provides support in four principal ways:

(1) The Council awards grants to help pay for equipment, materials or travel which are required for a research project, to enable a university or polytechnic to employ additional staff to work full time on the research project, or to visit or invite to the UK leading scientists in other countries.

(2) The Council has six research establishments:

Appleton Laboratory
Atlas Computing Laboratory
Daresbury Laboratory
Royal Greenwich Observatory
Royal Observatory Edinburgh
Rutherford Laboratory

Left: The Pilot Machine for the Van de Graaff accelerator

These establishments:

(a) provide some national services (for example the Greenwich Time service at the Royal Greenwich Observatory);

(b) are centres for research in their field, where university scientists in partnership with the Council's own scientific staff, can have access to equipment not available in universities (such as large telescopes or satellites for astronomy, accelerators for elementary particle physics or, at the Atlas Computing Laboratory, computing on a scale or of a complexity greater than a university's own computing service can supply);

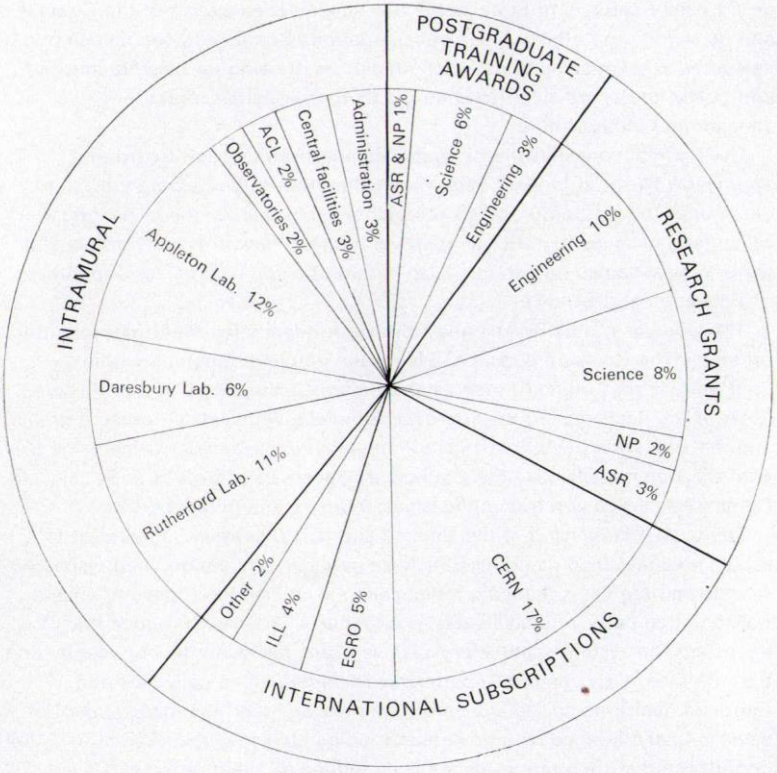
(c) are centres for the development of new research equipment where the scale of effort required is likely to be too great for a university;

(d) provide support for university scientists whose research needs access to facilities run by international research organisations.

(3) The Council arranges for British university scientists and its own scientific staff to have access to equipment abroad, such as the powerful particle accelerators at the European Organisation for Nuclear Research (CERN) near Geneva, Switzerland, the 150-inch Anglo-Australian Telescope at Siding Spring, New South Wales, Australia, or the high flux neutron source at the Institut Laue-Langevin, Grenoble, France. The access may be organised directly or through a research establishment as described in 2(d) above.

(4) The Council awards studentships, providing a maintenance grant and fees, to students receiving training in methods of research or taking advanced courses of study. Research students often themselves make valuable contributions to a university's research programmes. The Council also awards fellowships to promising young scientists or engineers to enable them to carry out an independent research programme that they themselves have put forward.

The chart shows how the Council expected to spend its funds in 1974/5; the Council's support of basic research and postgraduate training is described in greater detail in the following sections.


POSTGRADUATE TRAINING AWARDS
ASR & NP 1%
Science 6%
Engineering 3%
RESEARCH GRANTS
Engineering 10%
Science 8%
NP 2%
ASR 3%
INTERNATIONAL SUBSCRIPTIONS
CERN 17%
ESRO 5%
ILL 4%
Other 2%
INTRAMURAL
Rutherford Lab. 11%
Daresbury Lab. 6%
Appleton Lab. 12%
Observatories 2%
ACL 2%
Central facilities 3%
Administration 3%

Organisation

The Council itself consists of fifteen part-time members appointed by the Secretary of State for Education and Science, usually for a term of four years. They are drawn from universities, industry, government departments and public life. The Chairman of the Council, also appointed for a fixed term by the Secretary of State, is the full-time chief executive of the Council and its accounting officer. The Council appoints Boards and Committee and delegates to them some of its functions for the drawing up of programmes and policy, the approval of research grants to universities, and the allocation of studentships.

The Council considers the programmes proposed by each Board and approves a five year forward plan to be submitted to the Secretary of State; determines the staffing of the six research establishments and its headquarters office; and reserves to itself the approval of major new university grants and major new schemes (which may also require the approval of the Department of Education and Science).

The Council and its Boards and Committees determine their own scientific priorities. The Boards are responsible for the whole programme within their field, in the Council's own establishments, universities, and elsewhere. Most of the decisions on the approval of individual university research grants and the allocation of studentships to individual university departments lie with the Committees. Like the Council, the members of Boards and Committees are drawn from universities, industry and public bodies.

The wide membership of the Council and its Committees is intended to secure well informed decisions which are generally understood and respected. A wide and regularly changing membership is crucial, for it helps to ensure collaboration between universities, polytechnics, industry and government agencies. The system enables prospective users, the scientific community and the interested Government Departments to participate in collective and informed decisions on the course of basic research and the management of science in accordance with government policy. It also gives research workers confidence that their proposals are fairly judged and that programmes are directed by Committees as expert as can be assembled.

Corresponding to the Council's four Boards there are four administrative divisions of the Council's headquarters office for astronomy, nuclear physics, science (biology, chemistry, mathematics and physics other than nuclear physics), and engineering. There are also divisions for personnel matters and for finance, and a department under the Secretary of the Council responsible

for co-ordinating the Council's policy on research grants and studentships and for liaison with the bodies responsible for supporting basic research in other European countries and elsewhere.

At the Royal Greenwich Observatory an operator checks the broadcast time signal against the outgoing signal which is advanced to compensate for the delay of the land line and equipment

Research grants

The Science Research Council makes research grants to universities and other institutions of higher education for timely and promising projects that require greater resources than the university itself can apply to them. These grants are usually for a fixed term, often three years. If a project continues for longer the Council will consider an application for renewed support, but the Council looks to universities themselves to provide most if not all of the resources needed for research projects that prove of lasting importance.

Each of the Council's Committees assesses the new applications received in its field for research grants. Bearing in mind the funds available, it then decides on the level of support—if any—to be provided for each applicant.

From time to time each of the Council's Committees reviews the whole or some part of its field to ensure that promising areas for research are not being neglected. These reviews are published so that the scientific community can discuss and comment on them before the Council decides what action to take. As a result of the reviews the Council from time to time announces selected research topics in which promising research proposals will be particularly welcome, and may set aside enhanced funds specifically for these topics or even set up a new committee to consider applications for research grants to support work on them. This policy of selectivity inevitably implies that relatively less money is available for the support of research in other topics.

Research in some fields—such as radioastronomy or control engineering—requires such expensive equipment that the Council can only support it at a limited number of research centres.

In addition to its selective support of chosen fields, the Council ensures that support will always be available for any outstanding proposal put forward by an institution of higher education.

Dome of the 98-inch Isaac Newton reflector at Herstmonceux, Western Europe's biggest optical telescope. The projection from the cylindrical drum houses the Coudé spectrograph. In the background: the Equatorial Group of RGO telescopes

Postgraduate training

The Science Research Council awards two kinds of studentship to enable a proportion of the most able graduates in science and engineering to continue their training beyond a first degree, both to increase their knowledge and understanding of science and engineering and to help them to develop their intellectual powers and skills.

Research students are trained, usually for three years, in methods of research, and are given the opportunity to make their own personal contribution to the advancement of science and engineering. The Council awards over 2000 research studentships each year.

One-year advanced course studentships enable graduates to receive advanced instruction in a topic of national importance not covered in undergraduate courses, to attend 'conversion' courses (for example in the application of mathematics to engineering) or to prepare for specific careers. The Council awards over 1500 advanced course studentships each year.

British graduates with first or upper second class honours degrees are eligible for SRC research studentships and advanced course studentships. With a lower second class degree they are eligible only for advanced course studentships. In the awarding of studentships and their administration the Council is advised by its four Boards and their specialist Committees. Most of the studentships are allocated to individual university departments who act as the Council's agents in selecting the students who would benefit from further training. In deciding allocations the Council, Boards and Committees consider the training proposals of universities and other institutions of postgraduate education and keep these under regular review in the light of their assessment of national requirements and of the need to ensure the most effective use of limited resources.

The Council supports about half of the British postgraduate students in its field. As a result of the priority given to engineering in recent years, the proportion of postgraduate students supported by the Council is now about the same in both engineering and science. In 1974 the Council made awards to about 14% of new graduates.

The traditional research studentship, normally leading to the submission of a thesis on original work and the award of a PhD, and the normal advanced course of specific instruction, continue to serve their many purposes well and to be adapted as necessary; they account for most of the awards made by the Council. However, the Council has judged that the circumstances of recent years also required a few special schemes to encourage the orientation

of students to employment outside the higher education system, to encourage some graduates to defer their postgraduate training until they have had experience of outside employment, to encourage more co-operation between firms and universities, to stimulate broader postgraduate training and to encourage postgraduate training suited to the needs of engineers who do not intend to pursue research or academic careers.

As well as providing studentships the Council also helps universities to improve postgraduate training in other ways. For example, the Council has helped universities to mount special short vacation courses for postgraduate students in polymer science and physics to supplement the education available in their parent departments. The Council has also supported short courses designed to enable research students to meet young graduates already in industry and gain an insight into the problems of modern industry by tackling typical administrative or industrial exercises under the guidance of tutors from industry and public bodies.

The courses are now attended by about one third of SRC research students, and they seem to be both popular and successful.

In addition to postgraduate studentships, the Council awards each year about 70 postdoctoral fellowships to enable outstanding young scientists and engineers to carry out research projects of their own devising.

Application of research

The purpose of the Science Research Council's support of basic research is 'to develop the sciences as such, to maintain a fundamental capacity for research, and to support higher education'. (*Framework for Research and Development*, Cmnd 5046.) Quite often, however, research supported by the Council leads to results of potential practical value. The National Research Development Corporation then arranges for the exploitation of the results, when appropriate, by applying for a patent, and subsequent royalties are shared between the inventor and the Corporation. The Corporation thus ensures that the results of research supported by public funds are exploited with due return to the inventor and to the public purse. If the National Research Development Corporation declines to take up the results of a research project supported by the Science Research Council, the university is free to exploit the results itself as it wishes.

An important and welcome consequence of the Council's support to a university engineering department for a basic research project may be that the department acquires skills that are useful for further applied research projects supported by industry or a government department. When a project undertaken to increase basic understanding also tackles a practical problem of interest to an individual firm or government department, the Council expects it to be financed jointly. It is however rare for a project supported by the Council to be valuable, or potentially valuable, to only one user.

An example of research supported by the Council of immediate practical value is the work at Cambridge, London and Manchester Universities on the control of manufacturing plant by computer. Research into the chemistry of compounds of fluorine and carbon at Birmingham University has led to industrial applications which include refrigerants, aerosols, fluoroplastics and rubbers, waterproofing agents and hydraulic fluids.

The influence of pure science on technology is seen in the demands of scientists themselves for higher standards of performance, greater accuracy and the development of new materials. Notable examples are the giant radio telescopes at Cambridge and Jodrell Bank, the high energy particle accelerators at the European Organisation for Nuclear Research, Geneva, and the development of superconducting magnets at the Rutherford Laboratory, a development which may have great significance for the future of high energy physics and for the power-generating industry.

Mr D G House, Head of Operations Group, at the Atlas Computer Laboratory, explains to visitors the Exchangeable Disc Store, as he stands behind the control console for the nine EDS-30's; ('30' indicates that 30M characters can be stored on each disc pack). The control desk for the five EDS-60's is shown on the right hand side of the picture facing the other way

SRC research establishments

In its Establishments the Council has placed national facilities that are too large to be the responsibility of a single university. In addition to managing these facilities the laboratories and observatories have their own research programmes and are responsible for providing technical support for university researchers using the facilities or preparing an experiment that will be carried out in one of the big international laboratories.

The paragraphs that follow describe the programmes of the six Research Establishments.

The Ariel 5 control room at Appleton Laboratory

Appleton Laboratory

The Appleton Laboratory, formerly the Radio and Space Research Station, provides services in support of university space research, within the Council's overall programme of space science. The Laboratory is responsible for the management of major facilities such as high-altitude balloons, rockets and satellites which are used to carry geophysical and astrophysical experiments. In addition to its strong in-house space research programme which complements the universities' vehicle-borne space investigations, the Appleton Laboratory has its own research programme on the propagation of radio waves. The research in this area is both fundamental and practical. Current research includes a detailed experimental and theoretical study of the ionosphere, of the propagation of radio waves through it and of the effects upon it of solar radiation. Particular emphasis is being given to the influence of meteorological factors on the propagation of millimetric and submillimetric radio waves. Joint experiments are carried out with other organisations, notably the Post Office.

The Laboratory has a number of out-stations: at Chilbolton, Hampshire, there is a large steerable dish-type aerial used for tropospheric and ionospheric radio studies and for some radio astronomy; at Winkfield, Berkshire, there is a satellite tracking and telemetry station operated as part of the network organised by the National Aeronautics and Space Administration (NASA) of the USA.

In January 1973 the former Astrophysics Research Unit of the Council, at Culham, became a Division of the Appleton Laboratory. This added to the Laboratory's programme studies of the ultra-violet and X-ray emission spectra of high temperature astrophysical sources carried out both in the laboratory and using spacecraft, and the interpretation of the results of these studies in terms of the physical conditions existing in the sources of the spectra.

Address for enquiries The Secretary, Appleton Laboratory, Ditton Park, Datchet, SL3 9JX
Telephone Slough 44234

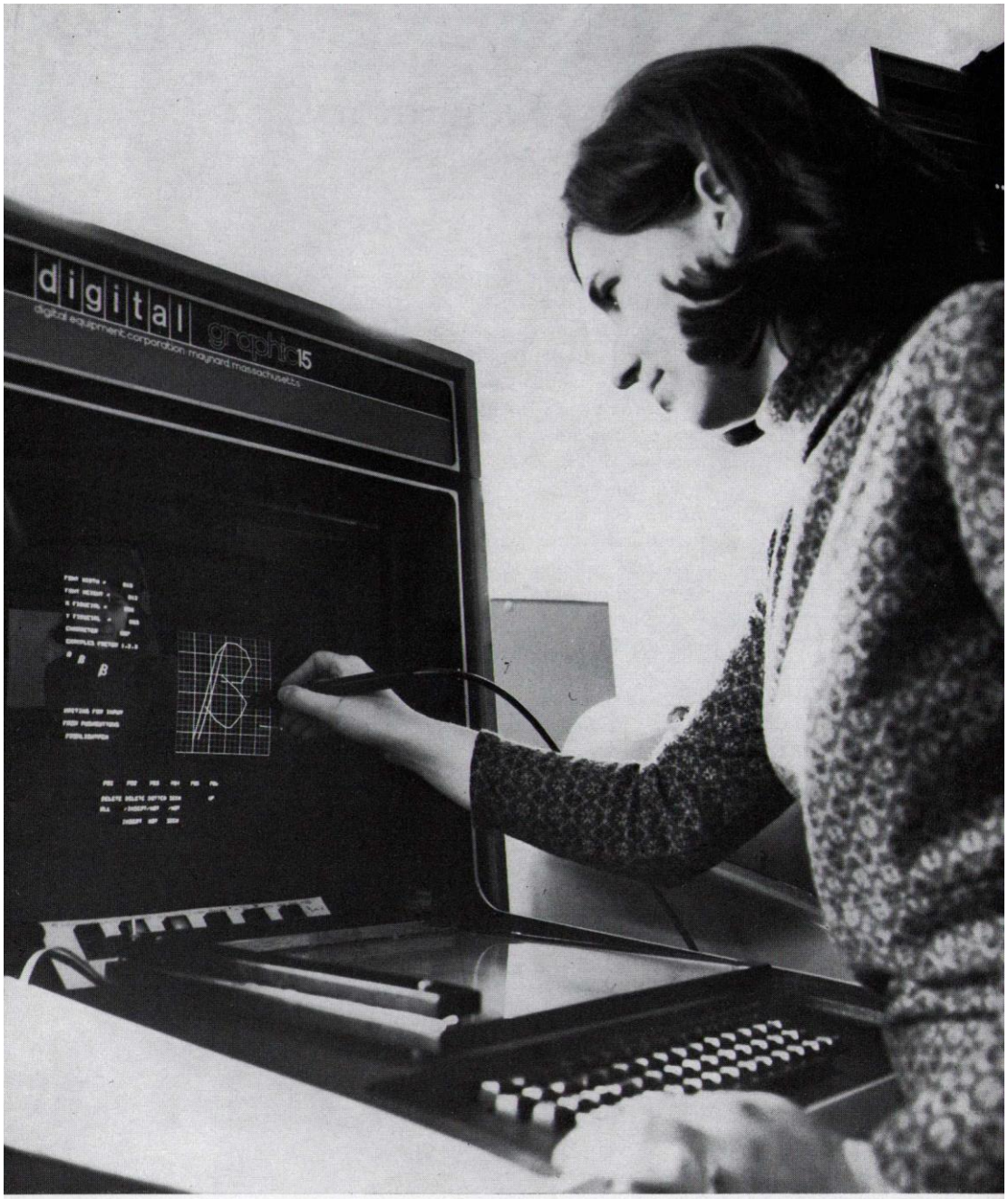
Atlas Computer Laboratory

The Atlas Computer Laboratory provides a computing service for large or otherwise special projects for research workers in all British universities, in other SRC establishments, and in government departments and laboratories. The original Atlas computer which gave its name to the Laboratory was closed down in March 1973, an ICL 1906A with large amounts of storage having been installed in mid-1971. The Laboratory also has an allocation of time on the large IBM 370/195 system at the adjacent Rutherford Laboratory. Communications facilities allowing access to either machine from terminals outside the laboratory are available and are being developed further.

There is also an interactive graphics system based on a PDP-15 computer and VT-10 display and a Stromberg Datagraphix 4020 microfilm recorder which will shortly be replaced by an Information International FR-80 recorder. The Laboratory has its own research and development programme which takes in a number of topics in systems and applications software, for example operating systems, character processing, graphics and applications in broad fields such as quantum chemistry, crystallography and statistics. It has taken a particular interest in the production by computer of cine films as an aid in research and for teaching. The film (either 16 mm or 35 mm) is made with the SD 4020 recorder which is driven by information generated by a computer program and output on to magnetic tape. The Open University has used a number of films produced in this way in the Laboratory in its foundation course in mathematics and in other programmes.

Address for enquiries Dr J. Howlett CBE, Director, Atlas Computer Laboratory, Chilton, Didcot, OX11 0QX
Telephone Abingdon 1900, extension 547

Right: A member of the Applications Software Group at the Atlas Computer Laboratory drawing a Greek β on the VT-15 Visual Display System with a 'light pen'. The double line will appear as one thick line and the curves rounded when the character is output on the SD 4020 microfilm recorder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Daresbury Laboratory

The Daresbury Laboratory was set up in 1962 as a second national laboratory for high energy physics research and contains a 5 GeV electron synchrotron. The accelerator, known as Nina, originally built to study the physics of elementary particles, now also produces beams of ultra violet and soft X-rays for use in a programme of atomic, molecular and solid state physics and molecular biology. Physicists from the Laboratory also take part in experiments at the international laboratory at CERN.

A 30 million volt Van de Graaff accelerator for use in nuclear structure research is at present under construction. The machine will be the largest of its type in the world. It is due for completion in 1978 and will provide its users with a unique facility.

The Synchrotron Radiation Facility has to share NINA with the high energy physics users. A specialised synchrotron radiation source, comprising a 2 GeV electron storage ring is now under active consideration. The machine would provide up to 10 beam lines to replace the 2 available in the present facility.

The Laboratory has an advanced computer system based on an IBM 370/165 computer connected 'on line' to a number of small computers associated with the various experiments and other activities.

Users of the Laboratory come from universities all over the country and from abroad.

Address for enquiries Mr H. Rothwell OBE Secretary, Daresbury Laboratory, Daresbury, Warrington, WA4 4AD
Telephone Warrington (STD code 0925) 65000, extension 235

Royal Greenwich Observatory

Founded in 1675, the Royal Greenwich Observatory is by far the oldest of the Council's establishments. Because observing had become difficult due to artificial lights, smoke and pollution over London, the Observatory was moved in 1957 from Greenwich to a new site at Herstmonceux Castle in Sussex where it considerably broadened its activities. As a result of the recent SRC review of astronomy, space and radio research, the RGO now has a three-fold role in the field of optical astronomy.

The first of these roles is to support university research particularly in the planning, construction and operation of major facilities for ground based optical astronomy. Thus the Observatory continues to manage the 98-inch Isaac Newton telescope which was inaugurated in 1967 and is the largest optical instrument of its kind in Western Europe. The INT and smaller telescopes at Herstmonceux are available to university and observatory astronomers alike. Astronomers and engineers at the RGO are contributing to the planning of a proposed Northern Hemisphere Observatory which it is hoped to build on a good site outside the UK. In addition the Observatory organises vacation courses for astronomy students from all over the British Isles and maintains close links with the Department of Astronomy of the University of Sussex.

The second role is to carry out research, with an emphasis on collaboration with university groups and research in complementary fields. Current research programmes are concerned with the motions of stars and attempts to explain these motions in terms of the mechanics of the Galaxy, with optical observations of quasars and X-ray sources, and with the chemical composition of stellar astrospheres. The third is to carry out other work in the national interest such as the Observatory's traditional work of determining time, measuring star positions and producing the Nautical and Air Almanacs.

Address for enquiries The Secretary, Royal Greenwich Observatory
Herstmonceux Castle, Hailsham, BN27 1RP
Telephone Herstmonceux (STD code 032 181) 3171, extension 206

Royal Observatory Edinburgh

The Royal Observatory Edinburgh combines a Council establishment and a University Department under the same roof. The Director of the Observatory is the Astronomer Royal for Scotland and Regius Professor of Astronomy at Edinburgh University. First established in 1818, the Observatory was raised to Royal status in 1822; it was greatly expanded in the 1960s.

Following Council's policy on the role of the astronomy establishments, the ROE has made valuable contributions in the field of automation, in the site survey for the NHO and in the operation of the 48-inch Schmidt in Australia. In addition, the Observatory complements the RGO by taking on special tasks involving the development of national ground-based optical facilities.

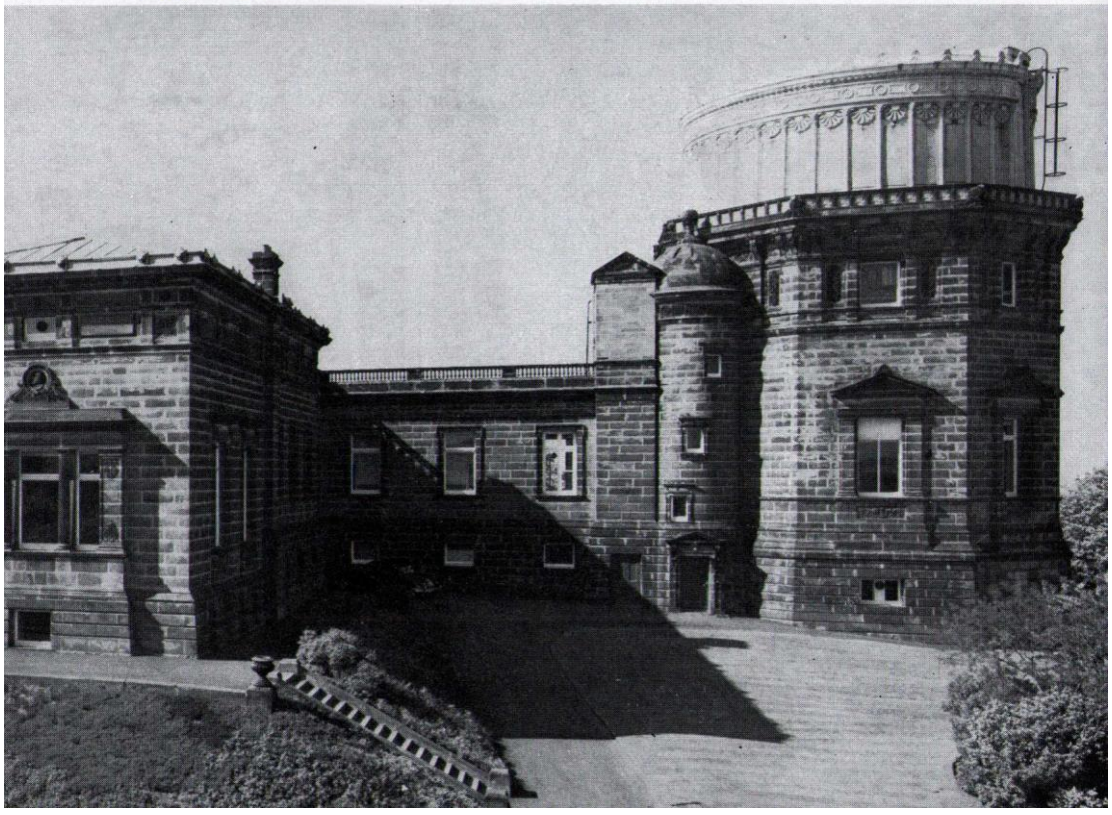
Advancements in automation attributable to the ROE include 'GALAXY', the first machine to bring complete automation to the precise measurement of star images on astronomical photographs. It has been used by many observatories throughout the world but is now being replaced by 'COSMOS' an even faster machine which can measure galaxies as well as stars at rates of

The Royal Observatory Edinburgh

up to millions a day. The Observatory has recently designed automatic guiding systems for telescopes and constructed site-testing instruments for use in determining a suitable location for a new Northern Hemisphere Observatory. These instruments have been used by teams of Edinburgh observers in various parts of the world. In addition the ROE has recently become responsible for the construction of a 3·8M Infrared Flux Collector.

The unit which operates the SRC's 48-inch Schmidt telescope in Australia is based at the ROE. Their first task is to carry out a southern sky survey leading to the publication of southern sky atlases in co-operation with the European Southern Observatory. The ROE's own instruments include a 36-inch reflecting telescope with spectrograph and image tube, and a twin 16-inch reflector. Two 16/24-inch Schmidt cameras are operated, one at Edinburgh, the other is at the Monte Porzio outstation in Italy which is run in collaboration with the University of Rome. A Michelson Stellar Interferrometer is also mounted at this station. Fields of study are the physics of stars and interstellar matter and the structure and evolution of the Galaxy. Observations are made in the optical, infrared and ultra violet ranges.

Address for enquiries The Astronomer Royal for Scotland, Royal Observatory, Blackford Hill, Edinburgh, EH9 3HJ
Telephone 031-667 3321



Rutherford Laboratory

The Rutherford Laboratory, which was founded in 1957, is a research centre providing on a national scale research facilities too large and expensive for individual universities to build and operate. The main field of research is high energy physics. Over 200 physicists from universities participate in the research together with resident high energy physicists. The domestic programme is carried out on beams derived from the particle accelerator Nimrod, a7 GeV proton synchrotron, which has been operational since 1964.

The Laboratory has a powerful computer installation to handle the immense quantities of data generated by high energy physics experiments. It is based on an IBM 370/195. Work stations, for remote submission of jobs, are installed at several universities and at the Council's Atlas Computer Laboratory.

The Laboratory also makes use of the Proton Synchrotron, the Intersecting Storage Rings and the Synchro-Cyclotron at CERN, the European Centre for Nuclear Research in Geneva, of which the UK is one of the 12 member states. Rutherford Laboratory staff have participated fully in the planning of new facilities at CERN, notably the SPS (the 300 GeV machine) and certain experimental devices.

A Neutron Beams Research Unit was set up in the Laboratory in 1971 to provide support for university programmes in neutron scattering research based on use of reactors at AERE, Harwell and AWRE, Aldermaston and at the Institut Laue-Langevin, Grenoble.

These activities are supported by a substantial programme of applied research on topics such as superconductivity, fast electronics and material fabrication techniques.

Address for enquiries Dr J. M. Valentine, Secretary, Rutherford Laboratory, Chilton, Didcot, OX11 0QX
Telephone Abingdon 1900, extension 469

A view of the interior of the Nimrod Magnet Hall showing a section of the large circular electro-magnet together with some of the beam lines used for transporting the high energy particles to the target area