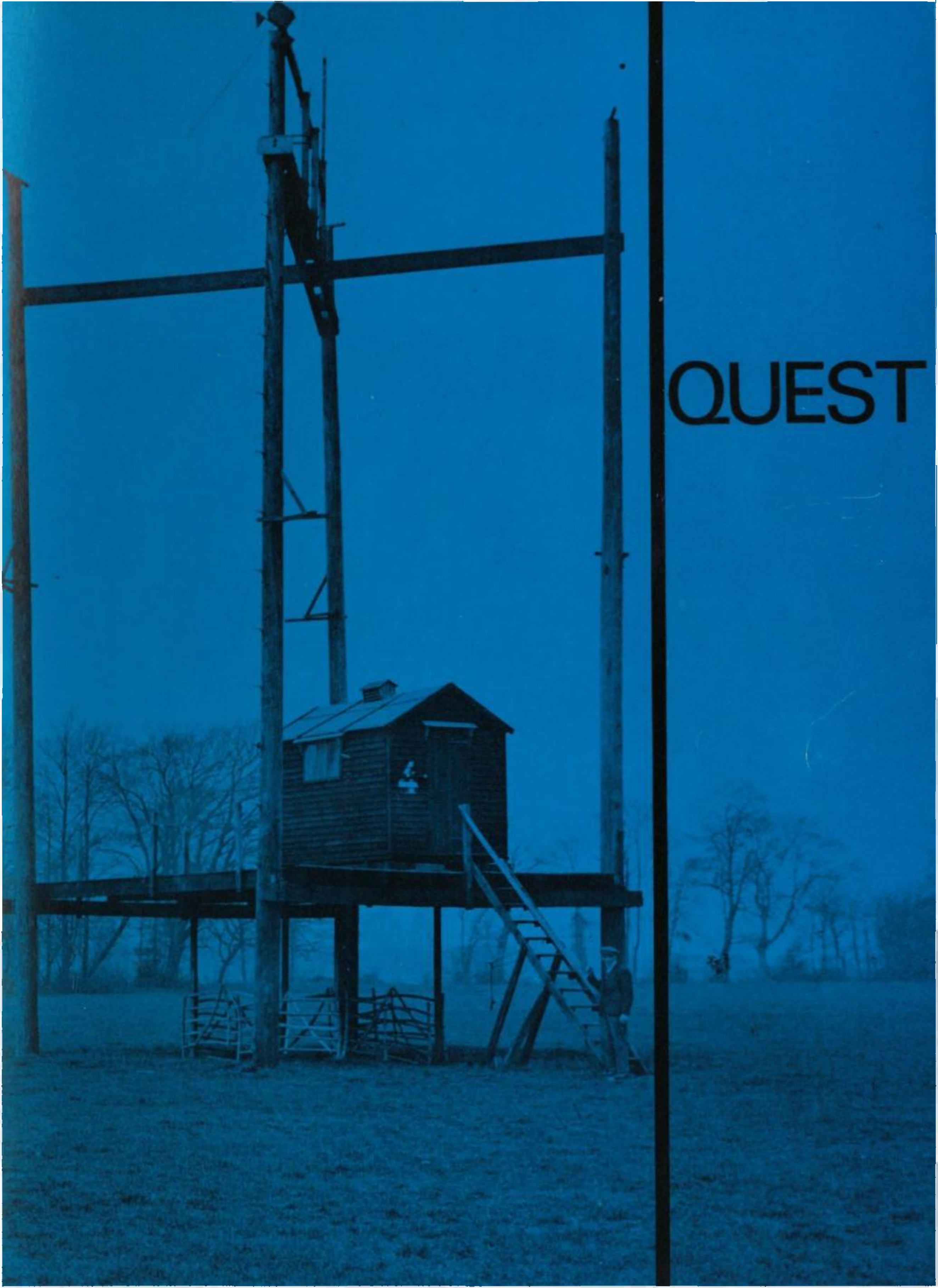

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QUEST

House Journal of the Science Research Council

Editorial Board

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contents

Cover

"The Tree House"

An early Smith-Rose experiment (circa 1929) using the Adcock system of direction finding. In order to ensure that the apparatus was in the electrical centre of the aerial, the platform was hoisted up between the guide poles and secured to the brackets.

editorial

Many factors contributed to the delays in the printing and distribution of the first issue, in many instances copies did not arrive in time to permit reasoned comment for publication in this issue. However, the editorial board met in London in February to discuss the general make-up of the journal and its future policy and they were able to present a fairly representative interpretation of the comments received. A summary of these will be found in the newsfront section.

First issues are always a problem, but now that we have overcome that particular obstacle and arranged firm printing and production schedules, future issues should appear promptlv at the beginning of each quarter, – July, October, and December, although we might decide to delay the December issue in order that we may report the Christmas celebrations in the various establishments.

The content of future issues will maintain the same basic formula of four or five technical articles, features, articles of general interest, further explanation of the organisation of SRC and a section which deals informally with news of people and interesting events.

It must be remembered that our brief is to produce a "house" journal. We do not set out to present a glossy image of SRC to the outside world; copies of the journal are intended for SRC distribution only.

We will endeavour to maintain a balanced content, but this will not be a prime consideration. For example, the first edition was predominantly astronomy but in a future edition when for instance we deal with a history of the Rutherford Laboratory, the content may be overwhelmingly high energy physics. We make no apologies for this, we have a broad spectrum of choice and it would be a pity to be restricted by fears of parochial affront.

'we must grant the artist his subject, his idea, his donnê : our criticism is applied only to what he makes of it'.

contributors

Edwin. N. Shaw
Head of Information, CERN. Formerly founder editor, 'Nuclear Engineering'.

G. W. Gardiner
Experimental Officer. Concerned with instrumentation and experimental physics, mainly in radio-meteorological field. Currently employed in RSRS solar radio astronomy laboratory.

Dr. P. F. Smith
Principal Scientific Officer, Rutherford Laboratory. Responsible for directing laboratory's research programme in superconducting magnet technology and studying future applications in high energy physics.

Dr. D. B. Thomas
Principal Scientific Officer, Rutherford Laboratory. Currently leading design study and development programme for proposed high field bubble chamber.

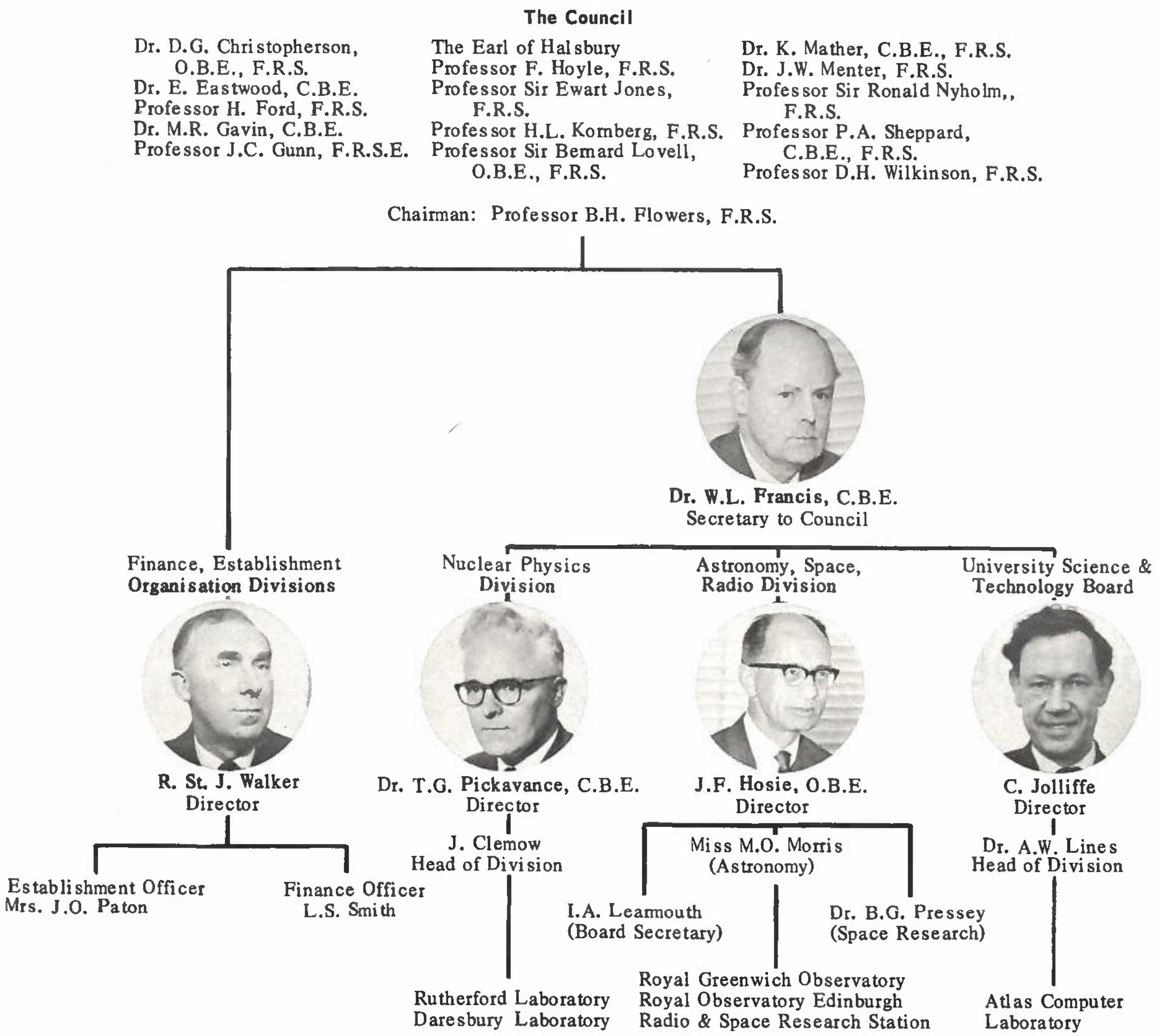
The origins & objectives of the SRC

Part 2
The London Office

In the first issue, we described how Council's work is organised through its Boards.

The work of the office is carried out through five divisions whose functions are illustrated by the chart.

The cost of this administration, including the fees and expenses of Council, Board, and Committee members represents about two percent of the expenditure of the SRC. In the current year, this will amount to about thirty-eight million pounds. The Nuclear Physics Division spends £16.5 m., ASR £9 m., and the UST Division, £11.7m. The annual report of the Council which is published in the autumn of each year describes the work of the Council and the underlying policy. Copies of the report are obtainable through the Stationery Office or through your own library.



profile

Professor Sir Ewart Jones F.R.S.

Wayneflete Professor of Chemistry at Oxford University since 1965 and a Fellow of Magdalen College, Professor Jones is the Chairman of the University Science and Technology Board. Prior to the merger in 1965, he was a member of the Council for Scientific and Industrial Research and Chairman of the Research Grants Committee.

Born in 1911 in Wrexham, Professor Jones was educated at Grove Park School, Wrexham, the University College of North Wales and the University of Manchester.

• • •

Professor Jones obtained his first teaching post at the age of 27 when he was appointed Assistant Lecturer in Organic Chemistry at the Imperial College of Science and Technology. Soon after the outbreak of war, the Head of Department, Professor Heilbron became heavily involved in work at the Ministry of Supply and the Ministry of Aircraft Production and Professor Jones gradually had to take over the responsibility of running the Department.

Those years were exciting in many respects and whilst the world seemed bent upon its own destruction, it also had the effect of persuading many would-be undergraduates who might otherwise have applied for universities in the provinces, to remain in London close to their families. With the result that Imperial College produced a vintage crop of Chemistry graduates. Many of these one-time students of Professor Jones' now occupy Chairs of Chemistry at universities throughout the country. The Professor, recalling those hectic war years, when in addition to his normal tutorial duties, he trained nearly 2000 Gas Identification Officers, commented ruefully, 'like the Windmill, we seemed never to close!'

Professor Jones returned to Manchester University in 1947 as Head of the Department of Chemistry. He was the first Arthur D. Little visiting professor at the Massachusetts Institute of Technology in 1952 and since then has given lecture series at Illinois UCLA, Edmonton, New South Wales, etc. He has been awarded the Meldola (Royal Inst. of Chem.) 1940, Fritzshe (American Chem. Soc.) 1962 and Davy (Royal Soc.) 1966 Medals and honorary doctorates from several universities. He has been very active in the affairs of the Chemical Society, was its president from 1964-66 and is now Chairman of its Publications Board.

The Professor lives on the outskirts of Oxford, is married with a son and two daughters, all involved in academic careers. Recreation figures but lightly in the Professor's life; in his own words, he is fond of music, especially opera, likes walking in the countryside, gardening and photography, but has not time yet to take any pastime seriously.

The European Organization for Nuclear Research

Edwin. N. Shaw

Rebuilding and reconstruction were the preoccupations of the post-war years. New homes, new roads, new factories, new schools, new universities, new institutions. Replacement was not enough, the world had changed fundamentally. Socially the countries of Europe were going through a period of rapid evolution: at the political level, new alliances were being sought under the spectre of atomic energy.

Science had come down from its ivory tower with a vengeance, and physics, even to the lay man, was no longer a subject of purely academic interest but a dominating force in the world.

The balance of power was not wholly vested in the bomb. For the first time the relation between science and industry was concerning the leaders of European countries. The popular phrase "technological gap" had yet to be coined, but the disparities in technological achievement particularly between the United States and Europe were becoming appreciated. It was also being realized that a basic element in this difference was research.

In the late 1940's and the early 1950's the distinctions between the various aims of research were not always understood but atomic energy was recognized by all as a major growth point, offering on the one hand opportunities for discovery and development and on the other, the possibility of major commercial and political gain.

Even before the end of the war the UK had decided to establish its own independent nuclear weapon which later extended to an independent nuclear power industry with the consequent imposition of secrecy restrictions of military and then commercial origins.

Pure Research

This approach was to be followed elsewhere. But there was an early recognition that high energy physics was a field apart. Here was a subject where the old rules of science, of collaboration, of exchange, of co-operation, of openness, of mutual interest could still apply. Burgeoning out from the confused but wealthy springs of atomic energy the study of the fundamental nature of matter could become again, natural philosophy.

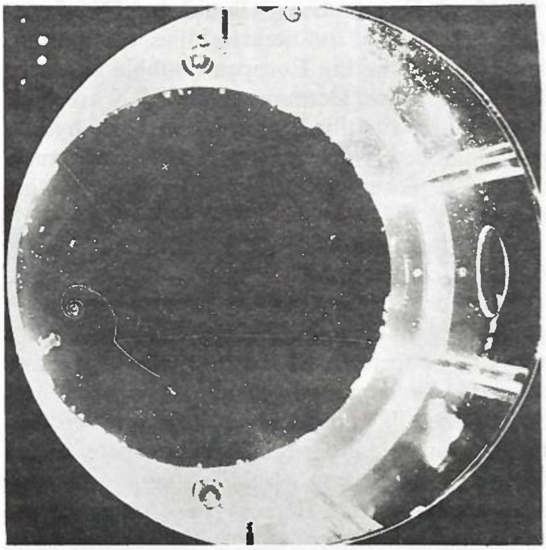
There was however a fundamental change coming over the science itself. Until the advent of the first major accelerator, the majority of new discoveries in the sub-nuclear range had come from the study of cosmic rays where the basic equipment was cheap and the means of research available to all. The arrival of the big accelerators changed all this, and physicists in Europe realized that if they were to have at their disposal, machines of comparable power and comparable interest to those which were being developed in the United States and the Soviet Union then a combined effort was going to be necessary. The urgency was perhaps less felt in the United Kingdom in view of the existence of the Harwell cyclotron, the Liverpool project, the Birmingham synchrotron project and the operation of the first 5 MeV electron linear accelerator at Malvern.

First Negotiations

Stimulated principally by Professors Auger and Amaldi, UNESCO took upon itself the job of bringing together the European governments to discuss the possibility of setting up a joint European nuclear research establishment. There was probably at that time in non-scientific circles some uncertainty as to its real *raison d'être* and the possible applications of its work, although it was recognized from the beginning that the time-scale associated with such applications would be long.

Amongst the scientists however there was little confusion—indeed the overall unanimity was remarkable. It was the sub-nuclear world that was of the greatest importance and the supreme purpose; the science itself and not the applications. So it is today.

At the UNESCO meeting in December 1951 and February 1952 the UK delegation led by Prof. G. P. Thomson was not completely in line with the other countries, as the UK was advocating the utilization by Europe of the laboratory being built at Liverpool. Some European participation at Liverpool was forthcoming, but when a Convention setting up a provisional Conseil Européen pour la Recherche Nucléaire (CERN) was signed at the second



A neutrino event in the heavy liquid bubble chamber.

UNESCO meeting, the UK retained the status of observer. This did not prevent UK scientists from taking an active part in the project and the report of Sir John Cockcroft in the Spring of 1952 on the progress that was being made with the Brookhaven machine was a profound stimulus. In the event, the Conseil was able at its sixth meeting in July 1953 (attended by UK 'observers') to agree a Convention establishing the European Organization for Nuclear Research (still called CERN).

In this interim period whilst Britain was clearly differentiated from the signatories to the provisional Convention, Prof. Blackett was a prominent figure in the discussions as was F. Goward from the Harwell accelerator group. UK sympathy was expressed by a gift of money to the Conseil made by Sir Ben Lockspeiser (then Secretary of DSIR) who was personally active in the drafting of the final Convention. Sir Ben was made Chairman of the first administrative and finance Committee and following the ratifications, became the first President of Council when in September 1954 the new Organization came into formal existence.

Britain was the first country to ratify the permanent Convention, eleven other states quickly following, viz : Belgium, Denmark, Fed. Rep. Germany, France, Greece, Italy, Netherlands, Norway, Sweden, Switzerland and Yugoslavia. The following year, Austria became a member of CERN and in 1961 Spain making the total 14. In June 1962 Yugoslavia had to withdraw owing to financial difficulties but retained the status of observer in company with Poland and Turkey.

Start of Construction

The Convention stipulated that two machines were to be built at the new laboratory near Geneva, one a Synchro-cyclotron of 600 MeV and the second a Proton Synchrotron whose energy was finally scaled up to 28 GeV. It was natural that British design teams should play a dominant role because only Britain in the early 1950's had had an opportunity of large scale accelerator design and construction. The early proton synchrotron group had in fact been set up under Prof. Dahl of Germany, but his deputy was F. Goward of the UK and under him J. Adams. The major influx of UK people was in October 1953 and for a time the comment could be heard in Geneva that CERN was that British laboratory out at Meyrin.

In the Organization, Adams was made head of the Proton Synchrotron Division and with the death of Prof. Bakker in 1960, became Director General. It is interesting to note also that the first experiments on both the synchro-cyclotron after it came into operation in September 1957 and then 2 years later on the P.S. itself were made by teams led by Prof. A. W. Merrison now of Liverpool (Director of DNPL) in conjunction with Prof. Fidecaro.

UK contribution

UK participation therefore in the growth of CERN during the first years was heavy, not to say massive, but the demands made by the design and commissioning of Nimrod and its subsequent operation, followed by Nina, led to a smaller use of the experimental facilities than might have been expected.

The UK financial contribution is based simply upon its net national revenue in comparison with the other member countries and is currently established at 22.16%. This remains fixed regardless of the number of UK employees at CERN (10%) or the number of experiments made on the machines. Similarly there is no correlation between this investment and the number of contracts which are placed with UK companies. Contracts are placed by CERN for equipment on a straight-forward price basis providing that technical competence and delivery times are also acceptable. Concern has been expressed in the UK for example, by the special Committee of the British Nuclear Forum at the small number of contracts going to Britain (amounting since 1952 to approximately $4\frac{1}{2}$% of the total) but this is an expression of lack of interest on the part of British industry rather than evidence of any differentiation or absence of technical competence in the UK

Developments at Meyrin

The second major step in the development of CERN Meyrin was the decision by the CERN Council in December 1965 to add to the 28 GeV Proton Synchrotron (PS), Intersecting Storage Rings (ISR) to allow collision beam physics to be undertaken at a centre of mass energy of 56 GeV. To achieve the same interaction energy in a conventional accelerator using a stationery target would require a beam energy of 1700 GeV. The British at that time gained the reputation of being luke-warm on the project and adopting the same un-European attitude that had been adopted towards Euratom and certain ENEA projects.

It was not generally realized that for legitimate scientific reasons, UK physicists were in general more anxious to go ahead with a 300 GeV accelerator and feared that the interposition of this major project—costing more than twice the original PS—would prejudice the chances of the next big accelerator. The present postponement of a decision on this project, partly as a result of the need to reconsider UK overseas commitments in the light of devaluation, gives some point to this attitude. It should neverthless be said that the ISR which are scheduled for completion in 1971 look progressively more and more attractive and should provide Europe with a quite unique experimental machine for much of the 1970's.

In addition the 'improvements programme' to augment the performance of the PS is now getting under way. During the coming summer shut-down, the new PS power supply will be coupled in, allowing a threefold increase in repetition rate. Work has begun too on the booster injector which will raise the injection energy into the main ring from the 50 MeV output of the linear accelerator to 800 MeV. This will allow a tenfold increase in the beam current. Other immediate projects of a major nature include the installation of Gargamelle, the 12 m^3 French heavy liquid bubble chamber at the end of the neutrino line, for start up in 1969, and the big European bubble chamber to which France, Germany and CERN are each contributing one third. This 3.7 m, 22 m^3 hydrogen chamber with a superconducting main magnet is scheduled to go into operation at the end of 1971.

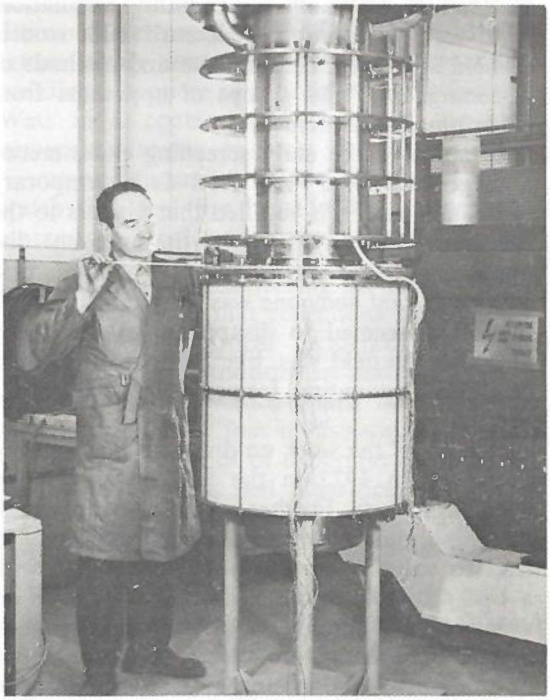
CERN's contribution

The world of fundamental physics has undergone startling changes in the years since CERN was first conceived. At that time the number of so called fundamental particles was small and the number of anomalies in their apparent behaviour sufficiently restricted for there to be hope that elucidation would follow in a reasonably short period. But, as has happened so often before in physics, an era of apparent order has given place to a period of growing confusion.

The number of so-called fundamental particles or resonances now approaches 200 and we are still some way from providing a sufficiently clear pattern of experimental evidence for adequate theoretical explanations to be forthcoming.

In this scene of mounting complexity, and mounting interest, CERN has enabled European physicists to play a leading role. It is not so much that individual experiments conducted at CERN are unique in the world as that in the growing pool of knowledge, the contribution of physicists in Europe, working with the CERN machines, has been at least on a par with that from other laboratories. Certain experiments, have, perhaps, become a CERN speciality such as muon physics including its electron and Beta decay and the measurement of the gyromagnetic ratio to ever increasing accuracy to determine in what way the muon can be distinguished from the electron other than by its mass. The missing mass spectrometer has provided direct information of the existence of many resonances which could be said to bear a specific CERN hall-mark.

Probably the most publicised experiment at CERN was the one which gave the negative result that charge conjugation was not violated in the three pion decay of the eta meson—the statistics of the CERN experiment being an order of magnitude better than those obtained in the US upon which provisional evidence of such violation was based. The existence of a sudden change at approximately 10 GeV of the proton-proton wide angle scattering cross-reaction is another result where CERN's effort has been dominant as also in the use of polarized targets. The very recent run of neutrino experiments is also unique and the analysis of the 90 free proton-neutrino events photographed during the period is awaited with keen anticipation. Nevertheless this is a field where world research moves forward together.



CERN has made many contributions also to theoretical advance but, so great is the collaboration between the senior laboratories, the distinctions between them and their results are continually blurred. It suffices to say that in the big league of world sub-nuclear physics, CERN is considered to be among the leaders —even perhaps at this moment, the top laboratory.

Maintaining Impetus

Its position does of course depend upon the machinery it has at its disposal and the quality of the physicists who come to use it. The majority of these are from the universities and research centers of Europe and the process is one of positive feedback; the better the machines, the better the physicists, and the better the physicists the better the work done on the machines. So it is natural that with a 70 GeV accelerator coming into operation at Serpukhov in the Soviet Union and work going ahead rapidly on the 200/400 BeV American machine, there should be anxiety amongst European physicists over delays in reaching a decision on the 300 GeV project.

Undoubtedly the attitude of the UK is crucial. From the scientific point of view a clear answer in favour of the project has been given; the vital question remaining is finance. Whilst only 3 countries have stated their intention of joining the project so far – Austria, Belgium and France, there seems little doubt that a clear cut assent on behalf of the UK could be decisive in influencing the remaining nine. As in the past, so in the present, Britain is in a position to play a key role in the future of CERN.

Left. Braracourcix, an experimental superconducting magnet for tests prior to freezing the 3.7 m bubble chamber design.

A History of the Radio and Space Research Station

Situated in the grounds of Ditton Park, a 'Domesday' manor on the edge of Slough in Buckinghamshire the station is bounded by the A4 and Slough to the North and the M4 which runs within feet of the South entrance. Windsor Castle and Eton College chapel are visible when winter denudes the screen of trees, London Airport is a too-close 7 miles away and Reading lies 20 miles to the West.

For nearly fifty years Ditton Park has been the scene of continuing investigations into the problems of radio propagation and allied subjects; dating back to the formation in 1920 of the Radio Research Board which was constituted under the DSIR to 'direct any research of a fundamental nature that may be required, and any investigation having a civilian as well as a military interest'.

The Board first met in February of 1920 and as a result, four sub-committees were formed to deal with Propagation, Atmospherics, Direction Finding, and Thermionic Valves. Among the famous people composing the first board were Lord Rutherford and Admiral of the Fleet Sir Henry Jackson, who was perhaps mainly responsible for the station being sited at Ditton Park. On the sub-committees were more famous names, among them Appleton, Smith-Rose and Watson-Watt. Admiral Jackson, the first Chairman was an enthusiastic and successful experimenter in wireless signalling; he was outstripped by Marconi and probably hindered by the need to observe security regulations, but his interest in the subject never flagged. It is said that during the nine years of his chairmanship he personally read every official paper produced by the Board's research workers.

In 1920 the Ditton Park site was manned by one scientific officer and an assistant, under the supervision of the NPL. A year later a translator with scientific qualifications joined them to produce abstracts for monthly circulation. The work was mainly concerned with studies of field strength measurements and methods of screening units and groups of apparatus from electro-magnetic fields.

In some of the early screening experiments, a large iron pipe was used as a temporary laboratory and it is recalled that visitors to the site were often mystified by the apparent disappearance of scientists engaged on the work. At one instant someone was visible in the Park then they seemed to disappear without trace, although the field was, like Prospero's Isle, full of noises emanating from this curious workshop!

Results of the work on direction finding were published in 1922 in the first of a series of special reports. Further studies were made of screening and 'experiments which are likely to lead to valuable results have been made with a coil rotatable about a horizontal axis'. This was work on the angle of arrival of RF energy, a type of investigation shortly to yield results of fundamental importance. Another directional experiment at this time was the simultaneous location by receivers at Ditton Park and Orfordness in East Anglia of a sender installed on 'a vessel of the Great Eastern Railway Company'. By this time the Board constituted five sub-committees, a further one having been formed to consider problems in wireless telephony. That year, at the International Conference on Scientific Wireless Telegraphy, it was decided to adopt the committee's programme as suitable for international research.

The years 1925-27 were of great importance to the science of Geophysics because it was in that period that Appleton and his co-workers proved the existence of an ionised layer at a height of about 80 Km., soon to be followed by the discovery of a further layer at a height of some 250 Km. Workers at Ditton Park had provided a great deal of the substantiating evidence relating to the existence of the ionosphere (christened thus by Watson-Watt) which was to occupy the attention of research workers for many years to come.

Two events occurred at the end of this period which had a profound effect on the workers at Ditton Park. The trinity of Direction Finding, Field Strength and Atmospheric Research were combined to form the Radio Research Station with Watson-Watt as Superintendent. The second event was a catastrophic fire which destroyed the Station's 210ft. wooden lattice tower and many of the surrounding buildings. A quote in caustic terms by Watson-Watt in a contemporary issue of the local newspaper seems to sum up the situation. '. . . arrived in time to do nothing useful but to watch the local fire brigade do a remarkable amount of needless damage!'

In the course of observing the ionosphere, it had been noticed that reflections were obtainable at nearly vertical incidence, so it was arranged that a transmitter and receiver be placed a short distance apart, one at Ditton Park and the other four miles away in Windsor Great Park. A series of experimental measurements of heights and densities of ionised layers was undertaken which gradually developed into an observational routine.

Meantime, a method of ionospheric investigation using radio wave pulses had been started in America and experiments were made at Slough to compare it with the continuous wave method employed by Appleton. The first transmitter was based on a simple, self-pulsing valve oscillator derived from a time base circuit produced at Slough for a Cathode Ray Oscillograph. This device was the ancestor of the modern automatic ionospheric sounding equipment.

It was eventually operated exclusively at Slough and when, shortly afterwards, an improved pulse transmitter developed by Ratcliffe and White was installed, the Ionospheric Laboratory may be said to have been truly established.

During the Second International Polar Year (1932-33), a party from Ditton Park operated equipment from Tromso and a loan of equipment was also made to Ratcliffe of the Cavendish Laboratory in Cambridge. Subsequent analysis of the collected data suggested that solar ultra-violet light accounted for the normal ionisation of the two main regions of the ionosphere and for the daily and seasonal variations. Abnormalities at lower levels might be due to charged particles entering the atmosphere and being acted upon by the earth's magnetic field. There was found to be a high correlation between thunderstorm activity and an increase in ionisation in the lower layer.

1933 saw the amalgamation of RRS and the Wireless Division of NPL to become the Radio Department, with Watson-Watt as Superintendent. Two years later, in January of 1935, Watson-Watt was approached by H. E. Wimperis of the Air Ministry to investigate the possibility of radiating energy at a sufficient flux density to cause damage to an aircraft or its occupants—the dreaded "Death Ray" of science fiction!

The impracticability of the suggestion was demonstrated when it was shown that to raise the body temperature of a man 600 yards away by two degrees in ten minutes, would require 5,000 MW of power. Even if practical transmitting powers were considered, the size of the aerial system to give the same effective radiated power, would have been prohibitive. These facts were communicated to the Air Ministry by Watson-Watt and in a final paragraph he said 'Meanwhile, attention is being turned to the still difficult, but less unpromising problem of radio detection . . . and numerical considerations on the method of detection by reflected radio waves will be submitted when required.'

The AM was intensely interested in these 'numerical considerations' and required them as soon as possible. Watson-Watt and co-worker Wilkins (now Deputy Director of RSRS) therefore calculated the amount of energy capable of being reflected from an aircraft when it was illuminated by realisable transmitter powers. The answers gave them grounds for supposing that a detection scheme was practicable even if the results were an order of magnitude smaller than predicted. Consequently on February 12th 1935 Watson-Watt prepared a draft memorandum entitled 'Detection and Location of Aircraft by Radio Methods'.

This communication has been called one of the most prophetic scientific documents ever produced. It stated the case for detection by reflected radio energy; showed the importance of pulse techniques in determining distance, and proposed the use of rotating beams to provide a system showing range and direction on a cathode ray oscilloscope display at a single station. The eventual desirability of using shorter wavelengths and a possible means of distinguishing between friend and foe was also considered.

The memo had an immediate effect upon the defence experts and an ad hoc experiment was arranged for the 26th February. Apparatus from Ditton Park, was positioned near the BBC's 50m transmitter at Daventry which was to provide the energy to illuminate a Heyford aircraft which was to fly on a pre-arranged course along the axis of the beam transmitted from Daventry.

Watson-Watt and A. P. Rowe of the Air Ministry, together with an assembly of defence experts were to watch the experiment. At 0945 hrs. on February 26th the aircraft duly appeared, not quite on the pre-arranged course, but near enough to reflect detectable energy into the receiver and a detection range of eight miles was estimated.

'Considering the crude nature of the apparatus and the lack of preparation, the results obtained were quite creditable'. Rowe was moved to exclaim that it was the most successful experiment he had ever witnessed. 'It was clear to all who watched the tube on that occasion that we were at the beginning of great developments in the art of air defence'. (A more detailed account of the experiment is contained in an article Wilkins wrote for Electronic Engineering). (Vol. 30, 1958).

An immediate result of the experiment was a strict security blanket and the movement of the relevant staff to Orfordness in East Suffolk where they formed the nucleus from which grew the vast complex of radar. The original apparatus used in that experiment was rescued from a store hut in Ditton Park, refurbished and presented to the Science Museum in 1958. For the benefit of the technically minded, the equipment was essentially a receiving system so arranged that the main Daventry signal was minimized. However, the Daventry signal reflected from the aircraft, arrived at a different angle to the aerial system, so was not much affected, and a signal appeared in the receiver which was displayed on the cathode ray oscilloscope.

The outbreak of war accelerated the evolution of the Ionospheric Forecasting Service to supply predictions of parameters to aid long-distance communication. The observatory which originated in the early '30's gradually acquired improved techniques which covered a range of ionospheric sounding from 0.5 to 20 Mc/s made at hourly intervals and recorded photographically.

The original sounding apparatus was operated manually and had a range of 2.5 to 5 Mc/s in steps of .1 Mc/s. The sounder of the mid-40's was not unlike present equipment, in which transmitter and receiver are kept in tune electromechanically, whilst the apparatus sweeps over the 20 Mc/s scan in about five minutes. It was at this time that an Ionospheric Substation was installed at the BBC transmitting station at Burghead, Scotland to provide additional information for the prediction service.

After the war it was realised that it was time to consider a revised programme of research more suited to the estimated needs of the future and in 1946 a report was submitted by the Board to the Committee of the Council for Scientific and Industrial Research.

It was implicit in this report that the direct connection which had long existed between the Radio Research Station and the National Physical Laboratory should cease and that the Department should have its own director. This was agreed and the Radio Research Organisation was formed with Dr. R. L. Smith-Rose as its first director.

Sir Henry Jackson, F.R.S.

First chairman of Radio Research Board. Admiral of Fleet 1919.
Pioneer worker in wireless telegraphy. Responsible for equipment of many naval vessels with wireless installations 1900.

Sir Robert Watson-Watt, F.R.S.

Superintendent Radio Research Stations DSIR 1921-33; Supt. Radio Dept. NPL 1933-36; Supt. Bawdsey R.S. 1936-38. Director of Communications Development Air Ministry 1938-40. Responsible for development of UK radar systems.

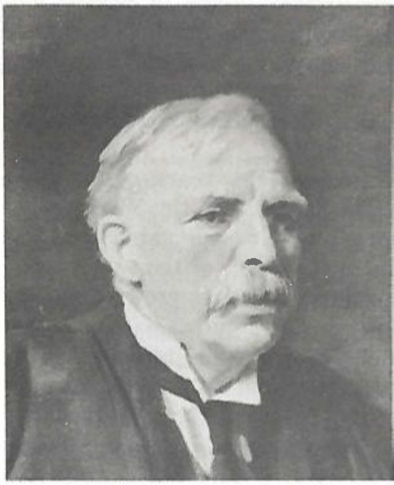
Dr. R. L. Smith-Rose.

Superintendent RRS 1936-48. Pioneer work in radio direction finding and study of radio wave propagation. First Director Radio Research Organisation 1948. Ret. 1960. President International Scientific Radio Union 1960-63.

Some of the famous people who have been associated with R.S.R.S.

Member of original Radio Research Board. Chairman Advisory Council DSIR 1930. Pioneer worker in radio transmission. Disintegrated the nitrogen atom with alpha particles from radium. Nobel Prize for Chemistry 1908.

Lord Rutherford of Nelson, F.R.S.



Director R.S.R.S. 1960-1966. Hon. Fellow of Sidney Sussex College and formerly Reader in Physics at Cambridge University. Associated with Appleton in pioneer studies of the ionosphere.

J. A. Ratcliffe, F.R.S.

Secretary D.S.I.R. 1939-49; Principal and Vice-Chancellor of the University of Edinburgh. Played major part in creation of science of ionospheric physics. Nobel Prize for physics 1947.

Sir Edward Appleton.

A number of outstations had already been set up and now more followed; the ionospheric observatory at Burghead was closed and replaced by one near Fraserburgh. In the southern hemisphere at Port Stanley, Falkland Islands, RRS personnel took over in 1947 an ionosonde station previously operated by the Royal Navy. In the next year, a similar installation commenced operation in Singapore for measurements in the equatorial region. In March of the same year the operation of low-powered apparatus at Port Lockroy in Grahamland provided the first ionospheric observations ever to be made in Antarctica. Nearer home, sites at nearby Sunnymeads and Winkfield were being used for directional measurements.

The increasing diversity of the work being handled by the Station accelerated the decision to build a new laboratory capable of combining the facilities previously supplied by the NPL with those existing at Ditton Park. There were known technical disadvantages attached to the Slough site and for some years, a thorough examination of alternative sites had been made; however, the investigations provided nothing materially superior to Slough so a start was made on a new laboratory in the West Park of Ditton Park in 1954. It was inaugurated with due ceremony in June 1956 and the man invited to perform the ceremony was Sir Edward Appleton who had long been associated with the Department and had made many great contributions to ionospheric research.

The International Polar Year of 1882-83 had been followed half a century later by a similar venture in 1932-33, in which staff and apparatus from RRS played a significant part. These two events had taken place at periods of minimal sunspot activity; now, after a period of twenty-five years, an International Geophysical Year was planned. This was to be a programme of observation and experiment not confined to the Polar regions, but extending over the whole globe during a period of sunspot maximum.

Within two weeks of being officially opened, the Station was thus committed to play a most important part in the enterprise. One of the four World Data Centres for the collection and exchange of ionospheric information was established at Slough and the activities of RRS now ranged from Singapore and Nigeria to South America and the Antarctic.

On the 4th October 1957 SPUTNIK, the first artificial earth satellite began to orbit the earth, so providing a completely new tool for investigating the earth's environment. Whereas to some it appeared as a prodigy of fear and a portent', to the Ditton Park workers it was an opportunity for a quickly contrived experiment in which bearings were taken on the satellite's transmitter. The apparatus used was the cathode ray direction finder, a device invented by R R S.

It is true to say that ever since about 1894 when Lodge used 'Hertz wave' methods in an attempt to detect long wave emission from the sun, radio workers have been concerned with events outside the immediate atmosphere. All the ionospheric work and the solar noise experiments of 1948 have made space science no new thing to Ditton Park, but now it was possible to place apparatus actually within these regions.

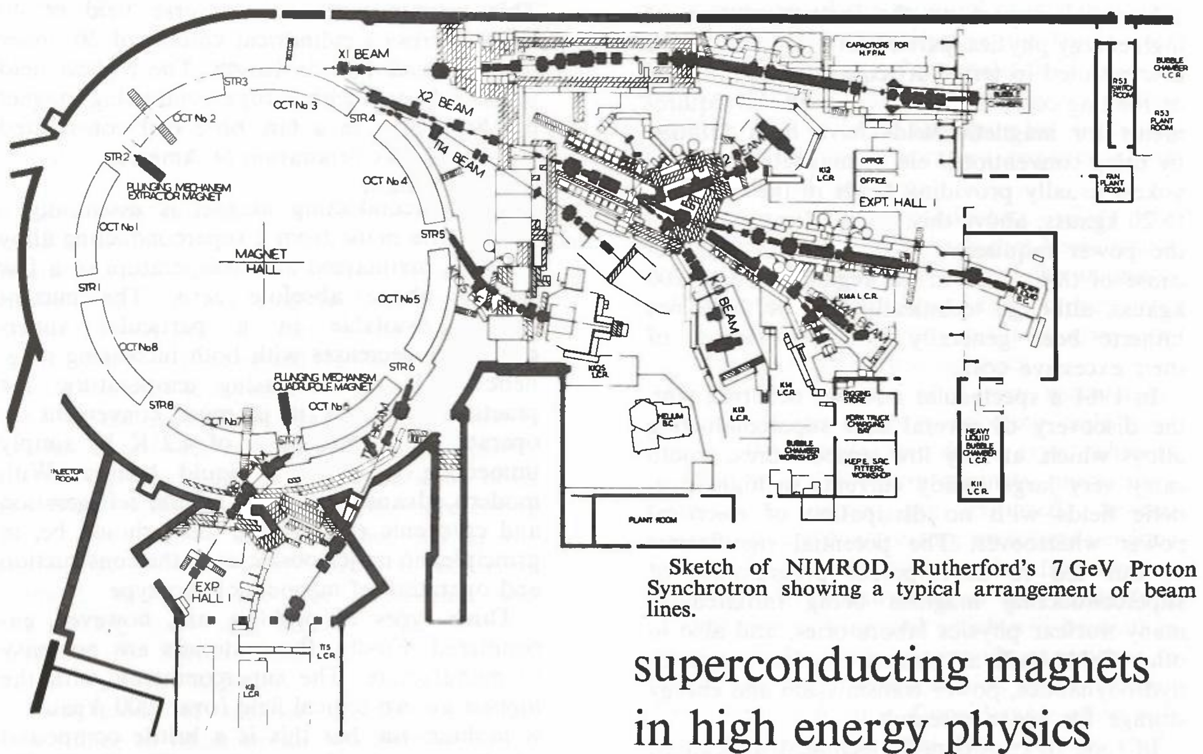
SPACE was added to the Station's title in 1965, appropriately because of the considerable interest in research on the propagation of radio waves through the troposphere and ionosphere, which had now been extended to include regions beyond the ionosphere.

In addition to what might be regarded as classical studies of propagation and their application to communication problems, new techniques arising from the developments in space research began to be used to improve the knowledge of the properties of the atmosphere important for an understanding of propagation phenomena and to undertake basic investigations of solar-terrestial relationships.

Currently about half of the work of the Station is concerned with space research; it has its own experiments flying in rockets and satellites. The satellite orbit prediction service co-operates with others on a world-wide basis and at the outstation at Winkfield, R.S.R.S. controls the main U.K. centre for satellite tracking and data acquisition.

So to 1968—forty-eight years of development, accelerated by two World Wars and a sphere of polished metal whose plaintive 'bleep-bleep' fired the imagination of the world.

The staff at Ditton Park has grown from the original two workers to almost 300. In recent years the output of papers published by the Station has risen to about fifty, covering subjects infinitely more diverse than those earlier contributions so carefully studied by Admiral Jackson.



Sketch of NIMROD, Rutherford's 7 GeV Proton Synchrotron showing a typical arrangement of beam lines.

superconducting magnets in high energy physics

P. F. Smith
D. B. Thomas
Rutherford High Energy Laboratory

In recent years in the high energy physics laboratories of the world, a large number of elementary sub-nuclear particles have been discovered by studying the interactions produced when suitable targets are bombarded with beams of charged particles from giant accelerators. These accelerators and their associated equipment use highly sophisticated experimental techniques, which rely on the use of magnetic fields in a variety of ways.

For example, during acceleration in a proton synchrotron, the particle beam is confined to a closed circular orbit by a ring of powerful electro-magnets. After acceleration, the primary beam can be either extracted from this circular orbit and directed at a target, or made to impinge on a target in the machine. In both cases secondary particles are produced and these have to be transported to experimental equipment often situated a hundred feet or so from the accelerator. Here again magnetic fields play an important part, magnetic lenses provide the necessary focusing; and bending magnets are used to steer the particles along the desired paths. In other experiments, separated beams consisting only of particles of the desired type and momentum are selected from the wide spectrum of secondary particles. For such beams, a bending magnet with collimating slits is used in an analogous fashion to a glass prism in an optical spectrometer. In the nuclear experiments themselves, the momenta of particles created by interactions within the experimental apparatus can often be determined by measuring the actual curvature of the paths of the particles in a known magnetic field. An elegant example of this type of apparatus is the bubble chamber, where the curved tracks of charged particles can be seen as lines of minute bubbles in a superheated liquid. The entire liquid volume is immersed in a high magnetic field and measurement of stereo photographs of the curved tracks allows the momenta of the particles to be calculated.

Any technological breakthrough in the generation of higher magnetic fields would have a substantial impact on the instrumentation of high energy physics, particularly so if economies also resulted in terms of reduced capital outlay or running costs. So far virtually all the requirements for magnetic fields have been fulfilled by using conventional electromagnets with steel yokes, usually providing fields in the range 10 to 20 kgauss; above this, the steel saturates and the power requirements increase sharply. Because of this, fields in the region of 30 to 200 kgauss, although technically feasible, have not hitherto been generally available because of their excessive cost.

In 1961 a spectacular advance occurred with the discovery of several new superconducting alloys which, at very low temperatures, would carry very large steady currents in high magnetic fields with no dissipation of electrical power whatsoever. The potential significance of this led to development programmes of superconducting magnets being initiated in many nuclear physics laboratories, and also in other fields such as plasma physics, magneto-hydrodynamics, power transmission and energy storage for space research.

In spite of considerable technical difficulties, much progress has been made, and already a liquid helium bubble chamber of 10 inches diameter equipped with a pair of superconducting coils giving a field of over 40 kgauss has been used in nuclear physics experiments at Argonne National Laboratory in America. A polarized target with a superconducting magnet has been used in experiments at Cambridge Electron Eccelerator, Massachusetts. One of the largest super-conducting magnets yet to be successfully tested was built by the Avco-Everett Research Laboratory, in the U.S.A. This magnet gives a transverse field of 40 kgauss across a cylindrical volume of 2ft. inner diameter and 10ft. in length. The highest field so far achieved with a superconducting magnet is 140 kgauss, in a 6in. bore coil constructed by the Radio Corporation of America.

Present Status.

A superconducting magnet is essentially a coil of wire made from a superconducting alloy which is maintained at a temperature of a few degrees above absolute zero. The current density available in a particular superconductor decreases with both increasing magnetic field and increasing temperature; for practical purposes it is most convenient to operate at a temperature of 4.2°K by simply immersing the coil in liquid helium. With modern advances in liquid helium refrigeration and cryogenic engineering, there should be, in principle, no major obstacles to the construction and operation of magnets of this type.

Three types of problem are, however, encountered. Firstly, the materials are not easy to manufacture. The superconductor with the highest known critical field (over 200 kgauss) is niobium-tin, but this is a brittle compound which cannot be drawn into a wire. Somewhat easier to handle are the strong and ductile alloys niobium-zirconium and niobium-titanium which are suitable for fields up to 80-90 kgauss. These can be made into strong wires but require special manufacturing techniques to achieve the required high current densities. Secondly, the superconducting state tends to be unstable under the conditions existing in large coils, and intensive efforts are being made to understand and eliminate this effect. Thirdly there are several major mechanical and electrical problems to be faced in the design of large

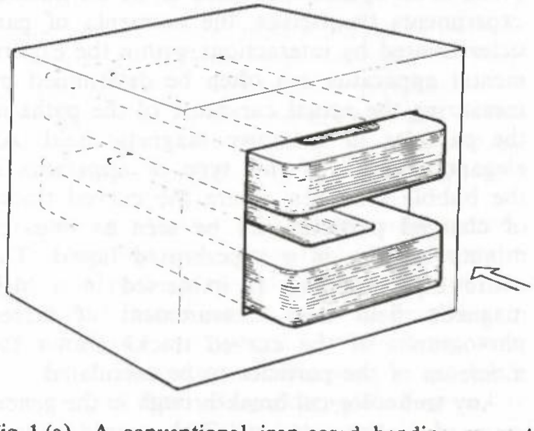


fig 1 (a) A conventional iron-cored bending magnet.

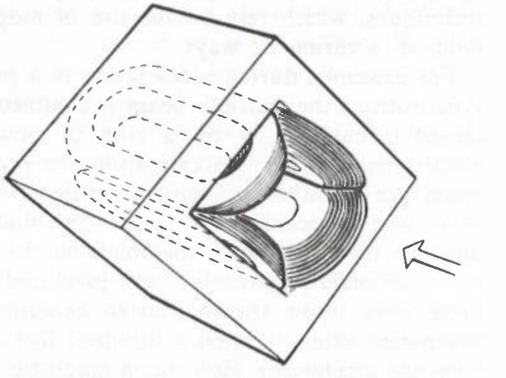


fig 2 (b) A conventional iron-cored quadrupole focussing magnet.

superconducting coils. Perhaps the most significant of these is the containment of the large electromagnetic forces on the windings at high magnetic fields and the need for protection circuits to extract from the coil most of the stored energy in the event of an accidental transition to the normal (resistive) state.

As an indication of the present position, small coils up to about 10 cm bore are now in common use, coils up to 30 cm bore can be constructed and operated without too much difficulty, and several coils in the region 2-5 metres bore are expected to be constructed during the next few years.

So far the demand for superconductive alloys has been relatively small and has yet to justify really large scale production. Processing costs are high, with the basic metals representing only a fraction of the total cost, but as the technology becomes established the increasing demand will decrease the conductor and engineering costs and larger, more powerful magnets will become possible.

Beam Transport Magnets.

Two kinds of magnet are of particular importance in beam optics, the first, generally known as a bending magnet (fig. 1a) provides a channel of uniform field and is used to change the direction of a particle beam and also to select particles of the required momentum; the second, known as a quadrupole (fig. 1b) provide a special distribution of magnetic field to focus the particle beam. Typical sizes are 1-2 metres length, with a 10-20 cm aperature for the beam; a large accelerator laboratory requires about 150 magnets of this type.

The use of superconductors offers the possible advantages that the higher fields would allow a reduction in the size of the magnets, and, if produced in large enough numbers, would reduce the capital cost and give considerable savings in running costs.

Development is still at a very early stage, since so far most superconducting coils have been of the simple cylindrical type, whereas for bending and focusing magnets, much more complicated shapes are required. Several laboratories are constructing prototype versions however and fig. 2 shows a bending magnet which will be constructed at the Rutherford Laboratory this year and which will be used in actual particle beams to provide experience in the engineering, instrumentation and operation of this type of magnet. Considerable effort will be made during the next few years to study and simplify the design of these types of magnet so that they can be produced reliably and economically in large numbers.

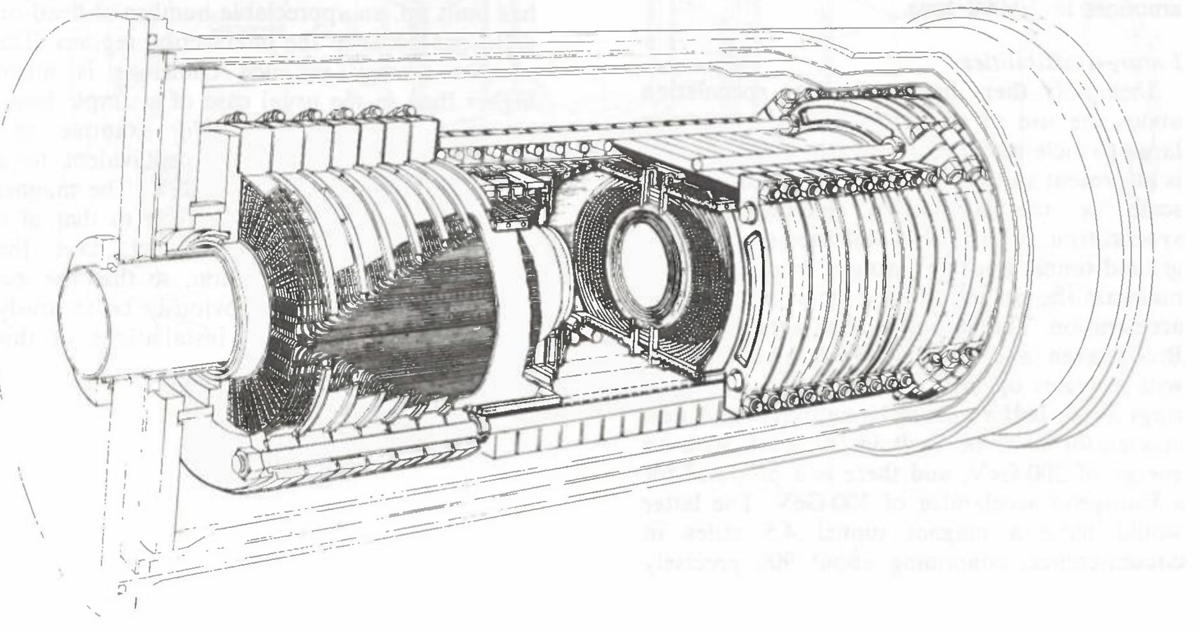


fig 3 Impression of a superconducting magnet now under construction at the Rutherford Laboratory.
The coils are shaped to produce a uniform field of 40 - 45 kgauss in a channel 140 cm. long by 18 cm. diameter.

Bubble Chamber Magnets

The new generation of hydrogen bubble chambers will all be equipped with superconducting magnets. It is the advent of this type of magnet which has made possible chambers of the size now contemplated, because the cost of powering conventional coils to produce magnetic fields of the required magnitudes and volumes would be prohibitive. There are at present two large magnets under construction in the USA and several others are at an advanced stage of planning in Europe and Russia. An artist's impression of the proposed 1.5m diameter high field chamber for the Rutherford Laboratory is shown in fig. 3. By modern standards this is a chamber of rather modest dimensions but it will be equipped with a superconducting magnet capable of providing an unusually high field strength of 70 kilogauss throughout the working volume of the chamber.

With these large coils, the engineering problems which dominate the design are principally those connected with the mechanical constraint of the massive electromagnetic forces within the windings, which amount for example to almost 4,000 tons for each of the two coils in fig. 3. In addition, to allow access for beams of particles, it is necessary to separate the coils typically by 20cm, and they must then be held apart against the attractive force between them which amounts to 10,000 tons.

Future Possibilities

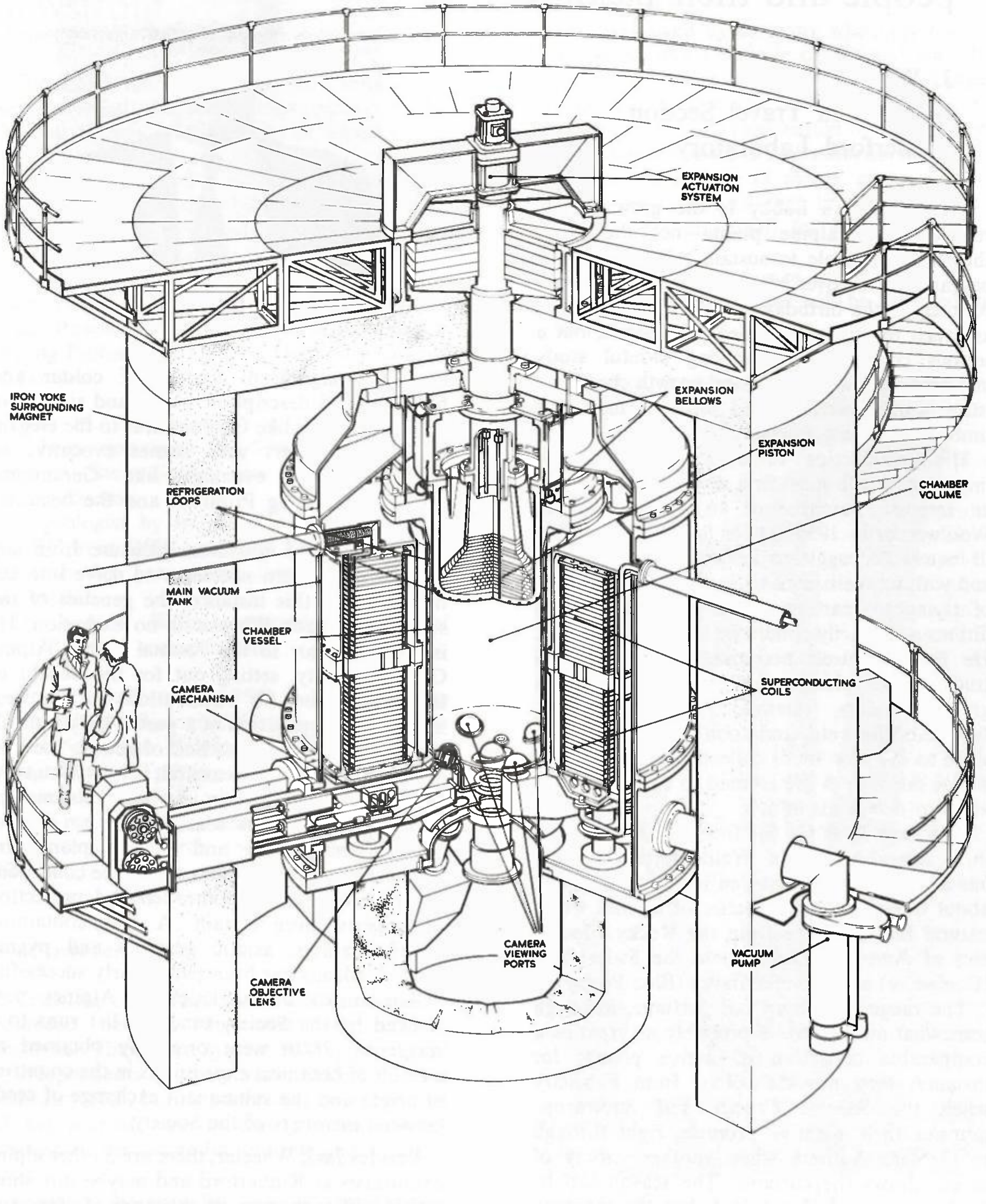
Inevitably there has been some speculation about the use of superconducting magnets in large particle accelerators. The only type which is at present suitable for construction on a large scale is the alternating gradient proton synchrotron; its principal feature is an underground tunnel housing a ring of magnets which maintain the particles in a circular orbit during acceleration. The largest existing accelerators at Brookhaven and CERN which give particles with energies up to 30 GeV* and have magnet rings about half a mile in circumference. A new accelerator is to be built in the USA with an energy of 200 GeV, and there is a proposal for a European accelerator of 300 GeV. The latter would have a magnet tunnel 4.5 miles in circumference, containing about 900 precisely aligned individual magnets, each 6m. long. The magnets alone will cost £16 million and the estimated capital cost of the project is £148 million.

These magnets have to be operated in a pulsed manner, in contrast to the previously discussed applications which are all d.c. It is not yet clear whether suitable superconducting magnets of this type can be developed. If they can, then the higher field should allow a large reduction in the diameter of the magnet ring and there should be a significant lowering of overall cost. An alternative idea is the possibility of converting a conventional accelerator to a higher energy. For example, a 300 GeV machine built in the near future would have to use conventional magnets; but in ten to fifteen years' time, with superconducting technology in a more advanced stage, these might be replaced by high field magnets, thus converting the machine to perhaps 1,500 GeV at only a fraction of the cost of a completely new machine of this energy.

Another possible accelerator application would be the use of superconducting magnets in particle storage rings. In this technique, beams of particles from an accelerator are fed into two intersecting rings of d.c. magnets; the two beams of particles circulate continuously and when a sufficiently high density of particles has built up, an appreciable number of head-on collisions occur in the intersection regions. The effective energy in such collisions is much higher than in the usual case of a simple beam hitting a stationary target; for example, two colliding 30 GeV beams are equivalent to a single beam of energy 2,000 GeV. The magnet rings are similar in type and size to that of a particle accelerator, but do not have the problems of pulsed operation, so that the use of superconductors will obviously be seriously considered for any large installations of this type in the future.

** 1 GeV is equivalent to acceleration by 10^9 volts.*

This is an edited version of an article which first appeared in Nature, Vol.216. 9.12.67.



Impression of proposed new hydrogen bubble chamber for the Rutherford Laboratory. A pair of cylindrical coils produced a field of 70 kguass, uniform to a few percent, over the working volume of the chamber 1.5m. diameter by 1 m. deep.

people and their pastimes

J. Wheeler
Claims and Travel Section
Rutherford Laboratory

Jack Wheeler's hobby is the growing and cultivation of alpine plants—not the usual short-lived struggle to sustain the knock-down bargain due to over-exposure on a self-service counter, or the birthday or Xmas present given as a last resort by well meaning friends, but a serious commitment involving careful study into propagation methods and growth characteristics which has absorbed most of his spare time for the past fifteen years.

His introduction to the hobby began as innocently as do most first acquaintanceships—an impulse purchase of an Edelweiss from Woolworths in 1953. There followed the usual ill-matched struggle to keep the plant healthy and without realising it he took up the challenge of trying to rear an exotic plant under conditions not exactly conducive to healthy growth. He found himself becoming engrossed in a study of the plant's natural environment, its growth habits, method of propagation, susceptibilities, etc. and soon became a happy slave to his now small collection of tiny plants whose one aim in life seemed to be a determination to defeat his efforts.

Jack now lives not far from the Laboratory, in a semi-detached in Wallingford where he has a 600 sq. ft. rock garden in which he grows about three hundred varieties of alpines who's natural habitat range from the Rocky Mountains of America (Lewisias) to the Swiss Alps (Edelweiss) and the Himalayas (Blue Poppy).

The range of colour and perfume, although somewhat attenuated, is probably as great as a comparable collection of native plants; for instance, they provide colour from February when the Species Crocus and Snowdrops murmur their plantive promise, right through to the late Autumn when another variety of crocus draws the curtains. The season can be further extended if required, but the majority of people are not too keen on 'gardening' in the snow. In between these extremes of season there is magnificent variety of colour and blooms of all description, shape and size, from the spiky thistle-like Carduncellus to the elegant Irises, and others with names evocative of balmy summer evenings like Geraniums, Dianthus, Evening Primrose and the beautiful Campanulas.

To obtain the maximum pleasure from any pastime, it is often necessary to delve into the theory, or in this instance, the genetics of the subject and Jack Wheeler is no exception. He is a contributor to the Journal of the Alpine Garden Society, setting out for the benefit of fellow devotees, his observations on the best method of propagation of a particularly difficult subject, or a proved method of getting the best results from the beautiful, but 'finickety' Lewisias which has been exercising his imagination for the past few seasons.

The most minute and difficult plants are successfully grown in sinks where the conditions can be more closely controlled and protection from pests more certain. A sink containing dwarf heathers, asiatic gentians and pygmy rhododendrons has been particularly successful.

Almost all the varieties of Alpines now stocked by the Society (and the list runs to a staggering 2840) were originally obtained as a result of botanical expeditions in the countries of origin and the subsequent exchange of seeds between members of the Society.

Besides Jack Wheeler, there are 3 other alpine enthusiasts at Rutherford and maybe this short article will encourage an exchange of ideas and comment among devotees in other establishments of the SRC

Newsfront

The Chairman, Professor B. H. Flowers, has been awarded the Rutherford medal of the Physical Society and Institute of Physics.

Professor C. F. Powell, Chairman of the Nuclear Physics Board, has been awarded the 1967 Lomonosov gold medal, the highest award of the Soviet Academy of Sciences.

Dr. J. A. Saxton, Director of the Radio and Space Research Station, has been appointed a visiting Professor of Physics, University College of London.

Miss M. O. Morris of the London Office has been appointed an SPSO in the ASR Division. She will have special responsibilities for Astronomy.

A geologist by training, Miss Morris came to SRC from DSIR and until her new appointment, she has been responsible for the Council Secretariat.

Dr. J. A. V. Willis, previously Secretary of the NP Board succeeds her.

Dr. W. G. Potter, a PSO in charge of the Chemical and Biological Group, UST, and the Secretary of the Halsbury Working Party on Postgraduate Training Awards, has been appointed an SPSO. In his new post, Dr. Potter will be responsible for developing the industrial relevance of research projects supported by SRC.

post mortem

Criticism of the first issue was fairly evenly balanced between the technical and the aesthetic. They were synthesized by the Local Correspondents at a meeting at State House on February 14th, during which the general format of the journal was discussed as well as the content of the issues for the remainder of this year.

Much of the criticism was self-cancelling as one might expect with such a wide readership, but these are the outstanding observations :—

Uneven printing and non-uniform type size :
These are acknowledged faults and will be rectified in future issues.

Colour of cover :
This was liked by as many who objected to it. Colour was a definite choice and not left to the discretion of the printer. It will change with each issue to suit the cover picture.

Not enough detailed explanation of the work of the Observatories and Laboratories, how they fit into the scheme of things, etc. :
If we dealt with all that in the first issue, there'd be nothing left for future issues . . . give us time.

No description of author of article :
Short biographical notes will be included in future issues.

"Meridian" a modern sculpture by Barbara Hepworth which is an integrated architectural feature of State House.

Civil Service Recreation Centre,
Monck Street, London, S.W.I.

The CSRC is situated in one of the new tower blocks at present being built on the Horseferry Road site. The entrance is in Monck Street.

The Centre will cater for a great many facets of Civil Service Sports Council activities and seems destined to become the 'home base' for all people connected with Civil Service sport. It will provide club and recreational facilities for many civil servants in the Central London area and for members visiting London.

The space available for the Centre is on two floors and in planning the use of it, the upper floor has been regarded in general as the social part, allying casual recreational facilities such as table tennis, billiards, darts, skittles, with social facilities like bars, light refreshments, lounges, etc. The lower floor has been used to cater for the more specialised sporting requirements such as rifle range, match table tennis rooms, gym, cricket and golf nets, etc.

The Planning Committee has catered for as many interests as possible whilst remaining flexible as regards future developments in the light of changing interests. For example, the Exhibition Room for art, photographic, and other displays, can be used as a cinema or lecture room seating fifty people. It can also be used as a TV room for special large audiences, e.g. for test matches.

The younger members will be specially catered for, they will have certain rooms allocated for their particular interests, i.e. discotheque, record sessions, informal dancing.

Rutherford Laboratory Chess Club

Thirty-eight players have taken part in a four month Swiss tournament to decide the title of Rutherford Chess Champion. Played during the lunch periods, the tournament attracted a great deal of interest and ended with an exciting tussle which produced not one but two champions!

The title was shared between Bill Turner of the Applied Physics Bubble Chamber Group and Dr. John Davies who is in charge of the K12 beam line. Each won five games and drew three.

As a result of the tremendous interest shown in the tournament, and in chess generally in the Laboratory, a club has now been formed to organise future tournaments and to arrange matches with other clubs. Further information can be obtained from P. Craske, ext. 225.

If the same degree of interest in chess exists in other SRC establishments, it ought to be possible to arrange 'postal' competitions, they should'nt be too difficult to organise. How about it....? Ed.

As we intimated in the previous issue, the Local Correspondent for the Daresbury Laboratory has been changed. The production of the Bulletin is now a Library commitment and as the editor is obviously in a good position to act for Quest; Mrs. J. Peatfield has taken over from Mrs. Chisholm.

Jill Peatfield spent five years with UKAE at Winfrith before joining the Daresbury Laboratory in November 1964. Recently promoted to Executive Officer, Jill now works in the library and is responsible for the production of the weekly Bulletin.

Dr. J. A. Saxton, Director of RSRS, presenting the first prize in the Station's first ever apprentice's prize-giving ceremony, to R. Dorey. The standard of work was so high that the runners up, R. Adlam (l) and A. Thackray, both received awards.

Science Research Council, Sports and Social Association

The association was inaugurated on 10th March 1967, and became affiliated to the Civil Service Sports Council on 1st May 1967.

The following clubs have been accepted into membership of the association.

Atlas Computer Laboratory
Daresbury Nuclear Physics Laboratory
London Office
Radio & Space Research Station
Royal Greenwich Observatory
Rutherford High Energy Laboratory

The Royal Observatory Edinburgh are affiliated to a regional association which is more suitable for their requirements.

Through the S R C association, clubs will be able to apply for financial assistance for development of their facilities from the Civil Service Sports Council.

The committee of the association, which consists of four officers and a representative from each club, will meet at least three times a year to consider any matter placed before it by a club.

The aims of the association are to :

1. Act as co-ordinating body between sports and social clubs within the association for the purpose of encouraging the pursuit of amateur sport and recreation.
2. Liaise between the various clubs within the association and the Civil Service Sports Council.
3. Encourage the formation of clubs within the S R C at establishments where none exist.

All members of clubs affiliated to the association are eligible to play for the Civil Service in representative matches. If any club has a member who is outstanding at a particular sport, the Secretary should forward details to the secretary of the association.

The Civil Service Sports Council also arranges inter-departmental competitions in most sports, and it is hoped to enter S R C teams in these events.

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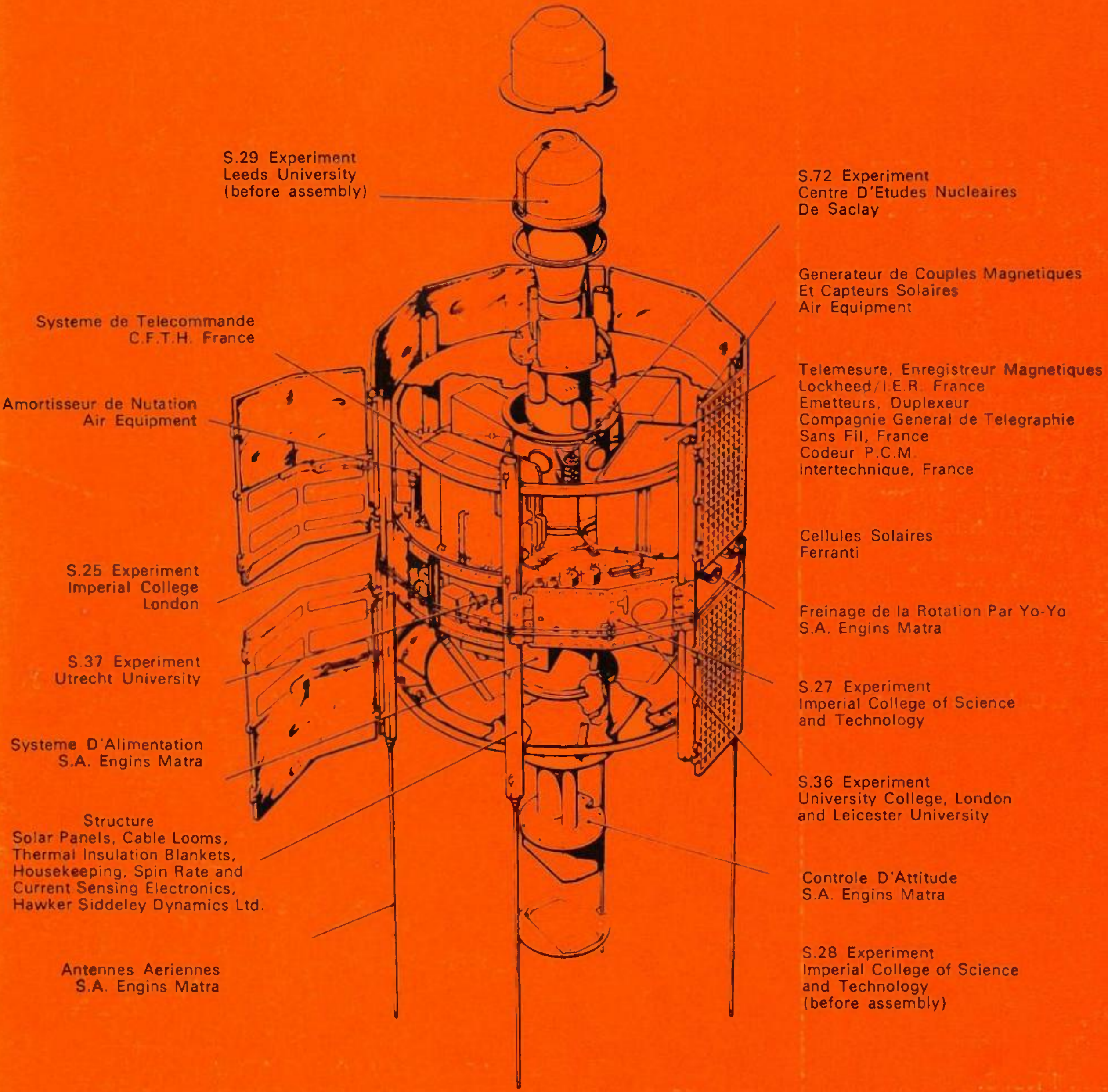
S.29 Experiment
Leeds University
(before assembly)
S.72 Experiment
Centre D'Etudes Nucleaires
De Saclay
Generateur de Couples Magnetiques
Et Capteurs Solaires
Air Equipment
Systeme de Telecommande
C.F.T.H. France
Amortisseur de Nutation
Air Equipment
Telemesure, Enregistreur Magnetiques
Lockheed/I.E.R. France
Emetteurs, Duplexeur
Compagnie General de Telegraphie
Sans Fil, France
Codeur P.C.M.
Intertechnique, France
Cellules Solaires
Ferranti
S.25 Experiment
Imperial College
London
Freinage de la Rotation Par Yo-Yo
S.A. Engins Matra
S.37 Experiment
Utrecht University
S.27 Experiment
Imperial College of Science
and Technology
Systeme D'Alimentation
S.A. Engins Matra
S.36 Experiment
University College, London
and Leicester University
Structure
Solar Panels, Cable Looms,
Thermal Insulation Blankets,
Housekeeping, Spin Rate and
Current Sensing Electronics,
Hawker Siddeley Dynamics Ltd.
Controle D'Attitude
S.A. Engins Matra
Antennes Aeriennes
S.A. Engins Matra
S.28 Experiment
Imperial College of Science
and Technology
(before assembly)

QUEST

House Journal of the Science Research Council

Editorial Board

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A. Powell

L. C. Jenkins (Editor)

Vol. 1 No. 3.

July 1968

contents

A 'FIRST' IN EUROPEAN CO-OPERATION

ESRO II the first satellite to be produced on a European co-operative basis was successfully launched from the Western Test Range (USA) at three o'clock on Friday, May 17

The proposed 300 GeV accelerator

A message from the Chairman

The Government decision that the UK should not participate in the proposed European 300 GeV accelerator is, inevitably, a set-back to the Council's scientific plans even though we know that it was taken after very careful consideration. The Government fully appreciated that the project was well conceived and that their scientific advisers favoured participation but they were concerned at the effect which it might have on the balance of resources between high energy physics and other scientific activities. In view of the economic circumstances and the implications of the recent devaluation of sterling, the Government finally decided that expenditure on the project, rising to about £6m a year, would not be justified.

I am sure that many members of the staff will share my disappointment at the decision and my hope that when the economic situation has improved we will be able to participate in a major European high energy physics project.

Meanwhile the decision does not affect our other activities. Indeed, Government policy favours civil science relative to other forms of public expenditure, as is shown by the fact that our provisional allocation of funds for 1969/70 is about 6% higher than the current grant. Thereafter we can, I believe, look forward to continued modest growth so long as we continue to make good use of the resources entrusted to us.

Brian H. Flowers

the Mullard Space Science Laboratory University College London

E. B. Dorling

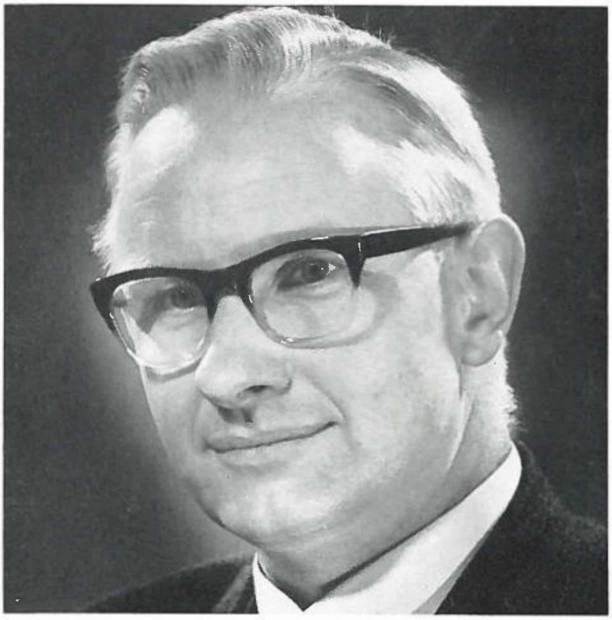
It is fitting that 1967, the year which marked the tenth anniversary of space research in this country, should also have seen the opening of the first laboratory devoted wholly to space science. The Mullard Space Science Laboratory came into being through a gift to University College London by Mullard Limited (whose help had already been marked in the related field of radio astronomy by the creation a few years earlier of the Mullard Radio Astronomy observatory at Cambridge). It was equally fitting that the Mullard Space Science Laboratory should have been opened by Dr. F. E. Jones, FRS, Managing Director of Mullard Limited, for, as Deputy Director of the Royal Aircraft Establishment, Farnborough in 1954–1955, it was with his support that the Skylark rocket was designed and developed. The first firing of this rocket, at Woomera in February 1957, can be said to have marked the start of the British space research programme.

University College London was involved in this programme from the very beginning. Indeed Professor Sir Harrie Massey, FRS, head of the Department of Physics at University College London, and Professor R. L. F. Boyd, who now heads the Mullard Space Science Laboratory, can be said to have initiated the programme by arranging in 1953, at Oxford, the first ever conference in this country on upper atmosphere research. (The nomenclature incidentally has changed with the years from upper atmosphere research to high altitude rocket research to space research and space science). The Oxford conference brought to this country a group of American scientists who, since 1945, had pioneered the new techniques of rocket research, and they inspired scientists and technologists in Britain to reconsider what start might be made, however modest, in this exciting new field of research. In June 1955 Treasury support was agreed to cover the design and provision of rocket vehicles by the Royal Aircraft Establishment, and also the cost of the experimental investigations. A working party met regularly at the physics department at UCL to plan the details of the programme. Many experiments were proposed and among the first was the so-called grenade experiment by Professor R. L. F. Boyd, which measures high level winds, temperatures and pressures by observing, at a number of points on the ground, a series of grenades fired from the rocket along the trajectory. In addition Professor Boyd proposed to fly a mass spectrometer for ion sampling in the ionosphere.

From these beginnings Professor Boyd built up over the next five years a group of scientists and technicians at UCL which had as its special study the structure of the neutral atmosphere and ionosphere. Little attention was paid at that time, however, to a topic which now dominates the laboratory's work – the study of far ultra-violet and X-radiation from the Sun. There is a very close connection between the ionosphere and solar radiation, because the various layers of the ionosphere, that electrified region of the atmosphere which reaches upwards from 60 km or so above us, are largely created and maintained by solar radiation in the far ultra-violet and X-ray bands. The reason for the apparent neglect of solar studies in these first few years lay in the fact that the Skylark rocket in its initial form would not fly quite high enough to take instruments to a point where the Sun's radiation could be observed without atmospheric absorption. The rocket needed a more powerful motor. In addition it needed a pointing device to aim instruments at the Sun whatever motion the remainder of the rocket performed. Both developments were destined to appear, but meanwhile more important events were taking place which gave Professor Boyd's expanding group the opportunity it needed for a more rapid development of the new branch of solar studies. In 1958 the International Geophysical Year took place and with it came the launching of the first earth satellites. In 1959, such is the pace of technological developments today, the USA was able to offer help to the international scientific community at large in carrying out satellite experiments. The offer was taken up enthusiastically in this country by the recently formed British National Committee for Space Research, a Royal Society committee chaired by Professor Sir Harrie Massey, and in 1960 work began on the first co-operative US/UK satellite ARIEL I. This satellite was built by the National Aeronautics and Space Administration at the Goddard Space Flight Center in Maryland, and of the total of seven British experiments which it carried, five instruments were provided by Professor Boyd's group at UCL. Two made ionospheric measurements, one measured the satellite's angle to the Sun, and two measured solar ultra-violet and X-radiation. Besides providing the major part of ARIEL I's payload UCL also gave a home to the small Royal Society group seconded from the Ministry of Aviation, which managed the programme and which later grew into the Space Research Management Unit of the Science Research Council.

Ariel I was launched from Cape Canaveral (now Cape Kennedy) in April 1962, went into a good orbit, and continued to send back useful information for the next three years. The UCL X-ray experiment made the first measurements of the sudden hardening of the spectrum of solar X-radiation which occurs during the eruption of a flare. Although the instrument survived for only three weeks, it was the beginning of this new branch of astronomy which now occupies an important position in research at the Mullard Space Science Laboratory, as at many other laboratories throughout the world. The ionospheric instrument in ARIEL I survived much longer, (no doubt reflecting the group's greater experience in this field), and contributed greatly to the rapidly increasing knowledge of topside ionospheric density, temperature, and composition data resulting from the US/UK, the NASA Explorer and the US/Canadian Alouette programmes.

Following the success of this first venture into satellite research Professor Boyd and his colleagues were quick to take up the further opportunities of assistance which NASA was now



Professor R. L. F. Boyd, Ph.D.
Professor of Physics, UCL, Head of MSSL

making. By this time NASA had moved on to the preparation of a new generation of large and complex observatory spacecraft, designed to concentrate solar research, geophysical research and stellar research into separate specialised payloads. Basing their designs to a large extent on lessons learned in the ARIEL I work and the SKYLARK flights at Woomera, the UCL space research group submitted to NASA a number of experiment proposals for the observatory satellites, and it was the success of these proposals which ensured the subsequent growth of the group. Four experiments were selected by NASA for solar radiation studies from the Orbiting Solar Observatory, to be carried in the fourth, sixth and seventh of these remarkably successful spacecraft. In November 1967 the first two experiments, one measuring far ultra-violet radiation from the Sun, the other measuring X-radiation, went into orbit successfully in OSO–4. One ionospheric experiment was selected for the fifth Orbiting Geophysical Observatory, and a stellar X-ray experiment for the third Orbiting Astronomical Observatory. During the preliminary work for these major enterprises two invitations to instrument smaller Explorer satellites with versions of the ARIEL I ionospheric experiments were received from the Americans, and this led to the orbiting of a second ion mass spectrometer in Explorer XX in 1964, and a third in Explorer XXXI together with an electron temperature probe in 1965. Indeed with the various experiments now in preparation, the group hopes to make continuous ionospheric measurements from satellites for at least ten years.

Such continuity will be possible because of the group's considerable contribution to ESRO through its satellite and rocket programmes. Professor Boyd and Dr. A. P. Willmore, the deputy head of the laboratory, have been active in ESRO since its earliest days, and have had many experiments flown already in rockets from Kiruna, Andoya and Sardinia. A solar X-ray experiment was carried aboard the ESRO II satellite, launched on May 17, 1968, and an ionospheric experiment will be carried on ESRO I when it is launched later this year. Two experiments have been planned for the larger Thor-Delta satellite, TD2 whose fate at present hangs in the balance.

A section of the electronic workshop at Holmbury House. The payload for a Skylark 501 rocket can be seen on the right.

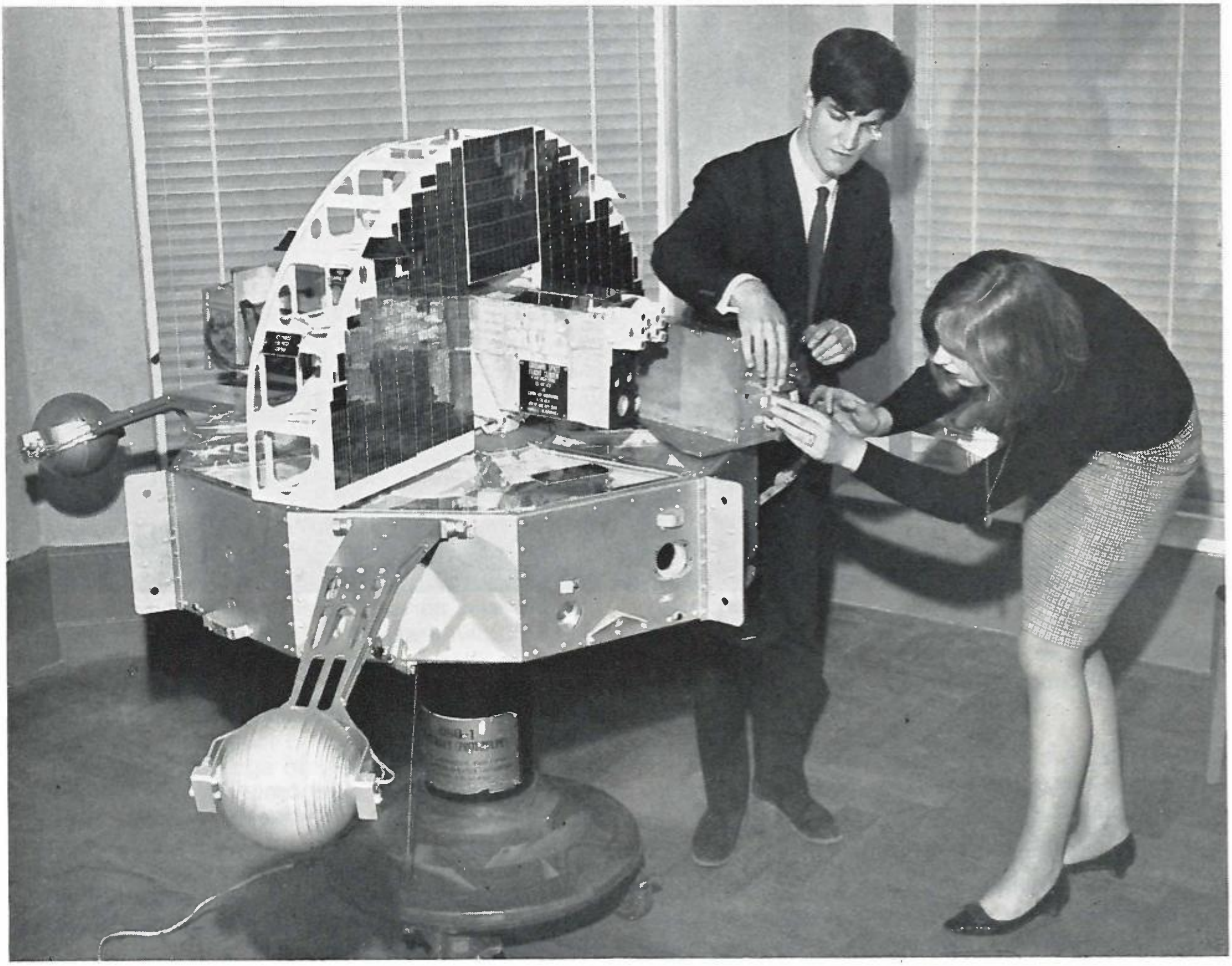
Meanwhile the national rocket programme still features many of the laboratory's experiments, from the complex solar ultra-violet experiments using pointed Skylarks to be flown from Woomera this year to the smaller experiments in the new SKUA II and PETREL rockets to be flown from this country.

Over a period from 1953 to 1968 the group has grown from one to a total of thirty-three scientists and thirty technicians. Demands on space at the physics department in Gower Street UCL increased as the satellite programme got under way, and hopes of a separate home for the group where for the first time all members could be under the same roof became a reality with the donation by Mullard Limited in 1965. This enabled the College to purchase a country mansion pleasantly situated in thirty acres of ground at Holmbury St. Mary, near Dorking. The conversion of the house, with the help of funds provided by the University Grants Committee, called for little structural alteration but almost entirely new services. A progressive move from London began late in 1965 and by September 1966 was complete.

The association of SRC and the Department of Physics, University College London (of which the Mullard laboratory is a part) dates back to 1959. The current annual grant is about £200,000 and out of the total of sixty-three laboratory staff, twenty-nine are supported by SRC grants.

Professor Boyd is a member of the ASR Board, the committee of the Royal Observatory Edinburgh and a member of three working groups of the Space Policy and Grants Committee.

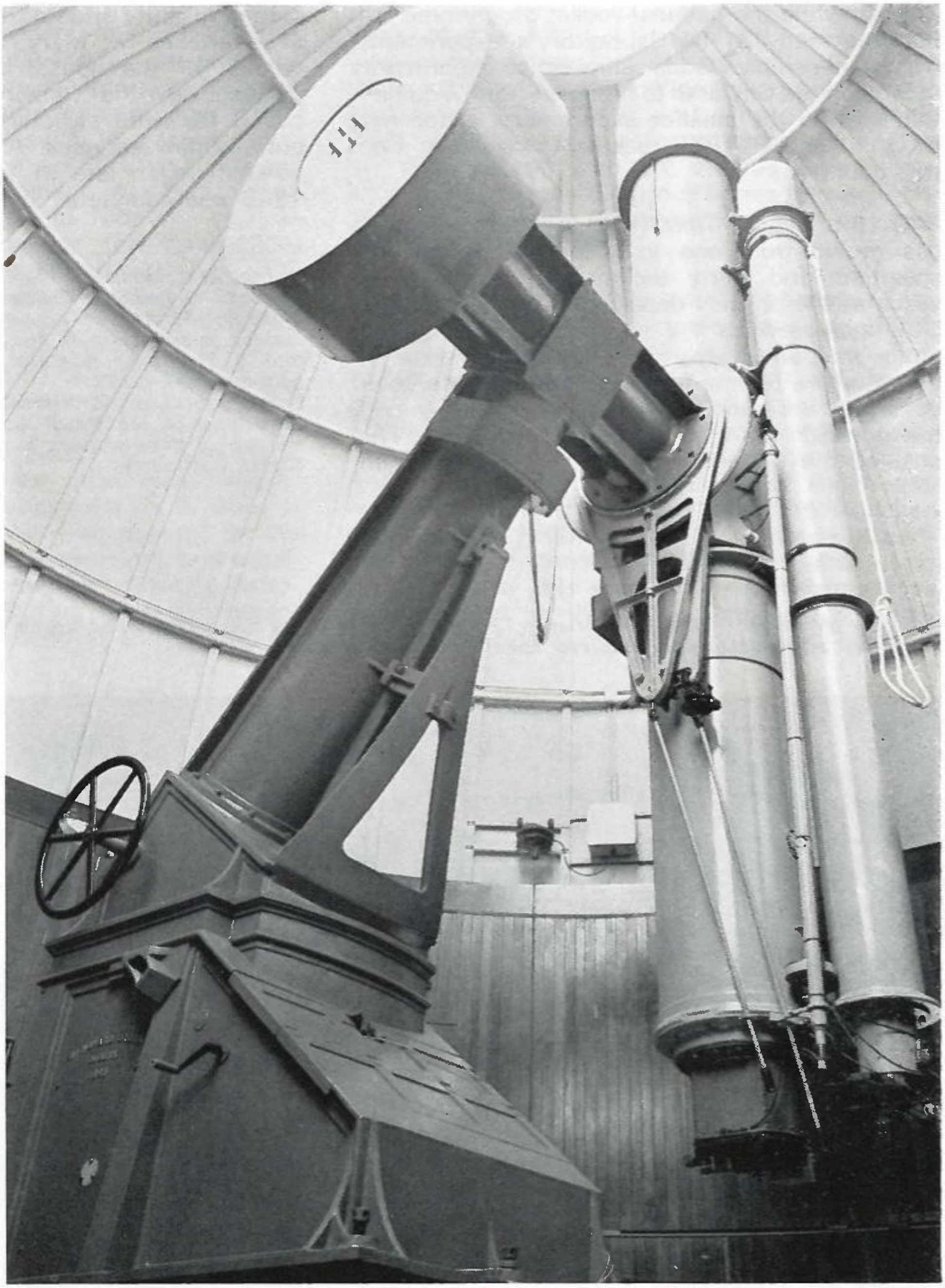
Graduate physicists Gethyn and Adrianne Timothy (claimed to be the only married couple working on space research) make final adjustments to a prototype model of an orbiting space laboratory.



Quasars

where... what... how... when... ?

Michael Penston



Most people will now have seen in the newspapers reports of objects called quasars which have been exciting great interest in astronomical circles. Exactly what are quasars, and why do we find them so interesting? The answer to the first question is still that we just do not know the basic cause of this phenomenon; we do not even know how far away they are. However it is possible to give some answers to the second question and set down some of the clues which have been uncovered and that in the next few years should lead to a deeper understanding of the quasars.

The word 'quasar' is probably a development of the initials QSRS, which stand for quasi-stellar radio source. The first excitement concerning quasars came in late 1963 with the discovery of these strange objects. At that time the Third Cambridge (3C) catalogue of radio sources had been produced by Professor Sir Martin Ryle's team at the Mullard Radio Astronomy Observatory at Cambridge. It had been discovered that a number of galaxies (great systems of billions of stars like our own Milky Way) were emitting a large amount of radio noise and were detected by 3C.

Since then of course the process of 'optical identification' of radio sources, whereby the radio sources are identified with an optical object seen or photographed by a conventional optical telescope, has continued and now about two thirds of the entries in the 3C catalogue are identified. However by 1963 it appeared that some of the radio sources might have their origins in stars in our own galaxy. At the positions of the radio source, photographs showed not a fuzzy image indicating a galaxy but a steller point image.

When the light from these stars was split into its component colours in the spectrograph, it revealed a familiar pattern of spectral lines, but shifted from their usual position in the spectrum towards the red. The usual interpretation of this 'red-shift' is that the object emitting the light is receding from us at high velocity and the phenomenon is familiar since it occurs in galaxies. It is found that the higher the red-shift the more distant the galaxy, indicating that a general expansion of the universe is taking place. It seemed natural to attribute the red-shift of the quasars to the same cause – the so-called 'cosmological' interpretation of the red-shift. However the surprise was that the nearest and brightest of the quasars were almost as distant as the furthest galaxies. Since then as we shall see later, other explanations for the red-shift have been mooted but the distance to the quasars remains uncertain.

Professor Maarten Schmidt of the Mount Wilson and Palomar Observatories has set out five defining properties of quasars which make them different from other stars. Firstly they are starlike objects identified with radio sources. Secondly they may be variable in brightness. Then they emit a large part of their energy beyond the blue end of the range of visual light, in the ultra-violet. They are also characterised by broad emission lines in their spectra. Lastly these lines are displaced far to the red of the colour at which we would expect to find them in the laboratory. Since these definations were made, two new discoveries have caused them to be modified. Objects resemble quasars in all their optical properties have been found remote from the positions of known radio sources so that the first property is changed to 'they are starlike objects usually identified with radio sources'. The second change is the discovery of absorption lines in the spectra of some quasars.

One of the main difficulties in understanding the quasars is that we do not know the distances to them. Let us review the usual methods astronomers employ in finding the distances to a new class of astronomical object. The first method used is that of parallax. Parallax is the name for the apparent change of position of a nearby object against the background as the observer moves. In the case of stars this movement can be detected as the earth orbits around the sun if the star is within about 300 light years of the sun. No parallax has been detected in any quasar so they are further away than this limit. Another similar method is the measurement of the proper motion of the star across the sky. If we have some idea of the velocity of the star this enables us to gain some notion of its distance. Again no proper motion across the sky has been detected for any quasar and since the high red-shifts of the quasars indicate velocities approaching that of light, we can conclude that the quasars lie outside our galaxy. Another method of determining the distance of astronomical objects useful for star-clusters and galaxies is from the recognition of a component of the object as a familiar type of star, usually a variable star, so that if the intrinsic brightness of the star is known, its apparent brightness enables one to estimate the distance. However useful this method is for galaxies, it does not work for quasars simply because no components can be distinguishable in a single starlike image.

So far one can see that we have scant guide as to the distance of the quasars except that they are outside our own galaxy. The next method of determining the distance of the quasars is to study whether the light from them has been interfered with in any way by an intervening object, for example a galaxy or cluster of galaxies. In fact it is found that absorption lines with a red-shift characteristic of the Virgo cluster of galaxies are indeed present in the spectrum of the quasar 3C273. This shows that this quasar is at least on the far side of the Virgo cluster and thus at a distance of greater than thirty million light-years.

As we have already said the distance to galaxies is often measured from the red-shift of the object. This is because the red-shift is known to be due to the expansion of the universe. Thus the more distant the galaxy the faster it is receding from us due to this expansion. It is tempting to apply this 'red-shift-distance relation' directly to the quasars. This gives distances even to the nearest quasar comparable with the most distant galaxies yet discovered and suggests that the most distant quasars lie at distances of greater than several thousand million light-years. Indeed the light would have been emitted from these quasars before even the sun was formed. However several astronomers including Professor Fred Hoyle of Cambridge have claimed that these distances are incorrect. They point out that the deduction of these distances relies on the assumption that their red-shifts are due to the expansion of the universe – as we say, are 'cosmological' in origin. They suggest that if, for example, the quasars were fragments thrown out of our own galaxy by a vast explosion, then clearly their recession from us has nothing to do with the expansion of the universe. Nor is this the only possible explanation of the red-shifts if the quasars are 'local' – the other main suggestion is that the red-shift of the light from quasars is due to the great mass of the quasar. In accordance with the results of general relativity the light becomes redder as it climbs away from a very massive and compact object towards the observer.

The last consideration that might lead to an estimate of the distance of the quasars is their distribution in the sky. For example if the quasars tended to lie near galaxies in the sky we could deduce the distance of the quasar from the distance of the associated galaxies. On the other hand if the quasars clustered near the galactic poles (i.e. were seen in directions at right angles to the plane of our Milky Way) this would be evidence for the version of local theory which claims the quasars are ejected from our own galaxy. In fact it has been suggested by different authors that both of these ideas are supported by observations.

In particular the American astronomer Halton Arp claims that radio sources, among them quasars, tend to lie in pairs on opposite sides of peculiar galaxies. However investigation by a number of groups of workers has not substantiated this and the general feeling is that Arp is mistaken in his statistics.

Alternatively another group of astronomers led by Peter Strittmatter and John Faulkner of Hoyle's Institute of Theoretical Astronomy at Cambridge suggested that the quasars with largest red-shifts tended to lie near the poles of our galaxies. Together with Michael Rowan-Robinson of Queen Mary College, London, I looked into this and we noticed that in fact the main feature of the distribution of the quasars over the sky was a virtual absence of sources from the region of the sky accessible to Northern Hemisphere observers in the summer. We made the suggestion that not only are the nights shorter in the summer but that astronomers often attend conferences during these months. This idea has not been altogether popular in some quarters! In fact the subsequent identification of large red-shift quasars has tended to fill some of the blanks left earlier and although the situation is not entirely clear, it seems likely that as more quasars are found so the distribution will continue to become more uniform over the sky.

From all the foregoing discussion the reader will see that we do not at present have any conclusive evidence giving the distance of the quasars. To see just how important this is, let us compare the distances proposed by the local and cosmological theories. The most popular distance favoured by the protagonists of the local theory is about 100 million light years, whereas the cosmological picture would place them ten times further away. This may seem a somewhat academic discussion since whatever view is taken the distances involved are truly immense. However the importance of the argument is seen when one realises that to be ten times more distant and still appear as bright in the sky, the quasars must be one hundred times more luminous. Indeed the luminosity of quasars on the cosmological theory exceeds that of an entire galaxy of stars and it is partly this surprising fact that has led to the strong support the local theory has received.

Thus baulked in all approaches to finding the distance of the quasars, astronomers have fallen back on a number of efforts to prove that quasars and radio galaxies are essentially similar objects. There are some obvious similarities – both are radio sources and both possess large red-shifts. However the two groups of objects appear quite differently in the sky: as we have seen, quasars appear as star-like points of light, while galaxies are fuzzy objects on direct photographs of the sky. The main difficulty lies in the effort to show there exists an intermediate class of objects between the quasars and radio sources with some of the properties of both. If such a group can be found this might establish the 'continuity' of quasars and radio galaxies and show the quasars were at cosmological distances. Luckily it seems that the N (or nucleated) galaxies do fill this requirement. The N galaxies appear slightly fuzzy on plates of the sky, but they have very bright nuclei which have many of the properties of quasars. Pictures of a typical radio galaxy, an N-galaxy and a quasar accompanying this article show some of the similarities and differences among these types of radio source.

At Herstmonceux, Russell Cannon and I have been studying if and how quasars and associated objects vary in brightness. We have been using a 26-inch telescope which is relatively small by modern standards but it has been adequate to keep a watch on the brighter quasars. There are

These pictures show a quasar, N-galaxy, and a radio galaxy respectively. They are all negative prints of the sky (black stars on a white background) which are preferred by astronomers for making small detail clear.

Plate I shows the quasar 3C273 (the bright star in the centre). Its well-known 'jet' from which much of the radio emission comes is marked.

Plate II shows the N-galaxy 3C120 which is marked and is slightly fuzzy compared with the star images.

Plate III shows the radio galaxy Messier 87 which also possesses a jet. The original from which this print was taken was one of the first plates taken on the new 98 inch Isaac Newton telescope at Herstmonceux.

ACKNOWLEDGEMENTS

1. *J. L. Greenstein, M. Schmidt, Ap. J. 140, 1. Univ. of Chicago Press*
2. *1957 Nat. Geographic Soc. Palomar Observatory Sky Survey*

Plate II

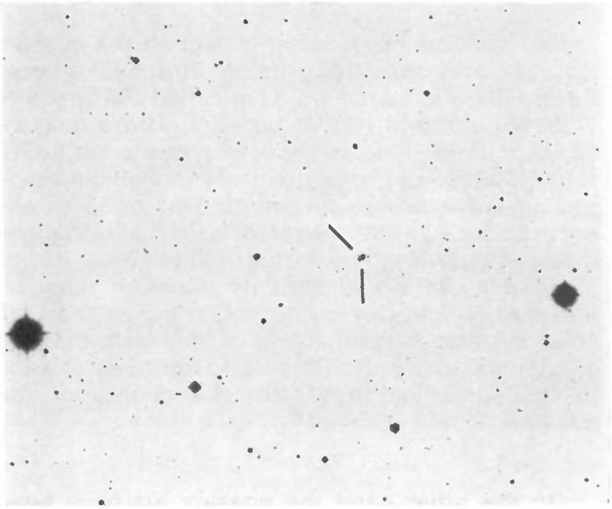


Plate I

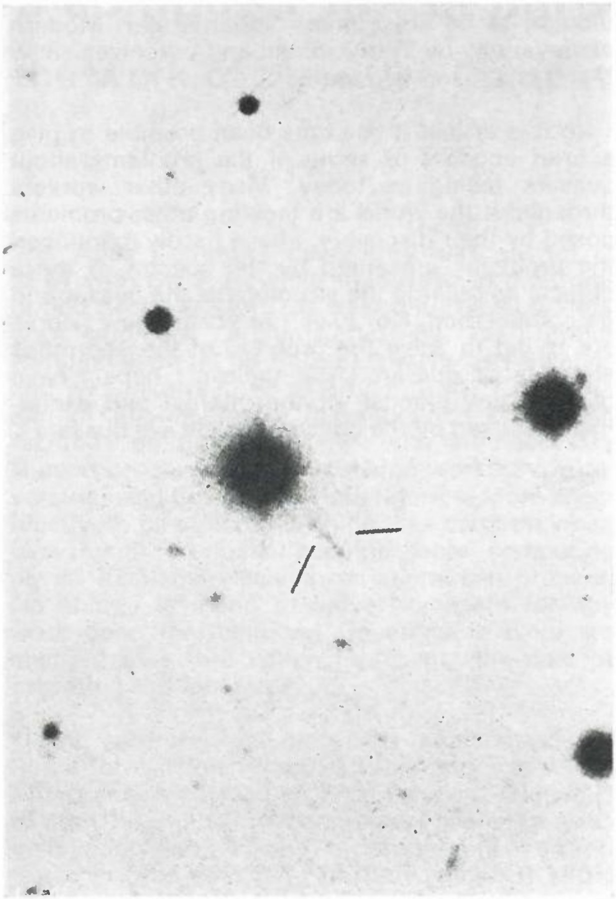
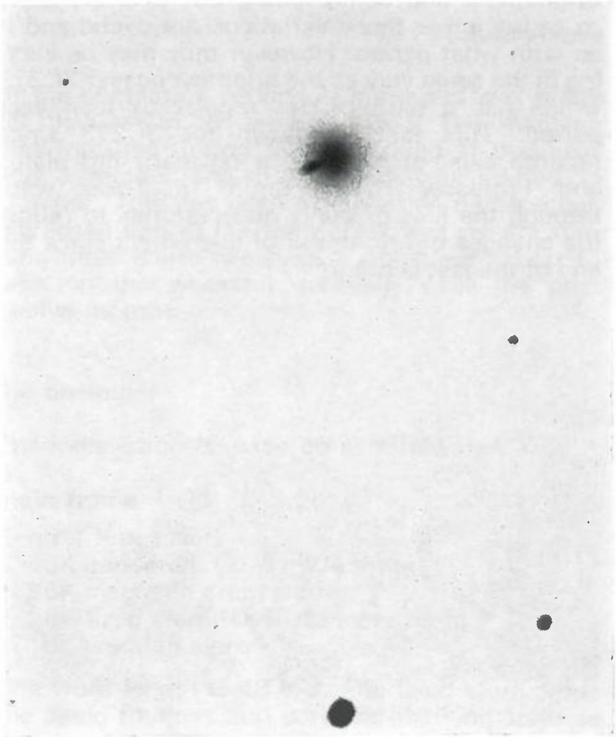


Plate III



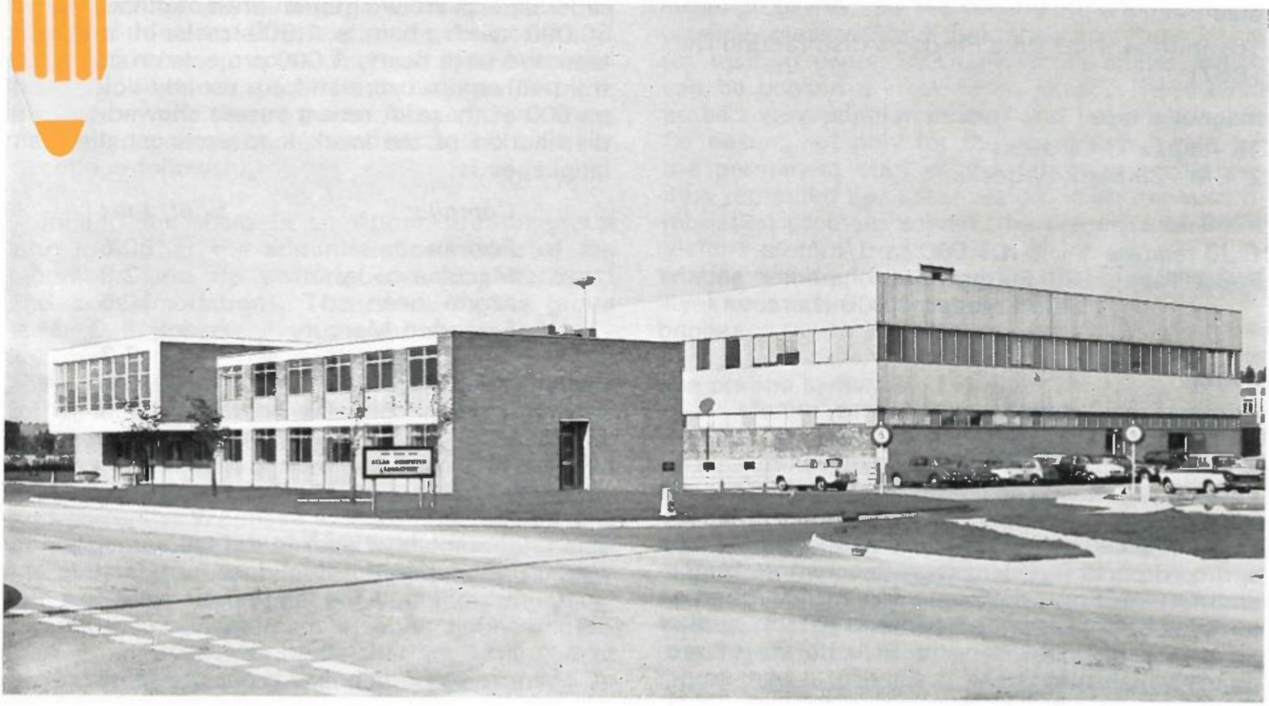
other groups, particularly one under Professor Tom Kinman at the Lick Observatory in California, who have been carrying out similar projects in different parts of the world. Whereas most of them have been concentrating on quasars already found to have variable luminosity, we have carried out a complete survey of all the quasars within reach of our telescope in order to establish whether they all vary and into what categories they divide.

We have concluded that in fact all the quasars do vary and that they divide into two groups. Firstly there are what we have called the optically violently variable (OVV) quasars. These quasars vary by large amounts – sometimes a factor of ten – often changing appreciably in a single day – and usually vary in the amount of radio power they produce as well. An interesting consequence of the rapid variation is that if the source varies appreciably in a day then its diameter must be less than a light-day, or not much bigger than the solar system. A comparison of this with the size of a typical galaxy (ten thousand light-years) adds to one's realisation of the strangeness of the quasars.

On the other hand the quasars we have been observing which have not turned out to be OVV also vary, but the pattern of this variation is quite different. We find after nearly three years study that they vary slowly, changing by an amount which we can just detect each year. Some are brightening and some fading but it is too early to say whether these variations are cyclic and if so with what period. However they may be varying in the same way as the brightest quasar 3C273 which has a more-or-less regular thirteen year period. This fact is known for 3C273 since records exist of this quasar on many old plates and Professor Harlan Smith of Texas went through the files of many observatories to follow the changes of brightness of this object since the end of the last century.

At Herstmonceux we have also been studying some of the N galaxies, hoping to confirm the link between these objects and the quasars by showing that they have similar variability. Now it has been found by Russell Cannon and myself and independently by the Californian astronomers that three of the brighter N galaxies show variations similar to the OVV quasars. We have also been examining these objects on the old plates taken when the Royal Greenwich Observatory was at Greenwich. We have found that two N galaxies 3C371 and 3C390·3 were considerably brighter between 1890 and 1910 than they are now. It gives me a strange feeling to look at these old pictures of the sky and to realise they were taken before my grandparents had started courting! A crucial conclusion from our results is that although these N galaxies are now fainter than almost all the quasars, at the turn of the century they were as luminous as at least some quasars. This shows an excellent continuity between quasars and radio galaxies since it is fair to say that if observed in the past, 3C371 and 3C390·3 would have been classed as quasars. Nor are these two the only N galaxies observed to vary, indeed the radio source 3C120 was discovered to be variable in 1940 by the great American astronomer Harlow Shapley. However at this time the existence of quasars and radio galaxies was unknown and this object was thought to be an ordinary variable star. Modern observations by Tom Kinman and ourselves show that it is still varying today.

In this article it has only been possible to give a brief account of some of the problems about quasars facing us today. Many other workers throughout the world are tackling other problems posed by their discovery. I have hardly mentioned the problems presented by the spectra of these objects as regards the structure of the quasar and its composition. Nor have I indicated how people are trying to solve the problem of the enormous energies of quasars. Nonetheless I hope I have given a tiny glimpse of the interest and excitement aroused by the question 'What are quasars?'



a computer for all purposes

the work of the Atlas Computer Laboratory

R. F. Churchhouse

The Atlas Computer Laboratory was set up in 1961 with Dr. J. Howlett, then Head of the Computing Group at AERE, as Director. The laboratory was originally administered by the former National Institute for Research in Nuclear Science and was incorporated in SRC in April 1965. The aim of the laboratory is to provide computing facilities on a large scale – with all necessary supporting services – to research workers in universities and government laboratories. More specifically, to be a place to which they can turn when faced with problems needing more computing power than their local installations can provide. No charge is made to university users for any work done for them but Government users are charged at a rate which represents the cost of operating the laboratory.

The laboratory is on a site adjacent to the Rutherford High Energy Laboratory and the Atomic Energy Research Establishment (Harwell) of the UKAEA. Its main equipment is a large Atlas installation which was ordered from Ferranti (later merged with ICT) in the summer of 1961. A building was designed with the special needs of the computing service in mind and was ready for occupation in January 1964. The machine was installed during May and June of that year and a regular one-shift service was started in October. This has been extended as demand has increased and at the time of writing we are running three shifts five days a week; we expect to take up the weekend gradually over the next twelve months.

the computer

The installation is made up as follows:

main frame

Central Processor,
- 48K core store (2 μs cycle time)
- 96K magnetic drum store
- 8K fixed store (0.4 μs access time)
- 16K working store

The word length is 48 bits. The fixed store holds the basic routines and uses the working store as working space

disc

$16\frac{3}{4}$ million word Data Products disc (added Dec. 1967)

magnetic tape

16 Ampex TM.2 decks
2 IBM 729 Mark IV decks

input

Card readers	2 ICT 600 card/minute
Paper Tape	1 Ferranti 300 character/second
	1 Elliott reader, 1,000 character/second

output

Printers	2 Anelex 1,000 lines/minute 120 character/line
Card Punch	2 ICT 100 card/minute
Paper tape	2 Teletype 110 character/second

This is backed up by standard equipment for tape and card punching, card reproducers, interpreters and sorters. From the beginning we have had an off-line Benson-Lehner Model J graph plotter driven by magnetic tape, with a library of programs which may make it easy for a user to get output in the form of point plots, histograms or continuous curves, including stereoscopic pairs for display of three-dimensional structures. This mode of output is so important that we have recently taken delivery of an SC4020. This is a microfilm plotter which can produce graphics on hard-copy, microfilm and cine film.

The machine runs at an average speed of 350,000 instructions per second. Floating point addition takes 1.8 to 2 μs, multiplication 5.9 μs, organisational instructions 1.6 to 2 μs. In machine code, inversion of a 100 x 100 matrix takes 17 seconds, sorting 5,000 floating-point numbers into numerical order takes 1 second. The operation of the machine is automatic and is normally under the control of a permanent resident program called the Supervisor, which monitors all its activities, organises the time-sharing of input, output and computation and of a number of programs held in the store at the same time.

One part of its action deals with automatic transfers between the core store and the magnetic drums, and enables the programmer to work as though the two formed a continuous directly-addressable store of 144K words. It also makes possible the use of many different compilers, and in fact Atlas users can (and do) write in Fortran, Algol, LISP, IPL-V, the Atlas Autocode produced by Manchester University, the Autocode produced originally for the Ferranti Mercury computer and since greatly extended, and several others.

The level of activity can be gauged from a few operating statistics. In a typical week we run 2,500 jobs, input a million cards and 24 miles of paper tape, print two million lines of output, punch 60,000 cards, handle 1,500 reels of magnetic tape. We have nearly 1,000 projects on our books from university users and are usually doing work on 600 of these. A recent survey showed that the distribution of the work load amongst the main languages is:

Compiler	*% of Jobs*
Fortran	50.6
Machine code	12.9
Algol	10.6
Extended Mercury Autocode	7.3
Atlas Autocode	3.6
Others	15.0

organisation

The total number of staff in the laboratory is now about one hundred. This does not include the computer maintenance engineers, who are ICT staff working under a maintenance contract.

There are four technical groups :

(i) The Operations group receives work (some of which is in manuscript and needs to be punched on to cards or paper tape), processes it through the main computer and any auxiliary machines, such as the SC4020, and despatches the results to the users. The head of the group is Mr J. E. Hailstone.

(ii) My own responsibility, the Programming group is concerned mainly with basic software – for example, changes or extensions to the Supervisor to incorporate new ideas or extensions to the installation – compilers and library programmes. It has built up an extensive library of programmes in Fortran and Algol. A small group are writing the software for the Sigma-2 Atlas on-line system. A number of programmers are engaged in more specialised activities associated with applications of computers, such as developing a system suited to the analysis of statistical experiments and an information retrieval project.

(iii) The Support group gives help and advice to users and is responsible for maintenance of the library programmes and various large 'packages' (such as the crystallographic programmes and the programmes for space research). This group also organises programming courses. The head of the group is Miss Barbara Stokoe.

(iv) There are posts for individual research: the laboratory has given fixed-term contracts of employment to research workers of established reputation whose particular interests

demand the use of a large-scale computer, or who are interested in exploiting the powers of the machine in novel ways. It has been the policy wherever possible to arrange that the holders of these posts also have some academic connection, such as a university or college fellowship.

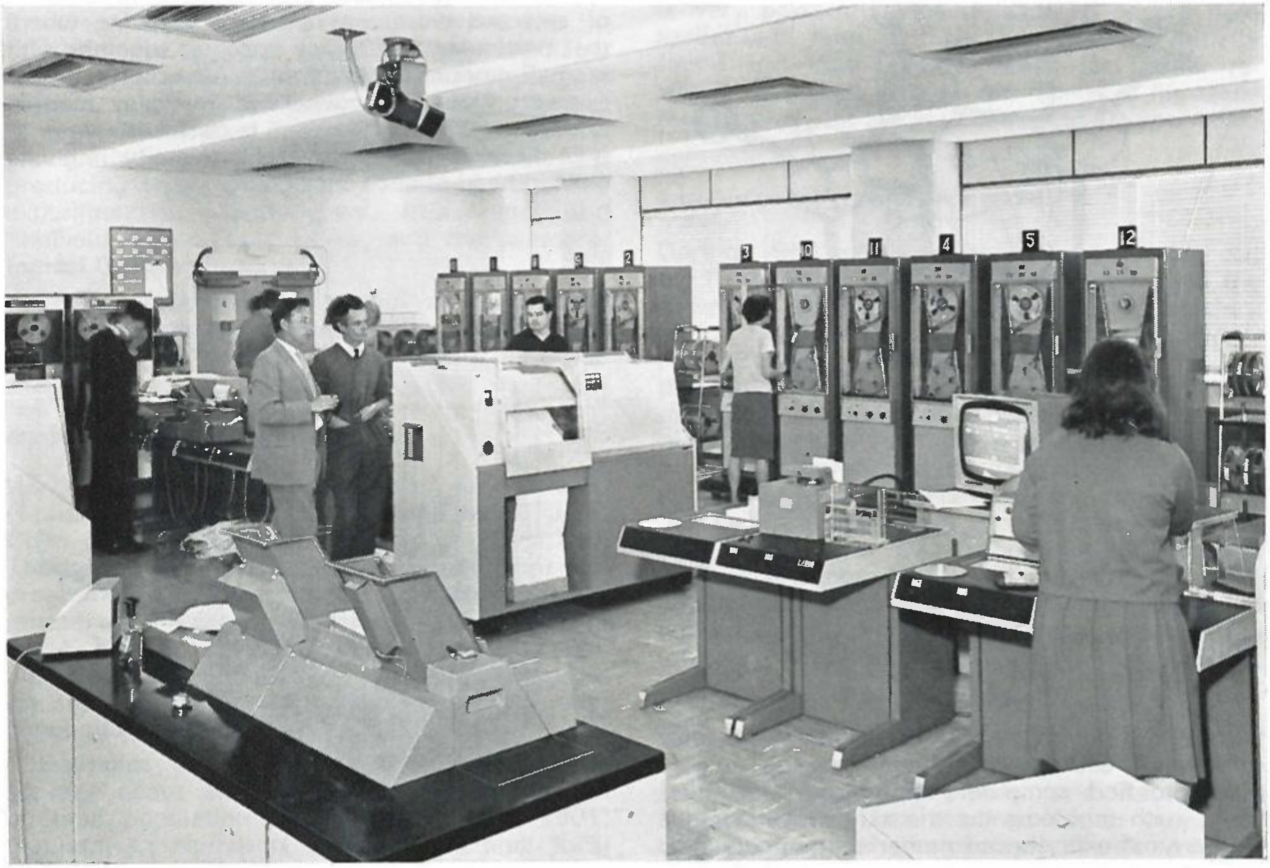
In addition there is an Administration group who look after the administration needs of the laboratory and its visitors (including transport and accommodation). The head of this group is Mr C. L. Roberts.

As can be imagined, we have had to give a lot of attention to the office-management aspect of the operation of the service, so as to ensure that the very large volume of work (with all its associated paper) is handled quickly, efficiently and correctly. We make as much use as possible of modern office machinery and, of course, we use the computer itself to produce all our accounts and statistics.

A point worth noting is that we expected to have significant numbers of people wanting to spend time in the laboratory, to develop large programs, so we planned the building to provide pleasant and practical accommodation for visiting users, in small single offices which can be booked a week or so ahead. These have proved very popular indeed and have made life far easier, not only for the visitors, but also for the permanent staff of the laboratory, who are thus protected against invasion. With the accommodation problem solved, the presence of many visitors, with a great variety of interests is stimulating and contributes a great deal of intellectual liveliness to the laboratory.

the on-line system

A small on-line system is being put together. In order not to downgrade the efficiency of Atlas the consoles are attached to a small computer, the S.D.S. Sigma-2, and this computer communicates with Atlas via the Data Products disc. There are very interesting technical problems on both the hardware and software sides. On the hardware side there is the problem of interfacing the Sigma-2 to the disc. Here we have had the good fortune to have Peter Wilde of RHEL Electronics group loaned to us for a year and he

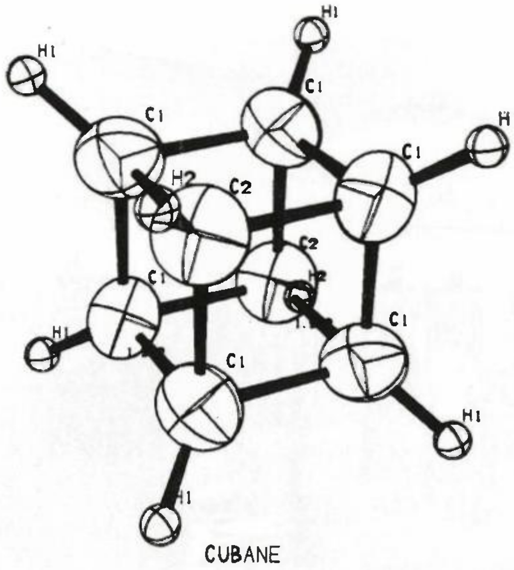


General view of the machine room

has designed and built the interface. All the software required for the on-line system is being written by a small number of members of the Programming group. We at present have six teletype consoles, but hope to increase this number before very long.

some examples of work done on Atlas

Big users of Atlas include the Meteorological Office, crystallographers, space research and people interested in survey analysis. At the other end of the scale quite small amounts of machine time may suffice for the development of some of our most important system programs (extensions to the Fortran and Algol Compilers, the Supervisor program etc.) as well as work on aspects of pure mathematics research (number theory, group theory, etc.). Here are brief accounts of some of the projects in which the machine is used. These are not necessarily the biggest users, but between them they give some idea of the wide range of application of the computer. I have made no mention of the more obvious applications of computers, such as the solution of partial differential equations. Although no-one is surprised to find computers being used for such work, such problems tax the skill and ingenuity of the most experienced numerical analysts and, indeed, one of our Fellows (Dr. Joan Walsh) is working on problems of this type.



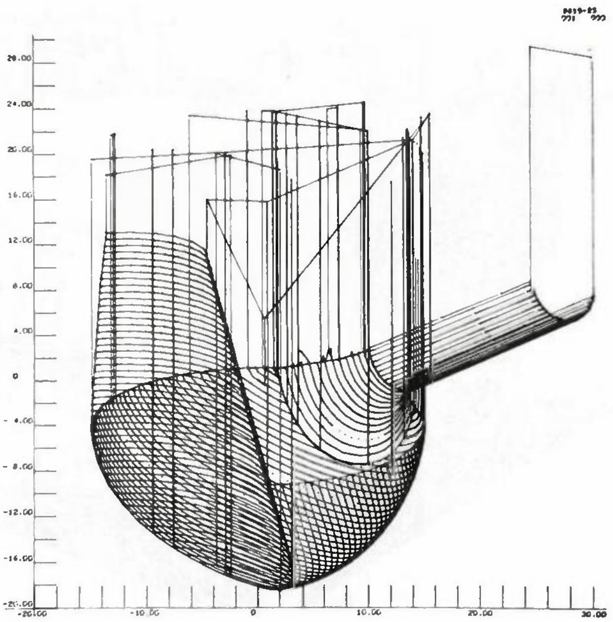
Cubane and Convolutes
Examples of graphic output of SC.4020 graph plotter.

crystallography (J. C. Baldwin)

Crystallographers have an inherent ability to use as much computing power as is made available to them and therefore they form a significant group among the users of a machine of the size of Atlas. By placing a crystal in a beam of X-radiation and studying the resulting diffraction pattern, it is possible to determine the approximate positions of the constituent atoms. Refinement of these and other parameters continues until close agreement is reached between the observed and calculated patterns. When complete, the crystallographer will wish to know the relative distances and angles between various atoms. Programs for these calculations are provided by an American system known as X-Ray 63 which has been adapted and expanded for running on Atlas and is currently used by research groups from fourteen universities.

literary concordances (D. B. Russell)

COCOA is a system which enables users to carry out quantitative analyses of literary texts punched on cards or paper tape. It can provide a count of the frequency with which words appear in a given text and for each occurrence of selected words; a reference showing where that particular occurrence appears; together with a small amount of its context. All occurrences of a given word are concorded for easy manual reference. This work was undertaken when it was discovered that several university linguists were in need of such a program.



Convolutes

simulation and analyses of compiler systems
(P. Bryant)

The Brooker Morris Compiler Compiler system, which is a tool for easing the writing of compilers, has been exploited in the writing of a simulation compiler with the object of studying various facets of computer systems, in particular a study of the Atlas drum and disc interaction and also some multi-access problems. The compiler has also been used in a variety of industrial problems.

Work is also proceeding on the evaluation of computers. This work breaks down into three main sections namely the hardware, the operating systems and the compilers and we hope that the results will provide some guide lines in determining the factors which influence a computer's performance.

space research (Miss Barbara Stokoe)

The Atlas laboratory is processing data received from the satellite Ariel III, which was launched from Western Test Range, California, USA, on 5th May, 1967.

Information is received from the satellite by several tracking stations around the world, and these are sent to RSRS Slough, where the information is digitised onto $\frac{1}{2}''$ magnetic tape. These tapes are sent to AWRE Aldermaston, who perform a preliminary run, producing a further $\frac{1}{2}''$ tape. This is sent to the Atlas laboratory, who process it, (using a program initiated by AWRE), producing tapes of a form suitable for the five experimenters – Birmingham, Manchester and Sheffield universities, RSRS, and the Meteorological Office at Bracknell.

The average rate of receipt of tapes from AWRE is three per week, and the machine time involved is in the region of three hours per week.

analysis of surveys (Mrs. Judy Lay)

We have available a program called MVC (Multiple Variate Counter) written by A. J. T. Colin of London University (now at Lancaster). There is a continual large scale demand for this program. Of seventy-two surveys currently being processed, thirty-five are medical; examples of these include various cancer studies; peptic ulcer; convulsive disorders; tuberculosis; coronary study; bronchitis in the Welsh steel industry; congenital malformation; and jaundice in infants.

Examples of other surveys include various surveys about students, graduates and school children; population movement from 1851–1901; reaction to televison programmes and local radio; industrial studies; hospital manpower; and bird movement study.

statistical program package, ASCOP
(B. E. Cooper)

ASCOP is a comprehensive statistical system. It has good editing and checking facilities, and data presented for it can be stored on magnetic tape for later use. Instructions are in the form of english sentences or Fortran-like equations, and may be formed into subroutines. The system is being extended continually, for example, to incorporate tabulation and graph plotting facilities, making it useful in the survey analysis field. It is currently being implemented on a number of other computers. ASCOP is useful for anyone who wishes to perform statistical analyses on data.

information retrieval (R. F. Churchhouse)

Information concerning about 5,000 articles in a dozen computer science journals has been written on magnetic tape. The information retrieval programs make it possible for a user to find out what papers have been written on topics in computer science, or works by particular authors. When a paper is retrieved, the papers to which it refers or which have referred to it, are also retrieved. This simple method of retrieval is very powerful since it leads to papers both earlier and later in time than the one initially found and thus provides leads for further retrieval. A search through the complete file takes less than ten seconds of computing time on Atlas.

work in collaboration with NERC

During 1967 an investigation was carried out by T. N. Gover of the Atlas laboratory into the computer requirements of the Institute of Geological Sciences, a branch of the Natural Environment Research Council (NERC). In the report that followed it was suggested that in order to make the data collected and held by each department universally available, a data bank should be created. In order to assess the feasibility of such a scheme, pilot projects are being conducted at the Atlas laboratory. A team of three, Gover, Miss Harvey and Mr. Turnbull of IGS, started work in December 1967. Coding has now reached an advanced stage and it is hoped that geologists will be able to put fairly simple requests for information to the system during this summer.

time series analysis (P. Kent)

In the examination of a problem one often obtains a sequence of data readings which vary in a consistent manner. For example, the air temperature at noon each day would vary with the seasons. In addition to this basic cycle there would be fluctuations from day to day and long term changes over periods of many years. The components of such a sequence can be separated and examined by means of 'Time Series Analysis'; a system of programs for the analysis of time series, written in America for the IBM 7090 computer by Sir Edward Bullard and others, and now in use on Atlas. The program, known as BOMM, has already been used in the analysis of daily water flow in the river Indus, temperature fluctuations at the bottom of the English Channel, electro-encephalograph records, and fluctuations in the national grid. It should also be of use in the fields of astronomy, geophysics, and economics.

radiative transfer (I. P. Grant)

We have developed new methods of solving the equations of radiative transfer numerically using difference techniques based on well-known principles of invariance. Such principles have been used before to calculate the reflection and transmission of light by plane scattering layers, but not to compute light fields within the layer.

Apart from tests to verify theoretical results concerning accuracy and numerical stability of the methods, the first practical application of these ideas has been to compute estimates for the radiation emerging from the top of the earth's atmosphere for wavelengths in the 8–150μ region in the presence of cirrus cloud, a problem of interest to a project for atmospheric temperature sounding by artificial satellite proposed by by joint groups at Oxford and Reading universities.

pure maths
(A. O. L. Atkin, J. Leech, J. K. S. McKay)

At the present time three of our Fellows are engaged in pure maths research (Dr. Atkin on number theory; the others on group theory). In addition another Fellow, Dr. Paterson, is working on theorem proving by computers. The work being done in these areas is particularly interesting for new results are being discovered which would not have been found if computers had not been available. The laboratory helped to sponsor and organise a highly successful conference in Oxford last summer on the use of computers in algebra and it is hoped to organise a similar conference relating to number theory in August 1969.

lessons learned

The laboratory has been providing a computing service for nearly four years, and very intensively for the past three years. The use made of this service shows how great is the need. We get work from every university in Great Britain, the demand is increasing and there is a steady increase in the general levels of size and complexity of the problems put on the machine. It is particularly pleasing to observe the rising demand from workers in the non-physical sciences – sociologists, psychologists, educationalists, biologists and others – as they begin to appreciate the help they can get from a powerful computer and a quantitative approach to their problems.

The Atlas laboratory is operating as a national facility for universities, and to a smaller extent for government research laboratories; it is a great deal bigger than anything else to which the universities as a whole have access and is comparable with anything in Europe. The scale of operations is great enough to justify the provision of many technical and administrative services and we have come to the conclusion that these are valued almost as highly by our customers as is the computing power of the installation. Simple things like the supply of cards, paper tape, coding forms and stationery generally are very important; people need ready access to card and tape preparation equipment and to desk calculators for odd checks and minor pieces of arithmetic; help in arranging transport and booking accommodation is very welcome; and of course somewhere to work is essential. On the technical side, and taking for granted the vital need for first class basic software and library programs, we found a great demand for a general advisory service for users. To satisfy this demand we created the 'support group'. In order to improve communications between the distant users and the support group we have recently installed a Telex. This has the great merit of producing at low cost a printed copy, essential where modifications to programs are concerned.

Finally, all experience has confirmed the view with which the laboratory started out, that the presence of research activities in the building and easy contacts with the academic world and with other computing centres are essential to the intellectual health of the members of the laboratory. A large-scale computing service is really a very sophisticated and highly professional undertaking which makes demands at all levels and is always needing both stimulation and criticism; without these it is fatally easy for the people who are providing the service to become stale and unenterprising, and the standard of the service to decline.

GLOSSARY of computer terms

FORTRAN, ALGOL, etc. are languages which allow the user to express a problem without a knowledge of the machine's order code.
COMPILER, program which does the necessary conversion.
HARDWARE, the actual electronic equipment within a computer system.
SOFTWARE. the programs.
INTERFACE, can be either hardware, software, or a combination, to facilitate the joining of two (otherwise incompatible) pieces of hardware.
BITS, binary digits. i.e., 48 bits = 48 binary digits of either 0 or 1.

old scientific instruments

radio telegraphy

part 1. circa 1899 to 1922

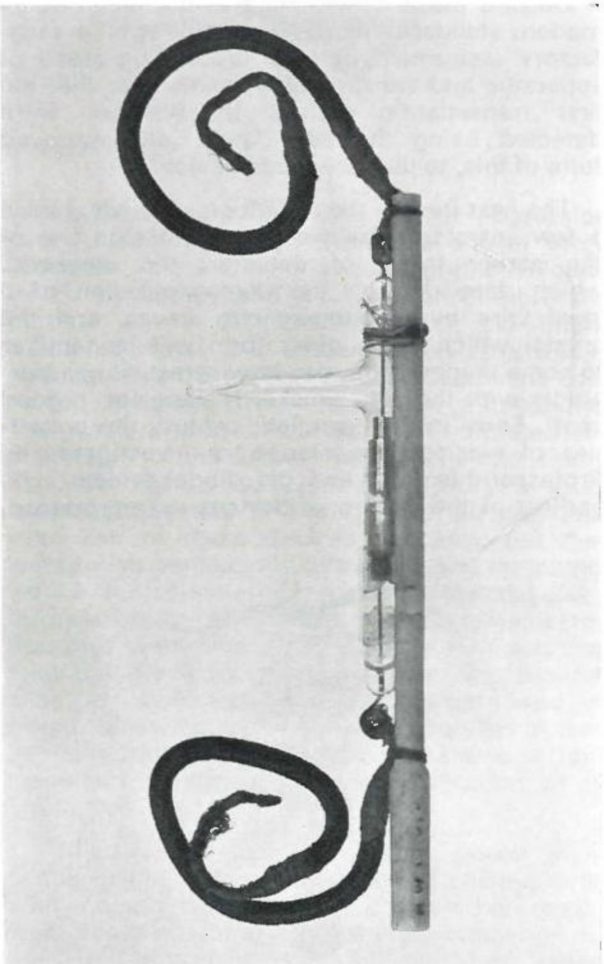
G. W. Gardiner

Research progresses and techniques change so rapidly these days that an establishment only a few years old may well possess apparatus of some historical interest. However, the odds against the apparatus being recognised as possessing historic value and surviving the period between obsolescence and ectopia are rather long. Unless a device has produced epoch making results which makes it an obvious candidate for preservation, it may well be cast on the scrap heap, or reduced to unconnected component parts which only serve to delay the inevitable limbo. It is therefore fortunate that in most groups of scientists and research workers, there is to be found at least one person with squirrel-like tendencies and an interest in the history of his occupation. Such is the case at Ditton Park where the Radio and Space Research Station has been established for almost fifty years and where successive workers have made considerable contributions to the understanding and growth of the science of radio communication. This is then a description of items from a collection of instruments and components which have contributed to the development of radio from its very early days.

The oldest surviving item in our collection is a book; this is perhaps not surprising because books have a habit of appealing to otherwise quite ruthless 'spring cleaners'. It dates from 1899 and is a history of radio as seen by John Joseph Fahie Esq. It may come as a surprise to readers to learn that at the end of Queen Victoria's reign, wirless telegraphy was sufficiently well established to warrant a historical record, but this was indeed the case.

The history spans about fifty years of attempts to signal without wires and lists the various methods which had been tried since the 1840's. These earlier methods usually made use of the properties of electromagnetic or electrostatic induction, conduction through the earth or through water, or a judicious mixture of both. Fahie was a telegraph engineer of considerable experience who survived into the twentieth century to become a veteran member of the Institution of Electrical Engineers. This book, together with an earlier one dealing with the history of line telegraphy, provides valuable source material for investigators of the dawn of electrical communications.

As events were to prove, the 'Electric Wave Method' triumphed and one of the main components of that success was the detecting device called the *Coherer.* This was a curious piece of apparatus which depended on the change in conduction of metal filings when electromagnetic waves impinged upon them. This effect had been noticed as far back as the middle part of the nineteenth century, but, except for one application as a lightning safeguard, had never properly been studied until researchers in the late 1870's and onwards brought it to the notice of the early experimenters in wireless telegraphy in the mid '90s. Its early form was improved upon by Marconi for use in his system of wireless.

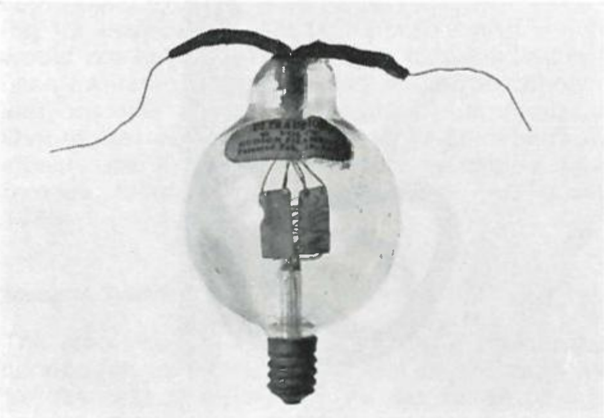


Marconi Coherer

Quite how this came to be at Ditton Park, when the Station was not founded until long after such devices were no longer in current use, is not obvious until we remember that the coherer continued to play a part for about the next twenty or so years as a lightning flash detector and it is almost certain that this little gadget has survived because it was used by Watson-Watt in his experiments in the counting of lightning flashes. The coherer is a small glass tube a few inches long, containing metal filings between two contacts, mounted on a cylindrical rod made of bone, one end of which has the letters M.W.T. engraved upon it. (Marconi's Wireless Telegraph Co.) No doubt it was one of a number of surplus detectors which must have been freely available in the early part of the century. It is unfortunately broken, but the author possesses another, which is still in reasonable working order, although it is, as the text books of the time assure us, 'a capricious and uncertain device'. Indeed Watson-Watt himself had written of it '. . . an intractable principal member, . . . little is to be hoped from any coherer recorder'.

Despite these comments and the fact that by modern standards the coherer isn't at all a satisfactory instrument, it is a fascinating piece of apparatus and we do well to remember that the first transatlantic signals by wireless were detected using the very latest and improved form of this, to us, very crude device.

The next item in the collection, a *Triode*, jumps a few years because we do not possess two of the earlier forms of detector; the magnetic, which depended on the demagnetization of a steel wire by electromagnetic waves, and the crystal which in its older form will be familiar to some readers who may have wrestled exasperatedly with the cats-whisker looking for 'a good spot'. Early in the twentieth century the properties of electron emission were investigated by Professor Fleming; and his diode detector, the earliest of the electronic devices, was produced.



DeForest Triode

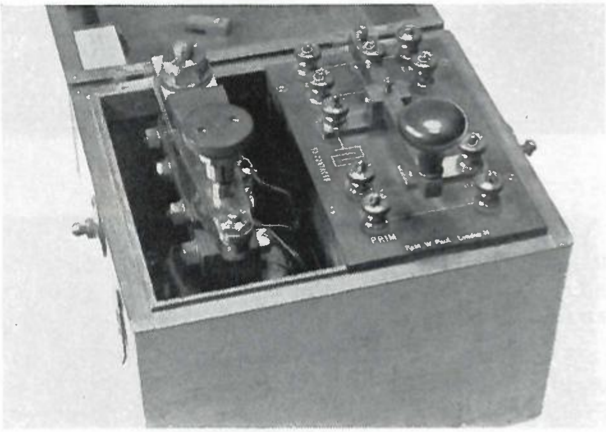
This was more reliable than the crystal but no more sensitive. In a year or two a third electrode, the grid, was added to the diode by the American, DeForest, making it the triode, and with it we see the beginnings of the vast range of thermionic devices which for the next forty years were to dominate the field of electronic research.

DeForest's triode went into commercial production round about 1910 and one of these early production models is now in our collection. It consists of a small glass globe a couple of inches in diameter in which can be clearly seen the filament flanked by two zig-zag plates to form the grid and with two parallel plane electrodes outside the grid which form the anode. The filament is connected by an ordinary miniature screw lamp fitting, exactly like a modern torch bulb, and two wires sprout from the top for grid and anode conections. Made before the first world war, these valves continued in use throughout it, although other and improved forms were being developed. It wasn't until the 1920's that they were beginning to be old-fashioned, though occasionally still used. We have in this triode an example of the progenitor of all the many valves which followed.

Within a year or two of the start of production of these early valves the World War began and, just as the 1939–45 war led to rapid advances in radar technique, so the needs of 1914–18 led to rapid advances in valve research and circuitry and to the improvement of wireless telephony. Another similarity between the two wars is a tendency for applied research to look at devices and methods which had long been discarded, in the hope of finding new fields of work for them. As in 1939–45 the depised crystal and cats-whisker re-emerged triumphant as a valuable component in very high frequency research, so in 1915 one of the early wireless telegraphy methods, mentioned by Fahie, that of earth conduction, formed a useful addition to the telegraphist's art for signalling between the trenches.

The basic requirement for an earth conducting system of telegraphy, which has a range of a mile or so, are very simple. They consist of a transformer or induction coil, a self-acting make-and-break device, to break up the direct current and to cause pulses in the primary, and a morse key to break up the pulses into short or long trains so that morse signalling can be achieved. From the secondary, wires are led to earth stakes about one hundred yards apart. When the key is pressed, high voltage alternating currents are caused to pass into the soil. The receiving equipment is even simpler, consisting merely of a pair of headphones and two earth points a similar distance apart and parallel to the sending 'aerials'. The alternating current generated at the transmitter is detected at the receiver earth terminals, producing a weak alternating current which actuates the ear phones, making a buzz of similar frequency to that of the self-acting interruptor.

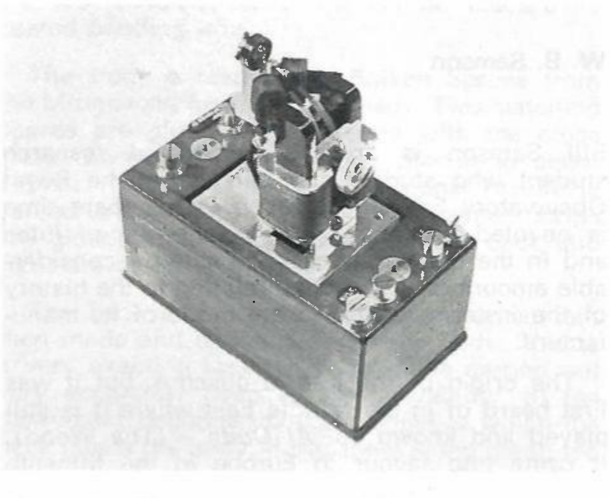
This is basically one of the wireless systems proposed shortly after the invention of the telephone, about 1878. For wartime use the system was greatly improved by employing the new fangled triode valve amplifiers which greatly increased the sensitivity of the detector and obtained a useful increase in range. It had disadvantages; the enemy using similar, more sensitive triode amplifiers could intercept the signals, and it was while attempting to do this that the German physicist Barkhausen was able to contribute to the study of a natural phenomenon known as the Whistler atmospherics in a more detailed way than earlier observers who had not had the benefit of the valve amplifier. All these improvements in earth telegraphy were made at the receiving end, the transmitter really didn't differ very much from that of thirty odd years before and we have such a *Transmitter* in our collection.



Earth Conduction Transmitter

It is a splendid laboratory type instrument in a polished wooden case, the automatic make and break is made of heavy brass and to one side is a lacquered morse key. It gives a sizeable voltage when the battery is connected and the key pressed, quite sufficient to deter one from touching the terminals. The whole instrument looks suspiciously well kept and clean and one feels that it may not have participated in the war, but been drawn from some stores well behind the line and from there found its way, for some long forgotten experiment, to our laboratories at Ditton Park. It is an interesting link, not only with the first World War, but, in a sense it looks back even further to those early systems of communication used in the late 1870's.

The invention and development of the triode valve marked a watershed in radio communication history. True, before it had appeared on the scene many aspects of radio communication had been achieved with continuous wave generation: wireless telephony and even, in a very limited way, experimental broadcasts; a commercial transatlantic radio telegraph service had been operating for some years and rudimentary experiments in radio control had been carried out. All these things had been attained, however, by stretching the pre-valve technology to the utmost limits. In a few cases valve and non-valve techniques survived for a while, side by side.



Brown Amplifier

The *Mechanical Amplifier* in our possession which dates from about 1922, is one of these examples. It was manufactured and developed by S. G. Brown and Co. and once more the familiar theme of polished wood and bright lacquered metal is in evidence. Basically it was nothing more than a very sensitive earphone connected mechanically to a carbon microphone. The weak signals in the earphone vibrated the diaphragm of the carbon microphone and amplified the signals sufficiently 'to work a loud-speaking telephone or a relay'. The full apparatus used two of these devices in series, but they were rather sensitive to vibrations and the output would scarcely satisfy the requirements of a hi-fi enthusiast. However it must be remembered that they were very often used for no more than magnifying a weak morse signal so that faithfulness of reproduction over a wide band of frequencies was not important. It formed in fact, as many triode amplifiers did at the time, a 'note magnifier', which gives some indication of its limitations.

Although but four in number, these items enable us to reach back, through obvious links with modern techniques, to a time when results were achieved using astonishingly crude apparatus. The Victorians were self-confident people and for the birth of the wireless telegraphy they needed to be.

people and their pastimes

lute making and playing

W. B. Samson

Bill Samson is an SRC supported research student who studies star clusters at the Royal Observatory Edinburgh. Much of his spare time is devoted to the making and playing of lutes and in the process he has collected a considerable amount of information relating to the history of the instrument and to the mode of its manufacture.

The origin of the lute is obscure, but it was first heard of in the Middle East where it is still played and known as *'Al Oude'* – (The Wood). It came into favour in Europe in the fifteenth century and a great deal of solo and consort music was written for it up to about 1700. The music is of special interest; whereas the majority of instrumental music is written in the familiar staff notation, lute music is written in tablature, which is easily understood by a lutenist, but is quite unintelligible to any other instrumentalist.

In its heyday the lute was a much prized instrument found only in the homes of the very rich; the violin on the other hand, was considered to be the instrument of common fiddlers and street musicians. To lend weight to this ancient opinion, a Stradivarius violin when new would have cost about £16, whereas a good lute would have cost about £100.

A Baroque lute had as many as twenty-six strings and a fingerboard more than four inches wide, which made it a most difficult instrument to play. All lutes are difficult instruments however, with their wide finger boards and groupings of strings, many of which are tuned in pairs; this together with the desire to fit even more strings, led to the decline of the instrument. Another great hazard was the maintenance of the 'tune' of the strings. We take nylon strings for granted, but in the heyday of the lute, it has been said that if a lutenist lived for eighty years, at least sixty of them would have been spent in tuning the gut strings of his instrument.

Lutenists were normally retained by the nobles and rich gentry of the period but it was often necessary also to retain the services of a lute tuner. Small wonder therefore that it often cost as much to keep a lute as it did to keep a coach and pair!

The great lute makers, or Luthiers, of the day were of German origin but working in Italy; Hans Frei, Wendelin and Gaspard Tieffenbrucker, Maler and Hartung, being the best known. Unfortunately few of their instruments survive in their original form. The fashion for more strings to increase the repertoire, caused the instruments to be modified and strengthened to support the increase in string tension and this usually succeeded in damaging the instrument or at least severely diminishing the tone.

Bill Samson was converted from an electric guitar – that cacophonous symbol of present day 'pop' music – to the more melodic and infinitely more demanding lute and its music after watching a performance on television given by Julian Bream, the celebrated guitarist. The conversion was a systematic affair, graduating through a year's study of the classic guitar, which gave him experience of intricate fingerwork and so building up the dexterity which the wide finger board and the many strings of the lute would demand.

When it came to buying an instrument, the local music shops could offer no help, nor were they forthcoming with literature, so with just two prints of old lutes to help him, he set about building his own. The result was a not-very-good copy of an eleven stringed early sixteenth century instrument, made with insufficiently seasoned wood and an internal support structure that would have given the early German masters heart failure. The tone was weak, but during its short life it did at least provide a platform for practice sufficient to whet the appetite for better things, so he set about the construction of Lute Mk. II.

This time he had some help; during the short life of the first instrument he had been introduced to a classical guitarist who had constructed a passable lute with the aid of a book from the Dundee reference library. The book, *'Musick's Monument'* by Thomas Mace contained a section on the upkeep and repair of lutes which included a suggestion that to maintain the tone of the instrument it should be kept in 'a well used bed!' Another book which contributed much to the venture was *'Musical Instruments through the Ages'* edited by Anthony Baines, which contained an article by M. W. Prynne, together with a photograph of the internal structure of a Hans Frei instrument.

The story of how Mk II was built is best told in Samson's own words:

Lifting the back from the mould.

'Apart from finding the materials which was the biggest task of all, the construction of the instrument took about three months. This time could have been shortened, but I could only work on those weekends when I could get home to Forfar where I had my workbench and tools.

A mould of the inside of the instrument is made and the gourd-like back constructed around it. The back is usually made of nine or more strips of hardwood, no more than 1.5mm thick, which are first moulded to shape on an electrically heated bending iron.

The front is made from Balkan Spruce from the Mittenwald forests in Germany. Two matching boards are glued edge to edge with the close grain toward the centre, then planed to about 1.5mm. The elaborate and traditional rosette is carved in the centre, and six reinforcement strips are glued to the underside, then the back and front are glued together.

The neck and pegbox of the instrument are then made and dovetailed into the body. This is a very exacting task which must be carried out very accurately because the 'playability' of the instrument depends upon the angle at which the neck meets the body. If the angle is too great, too much pressure will have to be applied to depress the strings, if too shallow, the strings will buzz against the fingerboard when they are plucked. Finally, the bridge is glued on and the instrument is varnished. Strings are fixed and tuned and the acid tests applied – the tone! If this is very poor then it may necessitate unglueing the front and modifying the thickness of the panel or the support strips. The aim is to reproduce the authentic lute tone of the renaissance instruments.

I took Mk II to the Lute Society Summer School in August 1967, where apart from tuition in playing, most of my time was spent in discussion with others who, like myself, had built their own instruments, and with professional Luthiers like Ian Harwood, Maurice Vincent and Sandro Zanetti-Golay, the distinguished Swiss Luthier.

Lute makers exhibit a freemasonry quite unlike the makers of (for instance) violins, and will discuss their manufacturing techniques without reserve. This is probably due to the fact that many of them have long waiting lists for their instruments, some of them extending into years, so that they are not subject to the intense competition which exists among the manufacturers of other musical instruments.

I am now working on Lute Mk III and with the experience gained in the making of the first two, plus the knowledge acquired at Summer School and from talking with experts, I have high hopes of being able to produce quite a passable instrument'.

profile

Professor D. H. Wilkinson, FRS

Professor Denys Haigh Wilkinson the new chairman of the Nuclear Physics Board, was a founder member of the National Institute for Research in Nuclear Science which was incorporated in the SRC in 1965. He is an internationally respected physicist who is perhaps best known for two major contributions to the instrumentation and to the theory of the science.

Born in Leeds in 1922, Professor Wilkinson was unwillingly transported from the County of Cricket to Leicestershire at the age of six months, but he still remains a loyal Yorkshire supporter. His education began at Loughborough where he showed a preference for chemistry and physics. He won a scholarship to Cambridge in 1940 and worked equally on both subjects until events confirmed physics as the subject of his choice. He became involved in atomic weapons research and this led, in 1943, to participation in the British and Canadian atomic energy projects, firstly at Cambridge, then at Montreal and Chalk River. In fact he was the first scientist to carry out an academic experiment on a nuclear reactor outside the United States.

One of the absorbing interests in Professor Wilkinson's life has been the study of birds and the first scientific paper he ever published was on the subject of bird navigation. This was in 1946 when he was forced by ill health to 'retire' from nuclear research. He had contracted radiation sickness and was given only six months to live, but within a year he had 'mysteriously recovered' and was back at work at the Cavendish laboratory where he set out to explain and improve the electronic devices used to detect and analyse nuclear particles. He was the first to give a coherent account of the operation of a Geiger counter and his book has become a classic. He also invented the principle of analogue to digital conversion which is now the basis of a multi-million pound instrument industry. Unfortunately the Professor did not take out a patent so has not received any financial reward for his invention.

Professor Wilkinson has lectured extensively in the United States and in the five continents. He was made a Fellow of the Royal Society in 1956 at the age of 33 and among the many honours which have been granted to him are included the Holweck Medal of the French and British Physical Societies and the Hughes Medal of the Royal Society.

The pressure of his professorial and committee duties inhibit his ability for experimental work in this country, so the Professor largely confines his experimental research activities to Brookhaven in America where he is undisturbed and free from official distractions.

In his early years, the Professor was a keen sportsman; at college he took part in athletics and rock climbing, gained a Blue for the high jump and was in the first team for lawn tennis. He was also interested in literary matters; he edited the school magazine and was for many years the drama critic of the Cambridge Review. He has always been very fond of music and possesses what is probably the largest private collection of pre-Bach recorded music in Oxford. Nowadays his main outside interests are medieval art and church architecture.

newsfront

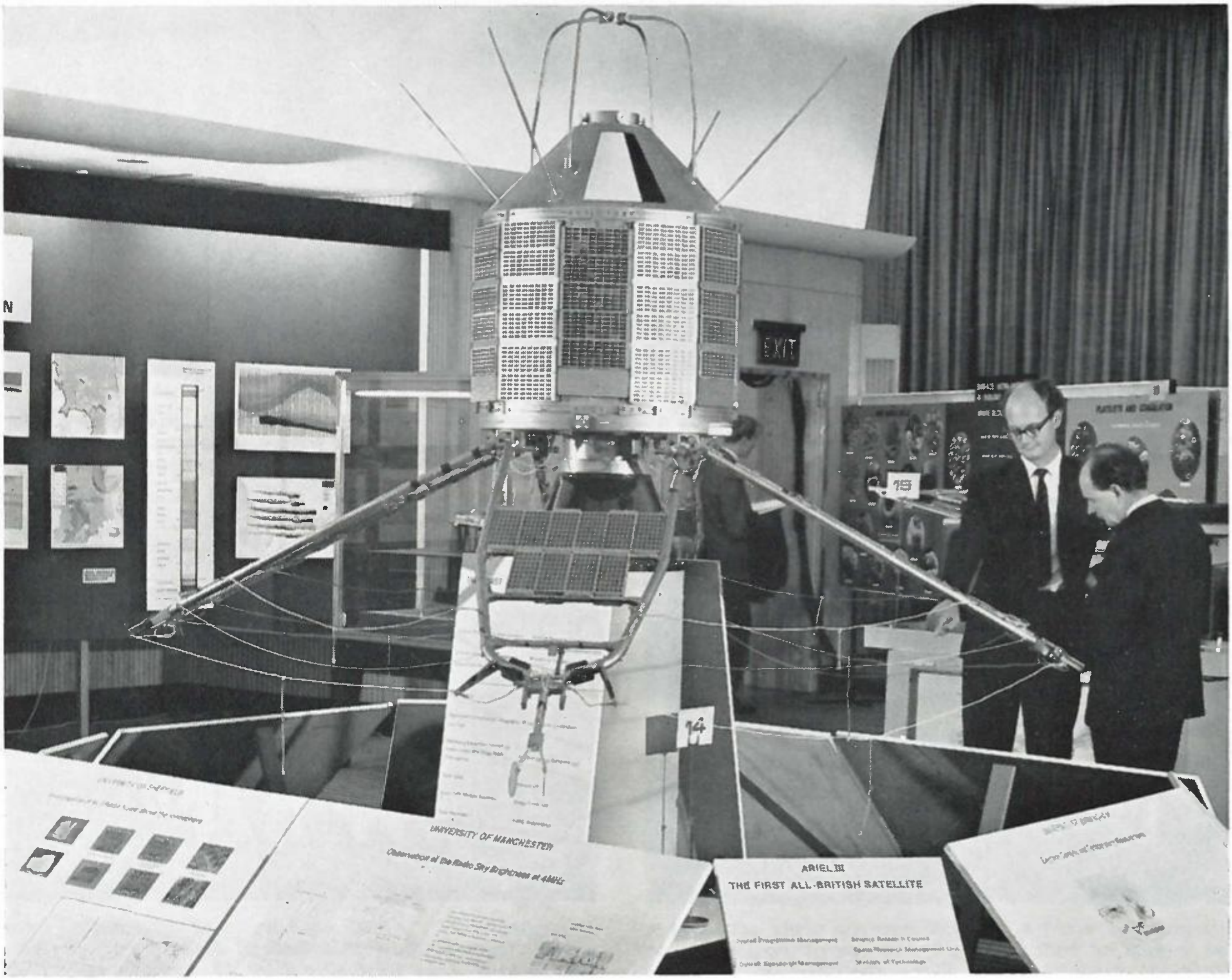
HAPPY BIRTHDAY

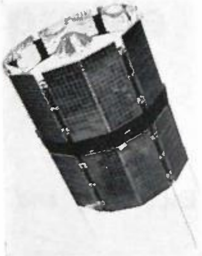
How many members of SRC Space Division remembered to 'tip a cup' to Ariel III during Sunday tea on May 5th?, because at precisely five o'clock that day the satellite completed 5,518 orbits and exactly twelve months in space.

This first all-British satellite is a great success and has sent back to earth something like four hundred million words of data from the six experiments it carries. Most of the data has been processed by the Atlas Computer Laboratory and RSRS.

Some of the final results were displayed by SRC around the flight engineering model of the satellite at a symposium held in the beautiful new home of the Royal Society in Carlton House Terrace.

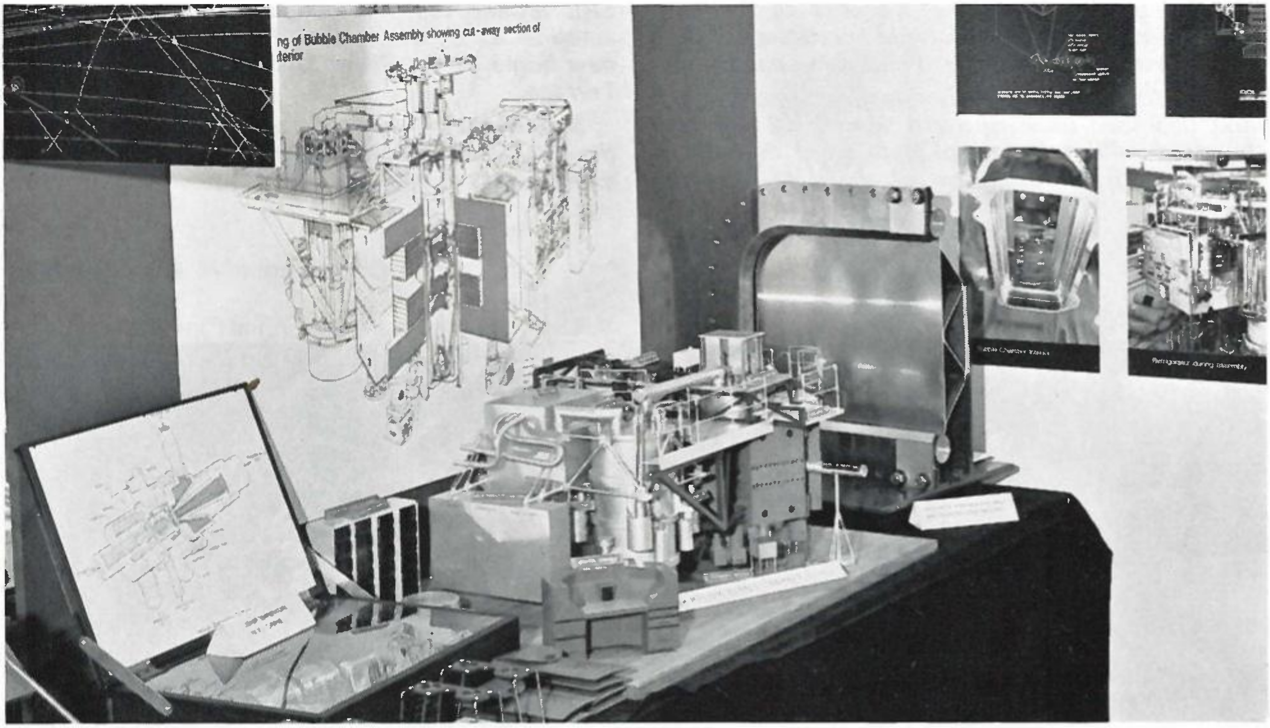
In the photograph, Mr. J. F. Smith, who was the SRC Project Co-ordinator, explains one of the experiments to a visitor.



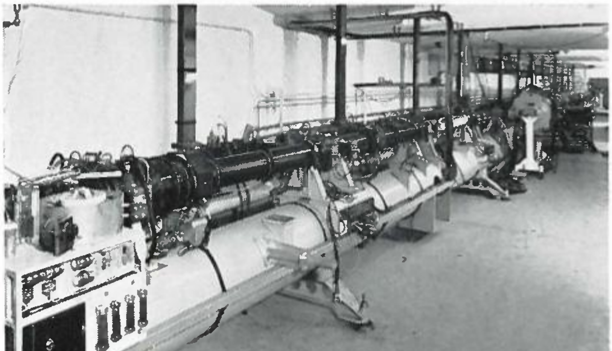


ESRO II carries seven experiments designed to study the sun and cosmic radiation. Five of the experiments are from British universities and will continue measurements similar to those carried out by Ariel III.
SRC is the agency carrying responsibility for UK participation in ESRO. In 1967/68, the UK contribution was 4.5 million pounds.

For the technically minded, the satellite weighs 163 lbs. It has a polar orbit with a perigee of 217 miles and an apogee of 684 miles. It will circle the earth in 99 minutes and each day its orbit will move one degree eastward to keep it within sight of the sun.

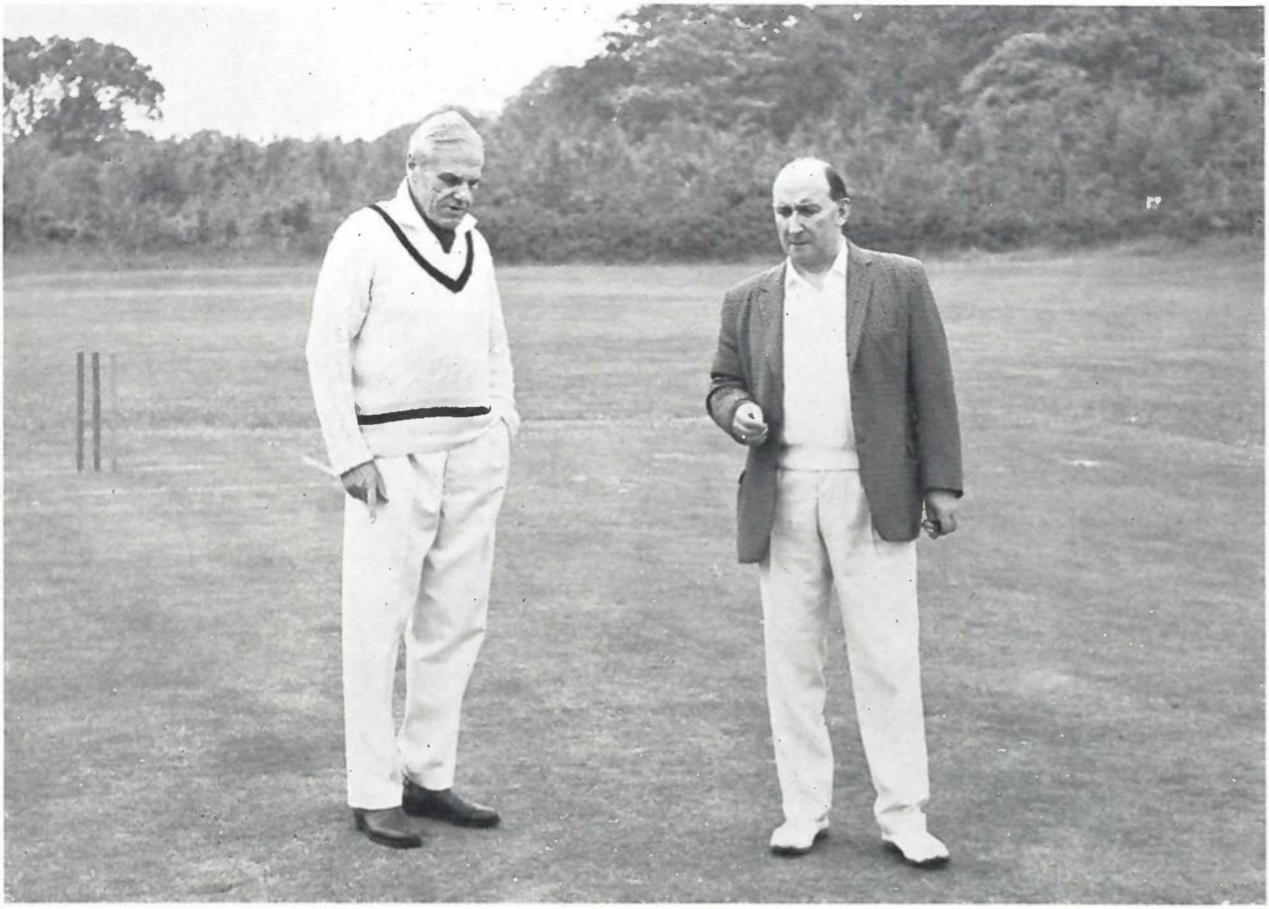


RUTHERFORD'S BUBBLE CHAMBER IS LARGEST IN THE WORLD
Also on display at the Royal Society symposium was a model of the large helium bubble chamber constructed as a joint project by the Oxford University Department of Nuclear Physics and the Rutherford Laboratory. It is the largest of its type in the world and contains 200 litres of liquid helium; the internal dimensions are 81cms by 40cms by 43cms deep.



Glasgow University's 100MeV electron linear accelerator, the largest yet built in Britain, was opened on June 10 by Professor Blackett, O.M., C.H., President of the Royal Society. There are now eight nuclear physics accelerators in British universities and the Glasgow linac is intended to serve the needs of Scottish universities.

VANQUISHED . . . SRC were well and truly beaten by a MPBW team in the Curtis Bennett Shield match at Harwell in May. They were all out for 48, Kershaw of MPBW taking eight for nineteen. In reply, MPBW made 52 for 2. Top scorer for SRC was Ray Smith (11).



'NO . . . IT ISN'T A QUASAR OR A QUARK . . . I THINK IT'S JUST A WORM-CAST.'

In fact it was a (seemingly pessimistic) inspection of the wicket by the Astronomer-Royal (left) *and Dr. Saxton during a match which was played between RGO and RSRS on June 16.*
'Greenwich' bowled out 'Radio' for 122 and went on to get the winning runs for the loss of only three wickets.
Top scorer for Greenwich was J. Hobden (44 n.o.). J. Philcox took 4 for 20, J. Hutchins 4 for 41 and Sir Richard 1 for 11.
Top scorers for Radio were N. Hussain 40, C. Bolton and E. Bramley 29. photo D. Calvert

contributors

E. B. Dorling, Ph.D.

'Mullard Space Science Laboratory' *page 2*

Senior Lecturer, Department of Physics, University College London. Former member of SRMU. Administrator, Mullard Space Science Laboratory, UCL.

M. V. Penston

'Quasars' *page 6*

Junior Research Fellow at Royal Greenwich Observatory; studying for D.Phil. at Sussex University.

R. F. Churchhouse, Ph.D.

'A Computer for all Purposes' *page 11*

Head of Programming Group, Atlas Computer Laboratory. Joint Author 'A Report of a Joint Working Group on Computers for Research'. (The Flowers Report); editor and joint author of 'Computers in Mathematical Research'.

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cover *Mute testimony to an English Summer. Sensibly clothed spectators at the first sports day*

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profile

Professor Sir Bernard Lovell, OBE, FRS

Chairman of the ASR Board

Who's Who devotes forty-eight lines to a catalogue of places, dates and distinctions awarded to Bernard Lovell the Scientist, but gives no hint at all as to the nature of the man. He has been described as an academic, detached, and severe, but these impressions are quickly disproved by his latest book 'The Story of Jodrell Bank'. This fascinating account of the agonising, sometimes desperate struggle to build the famous radio telescope is based on his diaries, so that the reader is quickly caught up in the excitement of the project. It is impossible to read this book without it creating a great feeling of admiration for his determination to succeed despite overwhelming odds and sympathy for the periods of utter dejection he experienced during some of the many setbacks.

No-one in the world had any experience of building such a colossus, so the engineering problems, financial guesstimations and the sheer magnitude of the project forced the small group of scientist, engineer and university Council to 'play it by ear'. Unfortunately they were playing with public money and the keepers of the public purse were highly sceptical of the soaring costs. The project floundered in a financial morass, with debts piling up and criticisms being fired from all directions. At one time, Sir Bernard lived under the shadow of being personally responsible for debts totalling a quarter of a million pounds, with a very real threat of imprisonment and the end to his career.

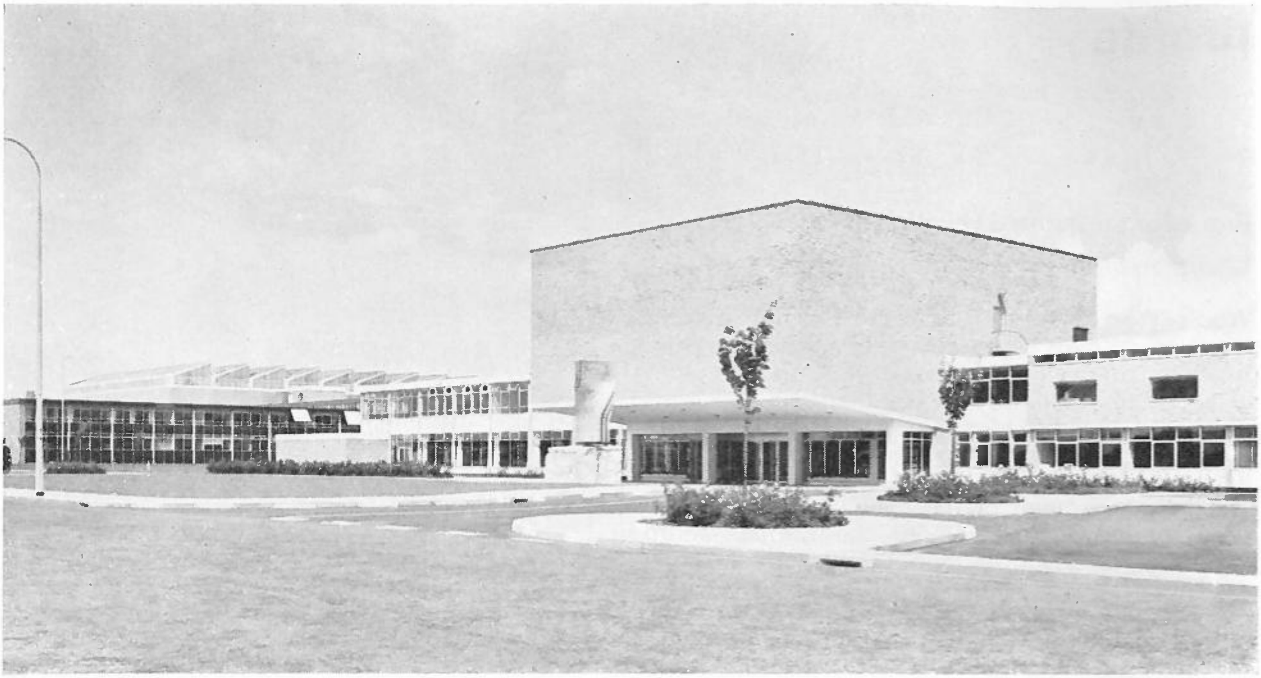
The result, as we all know justified the faith of the group and the instrument enjoys a unique position in the minds of the general public and in the scientific world. One book reviewer called it 'Our National Dish', if this be so, then assuredly Sir Bernard Lovell is the Chef de Cuisine.

Sir Bernard was born in a small village near Bristol and at grammar school devoted far more energy to proficiency at the wicket than to gaining academic kudos and was quite ready to leave after taking his School Certificate. It wasn't until he entered the Physics Department of Bristol University in 1930 that he settled into a routine of serious study. It was during that crucial six year period that he became enthralled by the new discoveries in physics and the revolutionary advances being made in astronomy due to the introduction of the 100 inch telescope.

He left Bristol in 1936 and went to Manchester as an assistant lecturer in the Department of Physics. A year later he married and was invited to join a team headed by Professor Blackett to study cosmic rays. The advent of war took him to the Air Ministry and to the Telecommunications Research Establishment where he worked on microwave radar.

He returned to Manchester in 1945 in an army truck towing a gun laying radar set, with which he eventually began his studies of large cosmic rays at a site in Jodrell Bank which belonged to the Botany Department of Manchester University.

The Professor is very fond of music and gardening and still finds time to play cricket, which he takes quite seriously as illustrated by a passage in his book: in September 1959 when the Russians telephoned to inform him of the launch of Lunik II which was aimed to land on the moon, the Professor was preparing to skipper the local cricket team; the American contingent based at Jodrell were being pressed by Washington to track the moon probe, but when they asked what the Professor intended to do, he replied 'play cricket'. It is part of history now of course, but he returned to set the telescope in motion and actually recorded the moment of impact on the moon . . . in the excitement of the moment he evidently forgot to record in his diary the result of the cricket match.



an SRC astrophysics research unit at Culham Laboratory

W. G. Griffen

The formation of an astrophysics research unit at the Culham Laboratory under SRC funding and control was announced in December 1967. The new unit is directed by Dr. R. Wilson and was formed from the Spectroscopy Division of the Culham Laboratory of the UKAEA. It takes over the programme of research of the Spectroscopy Division with some changes to align it to astrophysical aims rather than those of controlled thermonuclear fusion. The staff transferred to the new unit total about 30, mainly scientists, engineers and technical support staff, and they continue to enjoy the support of services and facilities from the Culham Laboratory. The annual scientific budget of the new unit (excluding salaries and overheads) amounts to about £100,000. Control of the scientific programme was transferred to SRC in April 1968 and transfer of staff and administration is planned for April 1969.

The laboratory, which is situated in pleasant country near Abingdon in Berkshire, was built during 1962–1964 to create a centre for controlled thermonuclear research in the United Kingdom. The staff was formed by the amalgamation of separate groups working at Harwell and Aldermaston and, in 1967, about 800 were employed at Culham, about 250 being professional scientists or engineers. In July 1967, following a re-appraisal of the progress towards and the potentialities of thermonuclear fusion for the generation of electric power in the UK, the UKAEA announced a run-down in the scale of fusion research by about 50% over a five year period. This decision led to a review of programmes of research at Culham including the work of the Spectroscopy Division; this work although undoubtedly of considerable scientific value had become of less significance to the fusion programme, partly because of the progress already made in the spectroscopic field but essentially because the immediate problem of fusion had resolved into one of plasma containment.

The main entrance at the Culham Laboratory. The large block above the entrance proper houses the lecture hall. The sculpture opposite the entrance is by Jeffrey Clarke and is symbolic of sheared magnetic surfaces in a plasma.

The part which spectroscopic observation had played in the study of high temperature plasmas for fusion research, developing from the work on ZETA in 1956–58, was a considerable one. This was a consequence of the basic nature of the spectroscopic method but also of the limitations of other methods of investigation imposed by the physical conditions within the plasma, for example a temperature of about 1 million °K and a density of 10^{14} particles per c.c.

Emission spectroscopy in the vacuum ultraviolet (VUV) region with wavelengths of 300Å to 3,000Å and in the soft X-ray region (XUV) with wavelengths of 3Å to 300Å have been the most useful for plasma investigations. Because the techniques, methods and the data available for these regions were at first inadequate, some research and development was necessary before spectra of adequate quality were obtained and satisfactorily interpreted. A series of papers on various aspects of spectroscopy at these wavelengths including instrumental developments, intensity calibration techniques, measurements of cross sections and the production and identification of new spectra were published between 1958–1968; these papers provided the basis of the international reputation now established in the field.

Because of the considerable physical similarity between the plasmas produced in fusion devices such as ZETA, and those occurring naturally in the atmosphere of the Sun and stars, comparisons between the spectra and the conditions producing them were instructive and occasionally even remarkable. The valuable interplay between fusion and astrophysics led, in 1961, to a proposal to the UKAEA and the British National Space Committee for Space Research to use the expertise and experience gained in the study of fusion type plasmas to carry out studies of the vacuum ultraviolet and soft X-ray spectra of the Sun from above the earth's atmosphere. It was expected that the improved understanding of the physics of the solar atmosphere which might result from these studies could well have a significant bearing on the problems of plasma heating and containment which were so vitally important for the fusion programme.

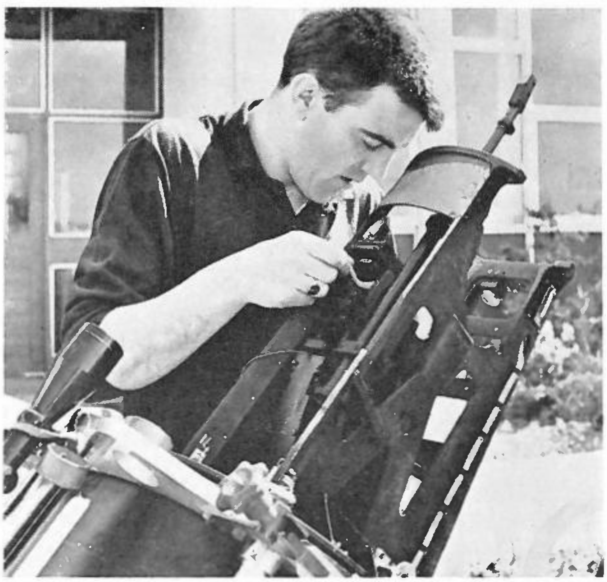
The Skylark rocket already used in the UK space research programme was ideally suited to this proposal but an essential requirement for such a programme was the development of a stabilised platform for the scientific package which would enable the spectrographs to be pointed accurately towards the Sun.

Proving flights of Skylark rockets with stabilised platforms instrumented by the Culham group were carried out from the Woomera range in Australia with considerable success, in August and December 1964; a pointing accuracy of about 5 arc sec was achieved, more than adequate to resolve spectra from the solar limb region. Spectra were obtained in the VUV region down to 950Å but the altitude was insufficient to record soft X-ray spectra. In the following year two Skylark flights with rockets equipped with the higher performance Raven VIA motor were made achieving altitudes of 210 km; these flights afforded excellent spectra in both VUV and soft X-ray regions. Further flights in this programme have since been made and have provided high quality spectra in the VUV and soft X-rays regions for different limb and disc positions on the Sun. These spectra have provided new data for the development of theoretical models of the solar atmosphere and this work is proceeding both at Culham and elsewhere.

In May 1965, ESRO commissioned a detailed study of a scientific payload of a Large Astronomical Satellite (LAS) to make VUV observations of the spectra of stars. This study, which was carried out by a UKAEA sponsored team led by Dr. R. Wilson and including several members of the Spectroscopy Division, was completed in January 1966. The report was adopted by ESRO in July 1966 but financial difficulties have so far prevented its implementation.

Thus by 1967 the scientific programme of the Culham Spectroscopy Division had already developed a strong astrophysical interest. While such a programme might no longer be important in a curtailed fusion programme there was little doubt about its value and significance in an astrophysical context. Thus, in December 1967, the Science Research Council decided to take the responsibility for this work and to incorporate the scientific programme within that of the Astronomy Space and Radio Board.

The account is now brought up to date. What of the future? The scientific programme of the unit has now been planned in outline for the



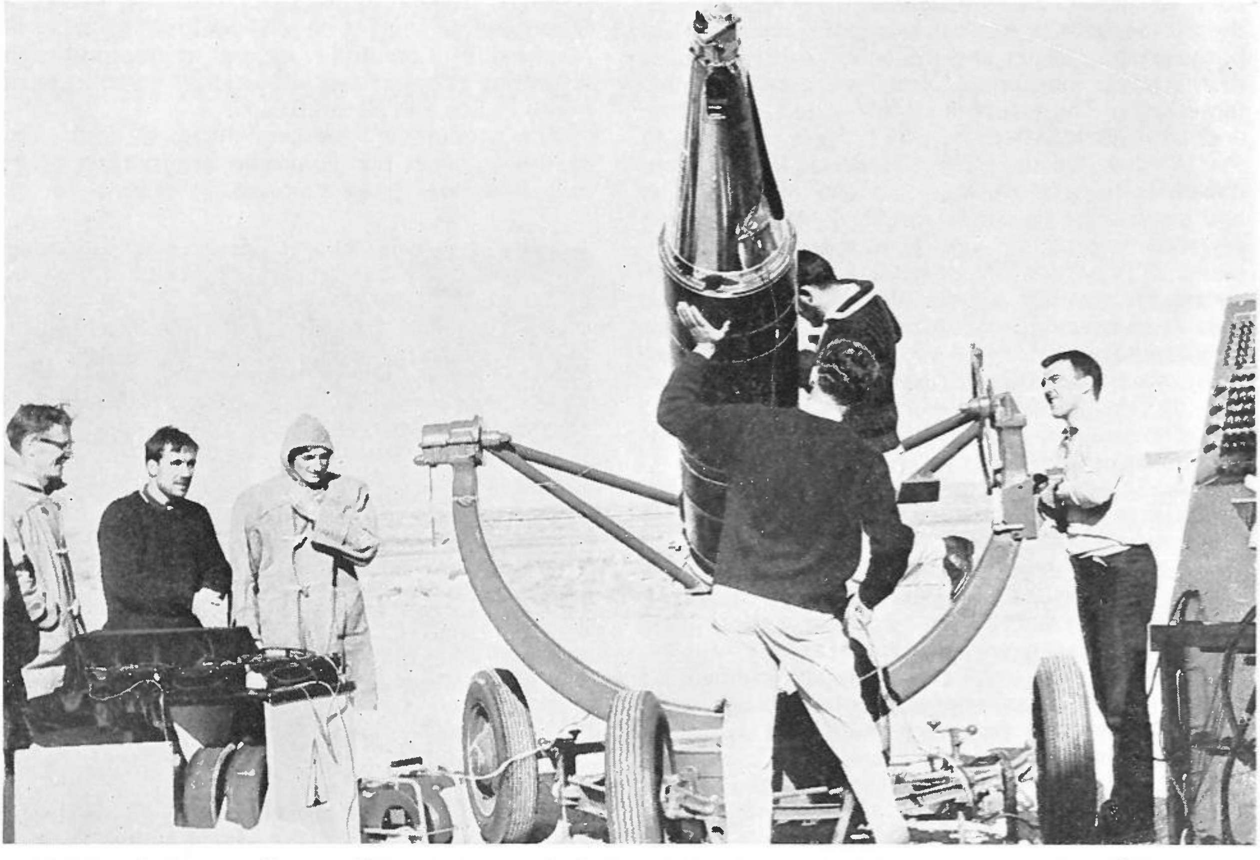
Sunlight testing of spectrographs of a Skylark rocket payload assembly.

next five years. Although the subjects to be covered and general distribution of effort will be similar to previous years, there will be expansion in some areas, particularly in the space research activities.

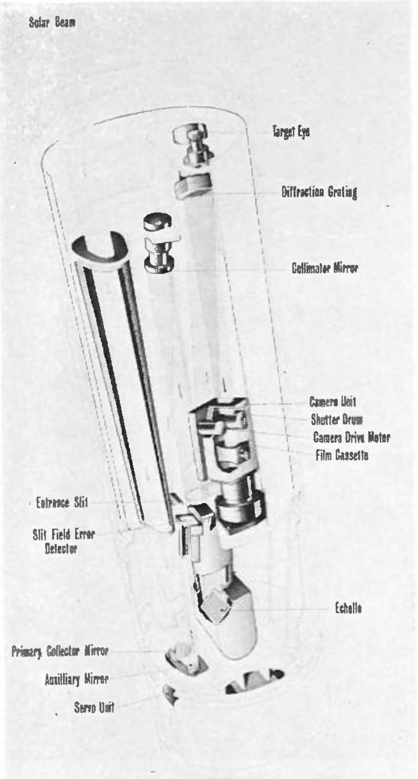
The programme of laboratory experiment will continue as before to obtain cross-sections and other data necessary for the understanding and evaluation of observed solar and stellar spectra. A new 40 kJ theta pinch device has been built which will provide a hot plasma ($T_e = 250$ ev), sufficiently well understood for useful studies of soft X-ray spectra of highly ionised atoms similar to those produced in solar flares. Theoretical work is in progress to try to improve our ability to calculate the basic features of complex spectra of this type. Further, in co-operation with physicists from Glasgow University it is hoped to make a substantial advance in our intensity calibration ability by employing the optical continuum emission from the Glasgow electron synchroton as a secondary light intensity standard. The synchroton continuum extends over a very wide spectral range from the soft X-ray region well into the visible and near infra-red regions and has the valuable feature that the spectral distribution of intensity is calculable from the synchroton parameters.

In the programme of studies of naturally occurring plasmas, the solar VUV observations from stabilised Skylark rockets will be extended with the emphasis on particular aspects of the coronal and chromospheric physics rather than with the broad surveys made hitherto. Flights early in 1969 are planned for payloads employing a crossed diffraction-grating and echelle spectrograph with high spectral resolution (0.02 Å) to make possible studies of the widths of solar spectral lines in the VUV region. The line profiles depend on opacity effects in the source region and also on broadening by Doppler motion of the emitting ions, so that study of the line widths (about 0.1 Å) could provide temperature measurements for different regions of the solar disc.

However in the future a large part of the space astrophysics work will be concentrated in a phased programme of studies of VUV spectra of stars and nebulae from Skylark rockets which received approval and funding during the year. This programme of stellar exploration will have access to an enormous range of observation, in a field hardly broached. It can look at stars differ-

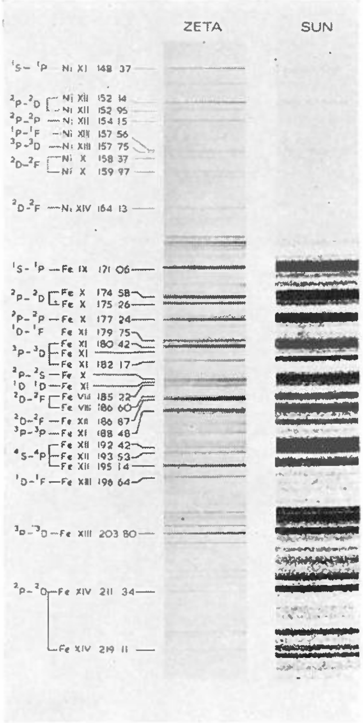


ARU staff and others making pre-flight checks on a Skylark rocket payload at the Woomera range in July 1964.



ECHELLE DIFFRACTION GRATING SPECTROGRAPH

Wadsworth Mounting
For use on Skylark Sounding Rocket



Comparison of spectrograms of the Sun and ZETA showing notable simularities in the region 140Å—220Å.

ing very widely in physical constitution, with a choice from many hundreds bright enough for observation (brighter than 5th magnitude). Extended stellar sources and also the spectral absorption of the interstellar medium can be examined. The implication of such a programme in terms of our understanding of the physical nature of stars and of inter-stellar matter could be profound.

The first stage of this programme, which is a joint venture with University College, London, employs a simple slitless spectrograph with vehicle stabilisation requirements similar to that of the solar experiments; parachute recovery of the film is required as in the solar programme. The first flights are scheduled for early 1970. Later stages of the programme will employ telescopes to increase the light gathering power thereby making possible the viewing of stars down to 5th magnitude. These experiments will demand a high degree of platform stabilisation (about 1 arc sec) involving the development of more sensitive pointing systems. Later payloads may use photoelectric detection instead of photographic film to increase the sensitivity and more sophisticated spectrographs to increase the spectral resolution.

In addition to these experiments in the national programme, several scientific payloads are in preparation for VUV and soft X-ray observations of solar and stellar spectra from rockets to be fired in the ESRO programme.

The unit is also involved in several VUV space experiments in association with University groups. Scientific payloads for high resolution studies of the resonance lines of Mg II across the disc of the Sun are being prepared in collaboration with Queen's University, Belfast for Skylark rocket and for balloon platforms. The feasibility of using rocket VUV observation during a scan of the solar disc by the moon at a total eclipse (1972 North America) to obtain precise information about the structure of the solar atmosphere is being examined in association with Imperial College and groups in the USA and Canada. Finally X-ray experiments for Leicester University have been flown with Culham instruments in many of Skylark solar flights. In addition to these joint ventures with University groups, academic links have been further strengthened by a working arrangement which has been established with University College, London for further joint experiments and for various academic exchanges.

For the staff of the unit the future should be exciting and if only a fraction of projected aims are achieved, the accomplishment will be considerable.

Leopards, landscapes, and 'Royal' telescopes

a short account of the work of the
Royal Observatory, Cape of Good Hope

J. B. Alexander

The Royal Observatory, Cape of Good Hope, was founded in 1820 for the improvement of practical astronomy and navigation. At this time, although several northern observatories were engaged in the determination of the positions of stars, the southern sky had been very neglected. The reason for this is not hard to find; most of the countries south of the equator were not highly developed at the beginning of the nineteenth century.

The Observatory was built about three miles from the centre of Cape Town in what was then a rather isolated position. However, it was near enough to Table Bay to allow visual time-signals to be given from the Observatory to vessels in the anchorage. Fallows, the first HM Astronomer at the Cape, chose a site which was part of a bare, rocky hill covered with thistles and infested with snakes; the jackals howled dismally around it at night-time and a guard of soldiers was required to protect the property of the Observatory from theft.

Sir David Gill, who was HM Astronomer at the Cape at the turn of the century describes an incident in these pioneer days. 'After the Observatory building had been nearly completed but before the scaffolding and ladders had been removed, Fallows went into the mural circle room one evening, after the workmen had gone, to test the opening of the shutters. He had prided himself on the design of these shutters and the ease with which any particular one could be opened. But on pulling the rope to open the shutter for observing zenith stars, he found that it would not move. He ran up the staircase leading to the roof, peeped out of the door at the top, and there comfortably seated on the central trap door of the meridian opening, was a large leopard. The astronomer and the leopard both disappeared rapidly in different directions.'

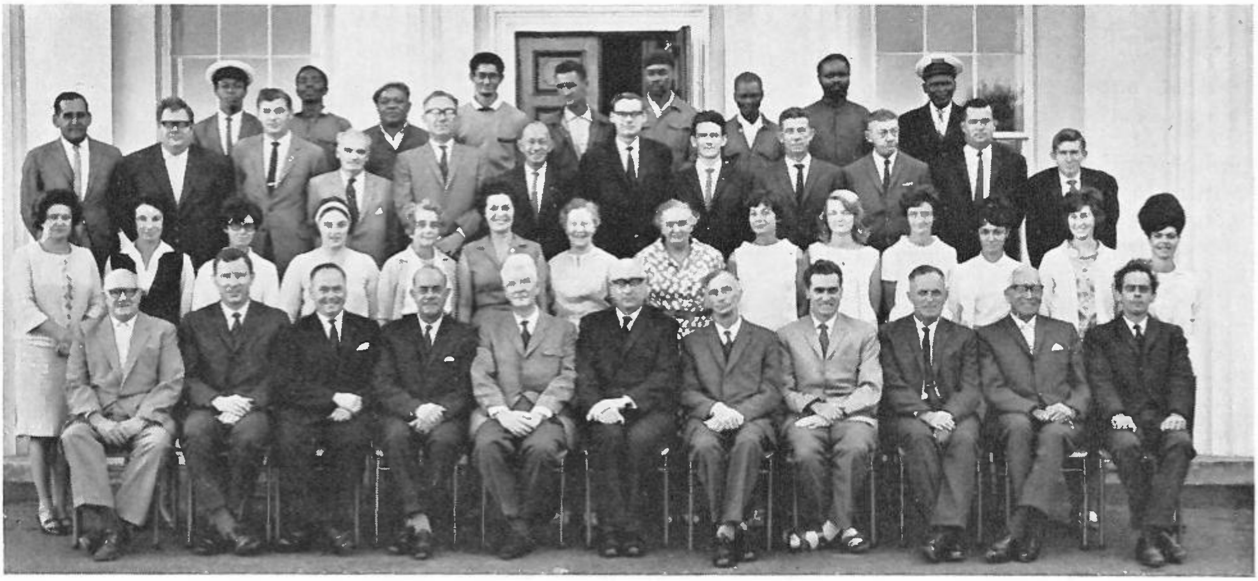
Determined to avoid a recurrence of this unpleasant experience, Fallows opened a school and taught the children of the nearby farmers for a fee of one load of earth for each lesson. The soil was used to cover the bare rock and this not only helped to remove the menace of the snakes but it allowed trees to be planted as a wind-break.

When the Cape Observatory was founded, there was a real need to improve the determination of the positions of stars for practical purposes. The precise positions of a relatively small number of southern stars were required for navigation and for the determination of time. However, the urgency of this problem became less and less as data of greater accuracy were accumulated. In the late seventeenth and in the eighteenth centuries, the main academic interest in astronomy was in the dynamics of the solar system.

Although this topic is still an active field today, it occupies only a small fraction of the total manpower engaged in astronomical research.

A series of rather gradual developments in the nineteenth century, followed by the very rapid advances of this century, has greatly broadened the outlook of astronomers. Astronomers are now very much interested in stars as entities in themselves; their positions, colours and spectra are studied for their own sake with no direct utilitarian view in mind. The Cape Observatory has shared in this general trend, at the same time continuing with the older aspects such as the provision of a time-service. We shall not review the history of nineteenth century astronomy in any detail, but we shall briefly mention two very important developments where the Cape Observatory made a major contribution. These are the derivation of the distance to a star by Henderson, and the introduction of photographic techniques on a large scale by Gill.

Conjectures as to the distances of the stars had been made by several scientists a long time ago. These were either lower limits based on the absence of any sensible parallax or estimates obtained by assuming that the intrinsic luminosity of a typical star is the same as that of the Sun. Because the Earth moves in an elliptical orbit around the Sun, a nearby star will appear to describe a small ellipse in the sky relative to a much more distant star. Three astronomers, Bessel in Germany, Struve in Russia and Henderson in South Africa, all made a reliable determination of the distance of a 'fixed' star at about



from left to right

front row
B. F. Offen
G. R. Acaster
H. P. C. Cook
J. v. B. Lourens
D. S. Evans
R. H. Stoy
A. W. J. Cousins
D. V. Thomas
A. Menzies
T. W. Russo
S. V. M. Clube

second row
M. C. Coetzee
R. M. Banfield
B. Brown
M. J. Parr
W. F. Turner
E. Fiamingo
G. P. Bradshaw
D. E. Johnson
G. G. Schonrock
C. Van den Berg
J. M. R. Cammidge
C. A. Byrnes
H. J. Webster
M. Malan

third row
A. T. Rose
J. Churms
R. E. Wallis
L. C. Browne
O. G. F. Fiamingo
W. A. Rasmussen
B. D. Yallop
D. J. Momsen
D. J. Rigby
R. P. de Kock
D. S. Malan
W. G. Pearson

fourth row
M. A. Congwane
Z. N. Matiwani
L. Makobs
P. P. Okkers
K. J. Jacobs
J. Blom
G. Mgayiya
N. G. Thompson
J. Masithela

the same times using this parallactic method. Henderson's results for the bright southern star Alpha Centauri were published in 1839.

Gill, who was one of the greatest observational astronomers of his time, made an outstanding contribution to astronomy with the introduction of photographic catalogues of the sky. When he examined plates of the great comet of 1882 taken with a portrait camera, Gill noticed how many stars were visible on the longest exposure. He immediately conceived the idea of taking direct photographs of the entire southern sky. Photography had been used before this in astronomy, but Gill was the first to use it in star charting.

The present Royal Observatory has a total complement of 55 people, of whom about 30 are directly involved in astronomical work. The majority of the staff are South Africans, but over half of the observational astronomers are based at the Royal Greenwich Observatory, Herstmonceux and are seconded to the Cape for a limited time. (The most common period is three years). In addition, there are often visiting astronomers from abroad and graduate students from the University of Cape Town using the facilities of the Observatory. The association between the Observatory and the University has for long been a happy and fruitful one. However, it was only in 1957 that this connection was formalised by the creation of a Department of Astronomy in the University, with the present H.M. Astronomer at the Cape, Dr. R. H. Stoy, as Professor.

The two largest telescopes are the Elizabeth reflector and the Victoria refractor. The Elizabeth has an aperture of 40 inches and was installed in 1963. It is used mainly for photoelectric photometry. The Victoria is a multiple refractor with a 24 inch photographic objective and an 18 inch visual objective. It is used for the determination of trigonometric parallaxes and for photoelectric photometry. There are also 30 inch and 18 inch reflectors, a 13 inch refractor, a 6 inch meridian cicle, a Danjon prismatic astrolabe and two photoheliographs, one for photographing the Sun in white light and the other in the light of H alpha. A variety of wide-angle cameras are used for astrometry and for photometry. Observations of artificial satellites are made with the Askania Kinetheodolite. The Cape staff also share in the use of the 74 inch Radcliffe reflector at Pretoria which is at present an SRC responsibility under the terms of a seven year agreement with the Radcliffe Trustees. Most of the observing time there has been spent doing radial velocity work on individual stars, planetary nebulae and galaxies.

The Cape Observatory is well-known for its work in positional astronomy. The transit circle, which is in regular use for observing the positions of stars and planets, is of particular importance since the Cape instrument was for a long time the only one in the southern hemisphere. In recent years, observations made with the astrolabe have served as a check on the systematic accuracy of the previously adopted positions of some of the bright stars in the southern sky. Experiments are being conducted with photographic plates secured with a wide-angle lens; using the method of overlaps, it is hoped to obtain greatly improved relative positions (and in time, proper motions) of stars widely separated from each other in the sky.

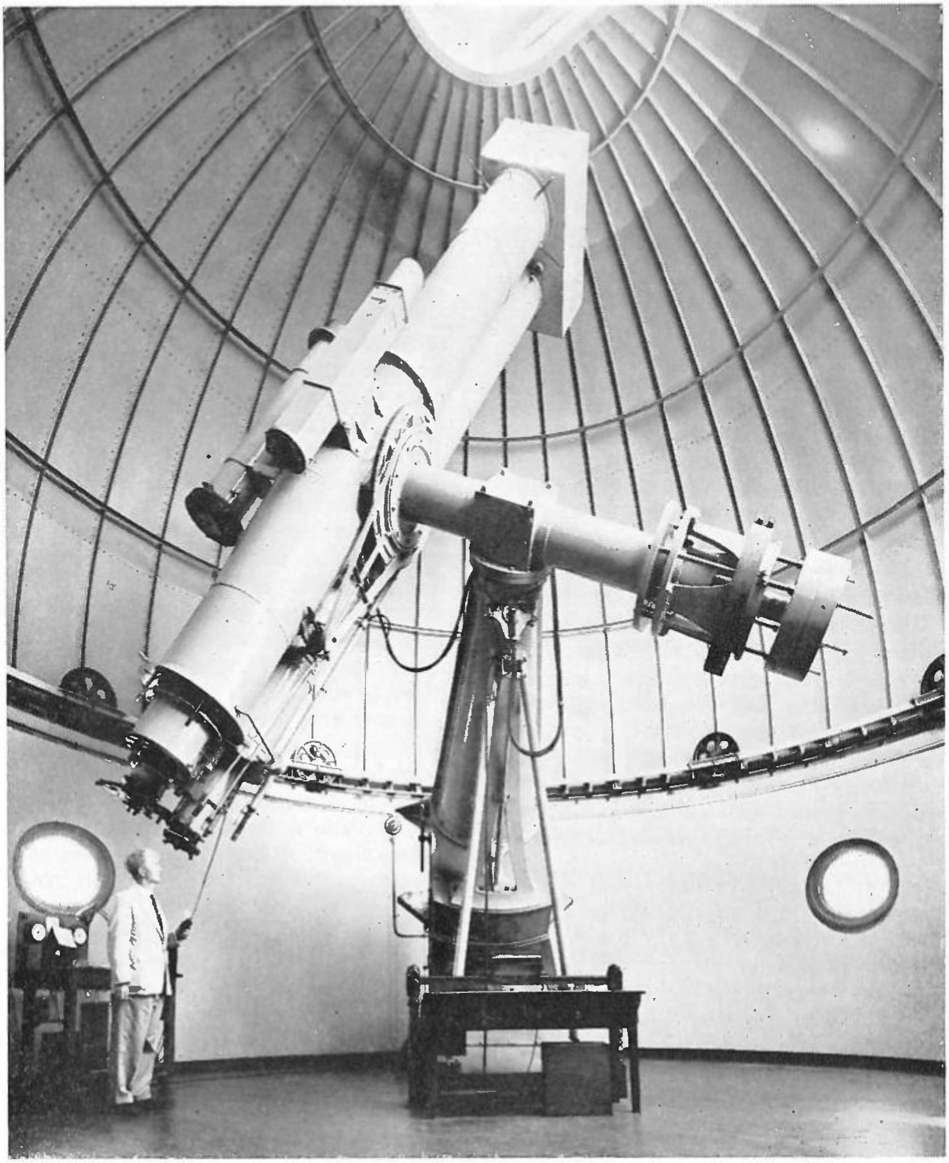
Mention must be made of the Cape Photographic Catalogue for 1950. This immense undertaking has just been completed after 25 years work. This catalogue gives accurate positions for 68,397 stars. Unlike its northern counterparts, it also gives newly determined proper motions, magnitudes, colours and spectral types. It is a mine of information both for the statistical astronomer and for the astronomer looking for individual stars of special interest.

In the field of photoelectric photometry, much work has gone into providing standard stars with accurately determined magnitudes and colours. Bright stars all over the southern sky have been carefully observed; these can be conveniently used as secondary standards. A large amount of routine photometry on stars of intermediate brightness (e.g. nearby stars, RR Lyrae variables) has also been carried out during the last few years. Photometry of faint stars is no longer possible at the present site because of the brightness of the night sky, but there is a possibility of moving the Elizabeth telescope to Sutherland, 235 miles inland from Cape Town, which has a climate favourable to optical astronomy.

Considerable attention has been paid to a study of the nearest stars in the southern sky. Trigonometric parallaxes have been obtained with the Victoria telescope. Radial velocities of these stars have in many cases been obtained from spectra taken by Cape personnel at Pretoria.

Radial velocities have also been obtained of objects of special interest such as selected stars in the globular cluster Omega Centauri, RR Lyrae and W. Virginis stars, planetary nebulae and galaxies. For the fainter objects, a specially fast spectrograph has been designed for the Newtonian focus of the Radcliffe reflector; it has now been in use for a few years. Finally, we shall make some general comment on the need, as we see it, for astronomical observations in the southern sky at the present time.

In certain branches of astronomy, there is a need to balance northern observations with southern ones in order to eliminate certain types of systematic errors. However, one of the main reasons for observations of the southern sky is that it contains considerably more than half of the interesting objects in the entire sky. The centre of our Galaxy is only observed with difficulty from California, but it passes near the zenith in South Africa. Observations of the Magellanic Clouds, the nearest galaxies to our own, can only be made from a site which is far south. A 20-inch telescope working on the Magellanic Clouds can detect stars which have the same intrinsic brightness as stars in the Andromeda nebula which are at the very limit of the capabilities of the 200-inch telescope on Mount Palomar. There are also of course a great number of interesting objects in the general field in the southern sky. Since there are far fewer observatories south of the equator than north of it, the interesting objects in the south tend to have been observed far less than corresponding ones in the north. There is therefore a great need for continued observations of an astrometric, photometric and spectroscopic nature in the southern hemisphere. The advent of the large telescopes in Australia and South America in the near future will increase rather than decrease the demand for observations with telescopes of moderate size.



Dr. D. S. Evans at the controls of the Victoria telescope.

enquiries from the general public

Some experiences of an Observatory spokesman

R. H. Tucker

It all started about a year ago.

The telephone rang. Being rather busy, I sighed before picking up the receiver and giving my name.

It was the DCSO.

'Could you spare a minute to come over and see me?'

I decided I wasn't so busy after all. You know how it is.

I made my way to his office. (What's up now, I wonder?)

'Take a seat' (Good sign. Nothing catastrophic, anyhow.)

'You know Mr. R has retired?'

'Yes I knew that, R had been quite a pal of mine. Nice chap.

'Mr. R was responsible for dealing with letters from the public and for arranging the conducted tours of the establishment.'

Aha, the light begins to dawn!

'It has been decided to ask Mr. S to look after the conducted tours. We should like you to deal with the letters. You will also share with Mr. S the duties of Press Officer.'

The blow had fallen. I gazed with wild surmise, but was silent.

'This does not involve answering all the letters yourself. In many cases you will be able to send them to other people for reply. You will soon get to know who is the best person to provide an answer on a particular subject.'

I thought that this was a rather novel way to make friends and influence people. After a brief discussion on minor matters, I said I would do my best and left the Presence.

So now to work. First job, take over the file. Judging from the size of the file, 'Enquiries from the General Public' accounted for a large fraction (it turned out to be about ten per cent) of the establishment's correspondence, but this was hardly surprising; after all, the Royal Greenwich Observatory is well known and is surely the obvious place to consult on the many astronomical topics which are so puzzling, and so fascinating, to the ordinary citizen.

It was soon discovered that there was a bit of a backlog to catch up. This eventually amounted to about thirty letters. On several of these R had made notes to assist in drafting replies, so I decided to polish these off by taking them all home for the weekend. By the Monday morning I had twenty-six replies drafted, and the typing pool sent in a relay team who took the dictation in batches of eight letters at a time. This was my first real experience of dictating, and I was greatly impressed by the magnificent way in which the young ladies rose to the challenge. After this operation, the job reduced to dealing with the letters as they arrived, usually a steady trickle of about eight per week, with occasional periods of greater activity when some astronomical subject aroused public interest.

At first there seemed to be no pattern in the letters; most of them contained specific questions, and required individually drafted replies, based on standard reference books, or on a little research in the library. My education began to make spectacular progress as I grappled with such problems as the state of the tide in Pevensey Bay on a certain date in 1703, the strange 'dark day' in New England in 1780, the meteor shower in 1833, the possibility of there being more than one Sun, and the identity of a bright star or planet seen in a certain direction at a certain time.

After the first two months, however, it became noticeable that a fair proportion of the letters came from school children who asked for leaflets, pictures or information which could be incorporated in a 'project' they were doing at school. The same answer would serve in all these cases, and a stock reply letter was adopted and duplicated, referring the enquirer to the local public library, and to the standard sources of information. When similar letters began to arrive from the USA, another stock reply was composed, giving American standard sources, and including a brief summary of the history of the Royal Observatory.

Some of the letters written by children are not connected with their school work, but these are extremely interesting, because the writers are obviously strongly inclined to astronomy in their tender years, and stand a good chance of making it their chosen hobby or profession in due course. As the Observatory is now recognised as being concerned with scientific research, we follow the policy of giving encouragement to all such enthusiasts, and endeavour to answer their questions in full detail. The preparation of such answers may involve several hours of work, for it is well known that children's questions often go right to the heart of the matter, and the young mind is not easily deceived, as any conjuror will tell you.

The question which took the longest time to answer came from a boy in Oxfordshire who became interested in single and triple conjunctions of the planets Mars, Jupiter and Saturn. These conjunctions are events which occur from time to time, and follow a pattern which seems to be irregular over the years, but is actually regular over the centuries. The problem is similar to the fascinating way in which eclipses of the Sun and Moon fall into a pattern when considered over the centuries, but the difference is that eclipses have been documented in detail over several thousand years of the past and future, while planetary conjunctions have not.

A class of letter which is not so welcome comes from people who hold unorthodox views, and who complain that there is a conspiracy among established scientists to suppress the unorthodox 'truth' and to compel conformity with orthodox 'falsehoods'. It would be very easy to dismiss these writers as eccentrics, and to ignore them, but this does not seem a very scientific thing to do. It can well be imagined that if Newton or Einstein had presented their novel theories in correspondence, the views would have appeared very unorthodox indeed, but the person who decided to ignore them would have done so at his peril. It may be irksome to conduct a futile argument with the gentleman in India who flatly denies the rotation of the Earth, or with another in Lancashire who sees diagrams proving Pythagoras' Theorem formed by stars in various constellations, but courtesy and patience cost little, and it does help these people to know that at least somebody has taken the trouble to read their letters.

Occasionally there is a letter which is completely incoherent, usually without an address for reply, to which an answer is quite impossible; and there was one example so offensive that it merited immediate destruction.

A sharp increase in the number of incoming letters followed the widespread reports of sightings of Unidentified Flying Objects in the autumn of 1967. Many people who had seen such things over the years, but who had not dared to say so, now plucked up courage and sent in their descriptions of saucer shapes, cross shapes, spherical shapes, cigar shapes, hovering, moving rapidly, flashing red lights, pulsating orange lights, silent, humming deeply, flying alone, flying in formation, departing rapidly, departing slowly, vanishing into thin air. One or two of the sightings could be identified with a bright star or planet, but most were clearly not astronomical at all.

After this episode things quietened down a little, and we got back to the usual run of school projects, and 'could you recommend a good star map', and 'is space really infinite', and 'what was the time in Bombay when it was 8.5 a.m. in the Malay Federation in 1937?'

There are a good many other people who are interested in the complications and details of Time, including Summer Time, Zone Time, and that far-off mystery the International Date Line, where you have to alter the calendar rather than the clock. The calendar itself causes one or two puzzles about Leap Years, and what was the first day of the 20th Century, and were there only 365 days in the year in ancient Egypt? The Moon often attracts attention, and people want to know all about its size and motion, and why was there no Full Moon in February 1866? One or two people can remember seeing an eclipse, or a comet, in their early days, and now wish to fix the date when it must have happened.

The other planets of the Solar System are a favourite topic for study by various folk ranging from a Londoner who is busy finding out whether there is an undiscovered planet beyond Neptune and Pluto to the Oriental philosopher who informs us that Jupiter is drawing atoms into itself, and that something exciting will happen on a certain date. The periodic comets are of great interest to historians as providing a means of fixing dates in the past. One school-girl looked up the dates of recent apparitions of Halley's Comet, and complained that the figures did not work out right if it appeared in 1066. She was quite correct: the interval between apparitions has varied considerably over the two thousand years since the earliest Chinese record of a sighting of this comet, and all credit to the young lady for discovering this little-known fact for herself.

One of the smallest members of the Solar System has recently come into the limelight, namely Minor Planet 1566, otherwise known as the asteroid Icarus. Its claim to fame is that it was expected to pass close to the Earth in June 1968, and this rather worried a gentleman in Surrey who planned to take a holiday in Sorrento at the critical time, and was anxious about being trapped at the foot of the cliffs by a tidal wave. We were able to reassure him that the diameter of Icarus is only a mile or two, and that when astronomers say 'close approach' they really mean, in this case, nearly 4 million miles. It is therefore extremely unlikely that any cataclysm will overtake us, but, of course, we cannot really be sure about such things.

council commentary

This is a new feature which will be of great interest to many readers. The Council has agreed that Dr. Willis of the Council Secretariat, shall prepare a potted version of the Council's monthly deliberations, so that in each quarterly issue of Quest, it will be possible to review three meetings.

In this first edition, the most newsworthy item is of course, the 300 GeV decision, and whilst the subject has been well aired in the press, the background to the decision makes interesting reading.

The regular Council meetings are held on the third Wednesday of each month except August and September and since the volume of work has been growing, they now regularly start at 11 a.m. continuing through most of the afternoon after a short break for a sandwich lunch.

In January, February and March the Council received broad statements of policy and programme from the NP, ASR and UST Boards respectively, various aspects of the work being further illustrated by oral accounts given by the Board members on the Council. The Secretary of State for Education and Science (The Rt. Hon. Patrick Gordon Walker) and the Minister of State (Mrs. Shirley Williams) attended the ASR and UST Board's presentations respectively. The Council have approved the publication this year of the most generally interesting parts of the ASR Board's statement, and intend from time to time in future years to approve the publication of similar statements from the other Boards. With the advantage of this very full review of the policies of the three Boards, the Council went on in April and May to draw up its financial five year Forward Look, which has to be submitted to the Government each year. The Chairman and the three Board Chairmen presented a summary of the Forward Look at a meeting of the Council for Scientific Policy, where it was well received. The May meeting was held at the Royal Observatory, Edinburgh. A very interesting tour of inspection was arranged, and members were most hospitably entertained.

At the June and July meetings, the Council considered altogether some forty matters great and small, the most weighty of which was the Government's decision not to participate in the proposed 300 GeV accelerator project. Notwithstanding the present adverse decision, the Council accepted the view of the NP Board that participation in either the 300 GeV or a similar European project was vital to the future of British high energy physics in the 1980s. The Council therefore agreed that, although a 300 GeV project could no longer be provided for in the planned programme, the possibility of the UK joining this or a similar European project later on must be kept constantly in mind. Meanwhile, in view of the economic situation and the 300 GeV decision, the Council decided to reduce its request for funds in the next five years. The new proposals seek funds increasing from about £42 million in 1968/69 to about £57 million in 1973/74 and, within a falling nuclear physics share of the total budget, envisage a slightly larger domestic nuclear physics programme than was proposed in the original Forward Look.

Sir Harold Himsworth Deputy Chairman and Secretary of MRC and Dr. J. A. B. Gray, Secretary-elect of the MRC, attended for part of the June meeting to describe the MRC's highly successful ways of supporting inter-disciplinary research. Another interesting item in June was the planning of a co-ordinated programme of development of ground-based infra-red astronomy by groups from Imperial College, Queen Mary College, University College and Edinburgh University with the ROE. This is a fairly new subject. Although water vapour in the atmosphere absorbs the infra-red radiation it has been shown recently that ground-based observations are possible at mountain sites in certain parts of the world.

In July, the Council received a general report from the UST Board on their work in the session, and approved six recommended grants outside the powers of approval delegated to the Board, five because they exceeded £50,000 and one because of its unusual nature. The latter was a grant of £14,500 over three years to Professor F. R. Bradbury (Stirling University) for an investigation into the best ways of allocating research and development funds between competing projects. Four of the five grants over £50,000 were for the development of computer applications, for example a grant of £68,100 over three years to Dr. D. H. Sleeman (Leeds University) for the development of improved techniques for computer-assisted learning. Two proposals for new centralised facilities were also approved. The first of these, a result of the concept of a National Instrument Centre which has been under discussion for some time, is an arrangement providing for the use by universities of the services of instruments such as nuclear magnetic resonance, infra-red and mass spectrometers at the AEA Harwell and Aldermaston laboratories. The second, in collaboration with the Rubber and Plastics Research Association, is for a polymer supply and characterisation centre to be sited at the RAPRA Laboratories at Shawbury, Shropshire.

In the ASR Board's field, the Council began its review of space research policy which will take some time to complete, and meanwhile recommended proposals for a further stage in the programme of British satellite experiments launched through the co-operation of the USA National Aeronautics and Space Administration.

The report of the Fulton Committee on the Civil Service was noted at the July meeting, and the Council looked forward to considering its application in the SRC later, in the light of discussion within the Civil Service and with the SRC Staff Side.

Finally, in July the Council approved a change in patents policy. This was complicated, as patents matters usually are, but broadly speaking, except at the Rutherford, Daresbury and Atlas Laboratories, which will continue to deal with the AEA, the NRDC will take over the responsibility for seeing that the results of research supported by the SRC are exploited in the national interest. The SRC will not seek a share in the revenue from exploitation, and the NRDC will not charge for its services.

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a plain man's guide to accelerator static power supplies

J. A. Fox

The orbital magnet systems of some particle accelerators require extremely large cyclic pulses of energy, 50 to 100 megajoules with peak power excursions of $\pm$ 150 megawatts or so.

Since pulsating loads of this type would cause unacceptably severe voltage fluctuations to be induced in the public supply network – equivalent to switching say Oxford on and off every few seconds – the normal solution has been to install motor-alternator sets near the accelerator to act as a buffer between the supply authority and the magnet. This kinetic energy storage method permits the input power from the 'mains' to remain almost constant whilst the output power pulsates.

About $2\frac{1}{2}$ years ago we started to become increasingly unhappy about the reliability of these large motor generator sets. Several failures had occurred, with more to follow, resulting in considerable 'outage' time at various laboratories. It was apparent that regardless of the ingenuity of design engineers, the special nature of the pulse load imposed complex loading conditions that were outside normal technological experience and consequently such motor generator sets would continue to carry a definite element of risk.

The reliability prospects for the proposed 300 GeV accelerator, with its even larger motor generator requirement, did not appear overbright and it was this consideration that provided the initial impetus to our study. Other accelerator applications have since followed.

In considering what sort of power supply alternatives might be available to us, our thoughts naturally turned to connection of the pulse load directly to the public supply – back to square one in fact. The two principal questions were:

(i) Could we install some reliable type of apparatus that would compensate for the reactive component of the pulse load and thereby limit, to acceptable values, the induced voltage fluctuation in the public supply.

(ii) If the voltage problem could be solved, were national power systems sufficiently strong to accept the pulse load and distribute it fairly uniformly among the various generating stations without incurring unpleasant disturbances.

There were, of course, a number of other questions but this article is entitled 'a plain man's guide' and, for the plain man, the law of diminishing deception applies.

The first task then was to solve the voltage fluctuation problem since if we couldn't do that there was little point in proceeding to the complicated, and potentially more expensive, problem of the dynamic behaviour of a large power system in response to a 300 GeV type pulse load.

The pulse-induced voltage fluctuation in public transmission systems is predominantly related to reactive drop due to the high X : R ratio of lines and transformers and the lagging power factor nature of most loads. Hence it can be compensated by the provision of reactive current at or near the load point with a phase relationship in opposition to that of the load reactive-current producing the original voltage drop. This in fact means having some form of variable shunt capacitor at the accelerator supply point and controlling it in a precise and repeatable manner to both minimize the pulse-induced voltage disturbance in the public supply system and provide a reasonably constant voltage platform for excitation of the accelerator magnet.

Variable capacitors are of course manufactured for radio sets but not alas in the size we require – 120 Megavolt amperes. The alternative approach, incremental switching of small fixed-capacitor units is a little too ambitious at present. There are however two other possibilities which seem quite practicable – a fixed capacitor bank in combination with either a large saturated reactor or a group of incrementally switched air-cored inductors. The reactor current which is, of course, in phase opposition to capacitor current, is controlled in such a manner that the resultant current from the capacitor/reactor combination can vary from inductive to capacitive in accordance with the compensation requirements.

The Atlas computer at Chilton has been used to study several variants of these basic schemes for application to the 300 GeV, Nimrod, CERN PS Booster and the High Magnetic Field Laboratory proposal.

Having resolved the voltage problem the more onerous task of establishing the power system dynamic behaviour was considered and it was agreed with the CERN 300 GeV group to take the United Kingdom power system (CEGB) and the Mundford site as the study basis. This proved to be a happy choice and we have benefitted greatly from the sustained and enthusiastic professional help supplied by our CEGB colleagues.

The joint SRC/CEGB investigation commenced with a computer study of the dynamic behaviour of the UK power system. The CEGB programme gives an advanced representation of all significent generator, transmission and load elements in their system. The time dependent pulse load quantities (i.e. the input) were provided by the SRC Atlas programmes.

It was of course recognized that, regardless of the sophistication of the theoretical approach, no gigantic engineering/commercial enterprise like the CEGB could afford to take chances with their system behaviour, particularly since we were jointly breaking new ground together, and some sort of convincing practical demonstration was obligatory. This was a sensible approach and also beneficial to the accelerator since if the 300 GeV load connection had gone ahead on a 'suck it and see' basis and system disturbances had proved intolerable it would have been rather embarrassing to redesign the magnet power supply using high-speed gas or some other energy-yielding commodity.

Self-interest, the key to most things in life, gave us the opportunity of exploiting the October 1967 Nimrod mg set breakdown by arranging a direct pulse test between the Nimrod magnet and the CEGB 400 kV super-grid connection at Cowley, Oxford. Pulse trains with peak power swings of up to 60 MW were applied at frequencies ranging from 0.3 to 0.1 cps. Measurements of the pulse-induced frequency disturbance were made at Daresbury and the results analysed on the Atlas Computer using the BOMM time series analysis programmes developed by Sir Edward Bullard and his colleagues (referred to on page 16 of Quest 3).

In June of this year the experience gained during the Nimrod dress rehearsal played a useful part when extensive 160 MW pulse tests were carried out between the CEGB and Electricité de France using the Cross-channel submarine cable that provides a d.c. interconnection between these two national systems. The CEGB system was repetitively pulse loaded and the EDF repetitively unloaded. The measurement programme was very comprehensive and included the Daresbury, Rutherford and CERN laboratories who undertook frequency measurement and the Atlas computer Laboratory where the time series analysis was carried out.

In August it was our pleasure to assist our CERN colleagues in the analysis of generator and frequency disturbances induced in the collaborative pulse tests with the CERN PS and Services Industriels de Genève power system which were undertaken to determine the feasibility of a direct connection of the Booster pulse load. The willing help of BEA, Swissair, Customs officials and, not least, the Atlas Computer Laboratory, gave a surprisingly fast turn round of data and results between Chilton and Geneva.

One final point, the cost of static power supplies; it is probably in contravention of some natural law but a 300 GeV static system costs approximately 50% of the mg set it is designed to supplant (a saving of approx. £750,000) and total running costs are 90% below.

'As I want a career with real power and authority I'm staying a student''.

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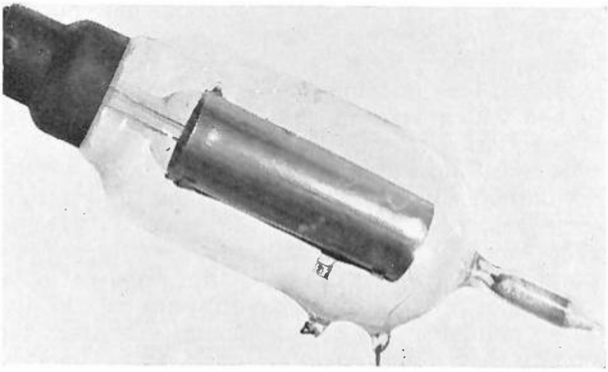
old scientific instruments

radio telegraphy

part 2.

The curious looking valve illustrated in Figure 1 was invented by H. J. Round of the Marconi Company just before the outbreak of the First World War. An example has recently been presented to the Station collection by Dr. R. L. Smith-Rose a former Director. As can be seen, it bears some faint resemblance to a mains electric light bulb, having the familiar bayonet socket fitting. The electrode structure is that of a triode; a central filament is surrounded by a thimble shaped grid which is in turn surrounded by an outer metal shell forming the anode; these two electrodes are reached by small wire contacts sealed in the glass envelope. A curious feature is a small extra chamber at the top of the valve which contains a pellet of asbestos. This pellet was a most important feature in the functioning of Round's valve for its characteristics, like others of the time, depended upon traces of residual gas in the valve being ionized. It was as called a 'soft' valve; that is to say one having a relatively



low vacuum. The degree of residual gas and hence the characteristic of the valve was controlled, as required, by heating the pellet of asbestos which would then give off gas absorbed by it. The flame of an ordinary match was usually sufficient, although in certain cases it was necessary to use two matches, hence the valves often become known as one or two match valves. Round's valve performed useful service in its day, but by the end of the First World War it was superseded by an ever increasing variety of thermionic devices of the 'hard' or high vacuum type. It remains an interesting relic of the progress of the vacuum tube.

The future of the valve as a powerful tool in many branches of physical science was quickly realized, once manufacturers could produce types having reasonably consistent performance. The multivibrator circuit and the valve-maintained tuning fork all date from the decade 1916–26 as well as many other circuits now almost, as it were, ascribed to tradition.

Early in the twenties a number of workers realized that the high impedances in a valve could be very useful in the measurement of voltages and several forms of valve voltmeter were attempted by workers in this country and on the Continent. In Britain, a particularly useful valve voltmeter was produced by Moullin. This is described in the Wireless World of 1922 and was produced for commercial purposes by the Cambridge Instrument Company. A production model

of this instrument dating probably from the middle 'twenties is shown in Figure 2. This has long been in the use at RSRS and is now in honourable retirement in our museum. We cannot quite get away from polished wood and lacquer and the voltmeter still tries hard to look like the ancestral and familiar laboratory meter shyly hiding any trace of its vacuum tube aspect. It is a far cry from the time when it was probably *the* valve voltmeter of the Station. Now such devices are found in all laboratories where electrical measurements are made.

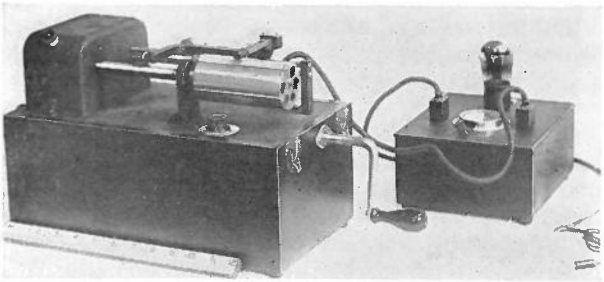
Readers may well recollect that part 1 of this article began, anomalously enough, with the description of something which was not an instrument, but a book. Having this precedent, I make little apology for introducing another literary matter, as it were, because it is of considerable interest and importance in the derivation of scientific terms. It is a letter of 1926 in which, we believe, the term 'ionosphere' was first defined and used. This is, I hasten to add, not the date of the first publication of the term, that was three years later in 1929, in Watson-Watt's paper 'Weather and Wireless'. In this particular communication of 1926 we find Watson-Watt writing to the Secretary of the Radio Research Board and putting forward his idea that the conducting layers of gas in the upper atmosphere might well be termed 'ionosphere'.

An extract from the text is as follows:

> 'With reference to recent discussions on the nomenclature of the 'upper conduction layer' of the atmosphere, may I suggest that it is not yet too late to obtain general agreement on a systematic name for the 'layer', avoiding the controversy arising from personal names.
>
> We have in quite recent years seen the universal adoption of the term 'stratosphere' in lieu of a previously well established misnomer 'isothermal layer', and the adoption of the companion term 'troposphere' for the 'convective layer'.
>
> The term 'ionosphere', for the region in which the main characteristic is large scale ionization with considerable mean free paths, appears appropriate as an addition to this series. The objection that ionization occurs throughout the atmosphere is no more adequate against the proposed term [than] is the fact that stratification occurs locally in the troposphere, the systematic name should be characteristic of the main 'grand scale' phenomena without reference to minor and local phenomena.'

This interesting note was found in the loft of an old building at Ditton Park, thus providing an example of the unlikely places in which the amateur historian of technology may find items of interest.

Although long forgotten by most people, there was a brief time when the BBC flirted with the idea of a facsimile service for the public. This was towards the end of 1928 when a curious machine called the *Fultograph* (Fig. 3) became available on the market. It was, apparently, capable of installation and operation by relatively unskilled people, requiring little more than the



ability to put a piece of paper on a drum and successfully manipulate the receivers in use at the time; although, bearing that fact in mind, this may not have been quite so easy as we may now think it. The Fultograph was the product of the ingenuity of one, Captain Otho Fulton and used a principle of operation common to many facsimile machines. The picture, placed upon a drum, was spirally scanned by a photocell which amplitude modulated the wireless transmitter. At the receiving end, the signal current variation caused variable density marks to be made by an electrolytic process on a piece of sensitized paper placed round a similar drum. Synchronization of transmitter and receiver was accomplished by an ingenious clutch mechanism, operated on the reception of pulses sent out with the transmitted photograph. With this relatively simple machine, photographs, weather maps, forecasts and drawings were transmitted, all of a quite tolerable quality considering the state of the art at the time. However, after a short time this service ceased, in fact, it never really caught on. Perhaps in the late 1920's the economic state of the time was against it, or perhaps it was just one of those things which the public, on the whole, did not want. Anyhow, within less than a decade, high definition television was available, at least to a limited section of the public in the London area, and the Fultograph was never revived. The reason for the existence of one of these machines at our Research Station can be traced back to an attempt made by the then superintendent, Watson-Watt, who wished to use the facility for investigating interference caused by lightning flashes. Some half-dozen or so were placed at strategic points throughout the country, the BBC transmitted a reference grid at a given time and then, when all the pictures were collected, it was possible, using the reference grid, to see which stations had received a particular atmospheric.

When this experiment came to an end the Fultographs were stored away and there they remained for many years. Surviving damp, and even flood, sufficient remained within the last few years for a working model of the receiver to be satisfactorily rebuilt. We have it with us still, the drum revolves, the stylus moves but alas, the signals that should have actuated it have ceased these forty years.

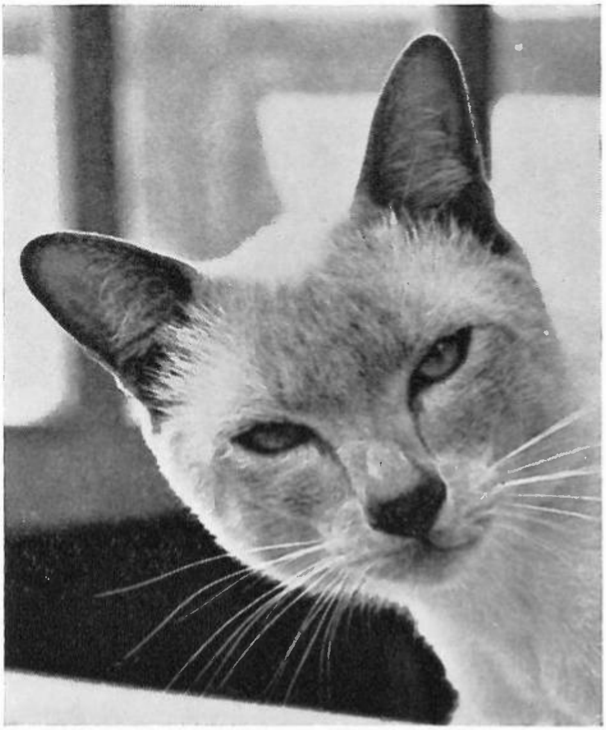
Those familiar with the work of the Radio and Space Research Station may well be puzzled about one omission; I have not referred to our most important piece of apparatus. This is a survivor from the 'thirties which we no longer possess; its importance was sufficient for it to warrant inclusion in the National collection of the Science Museum. It is the device used for the first radar experiment by the man who is our present Deputy Director, Mr. A. F. Wilkins. The story forms part of history on a bigger scale and, maybe, we can reserve the telling of it for some future date.

people and their pastimes

Cats

N. M. (and Marie) King

Rutherford High Energy Laboratory



This series is supposed to describe the *pastimes* of SRC personnel, but the activity as practised by Marshall King and more especially wife Marie, is more closely akin to slavery. Therefore in order that we may print as much as possible of the detail of the King family's subjection to their oriental captors, the usual (editor's) introduction will be reduced to a short overture, just to set the scene.

They were 'bitten' in 1963; when following the demise of their ordinary moggy they decided to go 'high hat' and *choose* a cat from a show. The outcome was the acquisition of a female Lilac Point Siamese who (subsequently) presented them with a fine litter of kittens, the first of the strain which bears the prefix TRISMEGISTOS, trade-mark of the King cattery. One of the litter became the best Lilac Point kitten in the 1964 Olympic National Cat Show. The next litter produced BELLEROPHON their resident Champion, then came CIRCE, now a USA Champion, then ENDYMION who became a premier (Neuter Champion) last year.

At this point it is appropriate to note that Marie King is not an SRC employee, but when you read the account of her daily life among the cats, you will readily understand that she just does not have the time for gainful employment. Here is an account of her life with her feline friends.

'All our cats are Lilac Pointed but Bellerophon's visitors may be Lilac, Seal, Chocolate, or Blue Pointed Siamese. Bellerophon's special house is not quite finished so he has a room to himself indoors. His visitors have another room containing a pen, through the wire of which they get acquainted.

If one of our females is 'calling', she has to be kept apart until we think it's a suitable time to have her mated. ('Calling' is what Siamese females do when in season—it consists of making a frightful racket, performing frantic contortions on the carpet, and investigating every possible mode of escape. The noise consists of deep howls, cries like a small child, and a species of bark.)

Kittens are all over the house during the day, and in the garden if the weather is good. We usually let them go to their new homes between 12 and 16 weeks, but often we have one up to six months.

If one of the females is in kitten she will have a room to herself (plus humans) at night: so it's not unusual to have cats in four different rooms for one reason or another. Each has to have a plastic tray of peat-moss and a water dish. Also, every cat, including each kitten, has its own food dish. All this means a lot of work washing and sterilising dishes; emptying, washing and disinfecting the dirt trays; and preparing food.

cat colony

1 Champion Stud (Champion Trismegistos Bellerophon)
2 Females (Trismegistos Filomela and Allegro Snow Maiden)
Usually, a litter of 5 Lilac Point Kittens (on average)
Frequently, 1 Female visiting Ch.T.Bellerophon.

daily routine

9 a.m.
Collect trays, empty, wash, rinse, refill with dry peat moss, and re-distribute as necessary.
Refill water dishes.
Heat up breakfasts – mixture of cooked beef (or rabbit, chicken, hare, etc.), egg yolk, meat jelly, a little 'Felix', a few drops of corn oil, a little vitamin supplement (Vionate), and some chopped parsley. Allow to cool and serve to adults.

With kittens in hall, place dishes on kitchen floor, open the door and deal with subsequent stampede, directing each kitten to its own dish. Supervise; removing fast eaters to hall as soon as they finish.
Wash and sterilise all feeding dishes.
During course of morning, let cats out for exercise, except calling females. Bellerophon has to be watched in case he strays – usually we try to let him out before breakfast as he will not then leave the garden.
Let the Champ. see his current girlfriend, and supervise mating. This can take up to $1\frac{1}{2}$ hours if they are not already acquainted.
1 p.m.
Lunch for kittens and pregnant female(s). Heat up cooked white fish and tinned pilchards and serve individually as for breakfast.
Wash and sterilise dishes.
Deal with dirt trays as required.
Spend time talking to Bellerophon, and his visitor. (Siamese *need* human company.)
5 p.m.
Mix a meal for kittens. Meat jelly, finely chopped cooked meat and Farex. Serve as before.
Give raw egg yolk to pregnant female(s).
9—10 p.m.
Prepare adults' supper – chopped cooked rabbit, hare, or lean raw beef, serve at room temperature.
Mix kitten suppers – chopped rabbit or chicken, chicken jelly, Farex, Vionate, and raw egg yolk.
Change all dirt trays.
Arrange cats in their baskets and particular rooms for the night, retrieving crazy scampering kittens from all over the house.

Kittens traditionally sleep in the kitchen; (we have complete central heating). Siamese are very fond of their comfort, but are really no more delicate than ordinary cats.

grooming, showing

Cats and kittens are groomed about once a week. Lilac Pointed Siamese have white (Magnolia) coats, and only look their best when absolutely clean. Before shows, we may groom our cats several times within a week, and always the night before.

Complete grooming starts with a rub-down using a warm damp cloth soaked in a pure soap which is not injurious if licked up. While this is being done, dry bran is being heated up in the oven, this is rubbed into the coat 'the wrong way', and brushed out again until the desired degree of gloss is obtained.

During the season we attend about nine or ten shows, about half of which will be in London, and the remainder up to about 150 miles from home. In addition, we are often invited to exhibit Bellerophon and last year he appeared in this capacity at the Cats of the Year exhibition at Eastbourne.

Show preparations include washing all white show blankets, hot water bottle covers and so on. Equipment such as white dirt trays, water dishes, food dishes, etc., is washed and packed in a suitcase, along with TCP sprays and cotton wool for disinfecting cages etc. When Bellerophon goes on exhibition, (as distinct from competition), his pen decorations have to be washed and ironed: these consist of silk and velvet curtains and cushions in two shades of blue. His five championship certificates, rosettes, and silver trophies also go along.

On the day of the show, we are generally up at 4 a.m. The cats are attended to as usual, except that those to be shown do not have breakfast until they arrive at the show hall. If the circumstances are not too complicated, we generally ask a friend to look after the resident cats and to talk to them from time to time – otherwise Marshall drives to the show alone, and I stay at home: this usually happens about twice a year.

The cats prefer to ride loose in the car. The older ones are experienced travellers, and like to ride draped around Marshall's shoulders as he drives. Kittens sometimes take up to an hour to get used to the car, but by that time they are content to lie in my lap or on the back window sill.

office work

There is a terrific amount of correspondence on kittens and breeding, writing pedigree forms, filling in registration and transfer forms, keeping stud and kitten records, entering for shows, advertising kittens, and so on. We keep in touch with a remarkable number of the people who have bought Trismegistos kittens, and the telephone is kept busy. Marshall is on the committee of the Lilac Point Siamese Cat Society, and represents the club on the Governing Council of the Cat Fancy, and the Joint Siamese Advisory Committee: this means more correspondence for him. He is also interested in the genetics of domestic cats, and gets a lot of amusement out of studying and working out probabilities of various matings.

finance

People always ask about this. We keep records, and find that cat breeding is definitely a hobby; it costs us about £100 to £125 per annum – not counting the £150 we have spent on Bellerophon's house. Kittens sell at about twelve guineas each, although a really good Best-in-Show prospect may bring about £20. Food, car expenses, inoculation fees, equipment, disinfectant and peat moss are the greatest expenses. Even with first-class prizewinners, show entry fees are only just covered by the prizes. Stud fees at five guineas a time supplement the economy, but as we live rather remote from London, Bellerophon doesn't get as many visitors as a Champion otherwise would.'

ARISTOCAT

Ch. T. Bellerophon, wide eyed and alert as all good show-cats should be, is just about to be put into his show cage.

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editor's note

We have now described the hobbies (or pastimes) of three members of staff and, besides this 'cat' article, we have been introduced to the intricacies of lute making and to the fascination of rock plant cultivation. In the next issue, J. C. Baldwin of the Atlas Computer Laboratory will describe his hobby of bellringing, which has taken him to many churches throughout the country.

There must be a wide variety of hobbies (printable ones) pursued by members, and the inclusion of Culham now adds another thirty prospects. We would like to hear about any unusual spare time activity, so if you have a hobby which you think is worth publicising, then write or telephone me at Room 1517, State House. ext. 255.

newsfront

'This Time It's Final'

It is not the policy of Quest to print 'hatches, matches and despatches', but the retirement of Charlie Osborn (68 years) from the Rutherford Laboratory, is rather different. He has worked for SRC for only three years, but such is the character of the man, that when he left on Friday, August 23, he was presented with a portable electric drill, a wallet and an illuminated scroll, by Mr. G. N. Venn, the Head of the Nimrod Engineering Department.

Charlie's working life began in the fateful year of 1914, when, at 14 years of age, he volunteered to do messenger work at the coastguard lookout stations in Cornwall until such time as his application for apprenticeship in the boilermaking works of the GWR at Swindon came through.

He has a wonderful memory for names and in laconic fashion recalled how he was sent from the coastguard station at Poldu to Mullion at night and via the hazardous cliff path, to collect the key of the code safe which the off-duty Petty Officer had taken home with him. On another occasion he recalls the stern admonition of the Station Commander who instructed him that 'in the event of a skirmish' he was to take the key and unlock the safe, take the code books and consign them to the boiler fire.

The GWR apprenticeship terminated Charlie's service as a coast guard messenger and he served his five years, plus a further two in the Carriage and Wagon Department. He was then covenanted to work for the Indian Railways for a period of five years. In Lahore, and eventually Rawalpindi, he was, in turn, Chargehand, Assistant Foreman and Boiler Inspector. He lived a very comfortable middle class life with a large bungalow and servants and has a fund of intriguing stories to tell. However, he decided not to return to India at the end of his contract and left the railways to become the Wantage area District Manager for the well known firm of J. Bibby and Sons of Liverpool. He stayed with the firm until retirement No. 1 at 60, but within the year, he was back at work again, this time as a Storeman with the American contingent at RAF Wellford. With the run down of the American overseas bases in 1964 he was once again retired and a year later, at the age of 65, he joined the Rutherford Laboratory as a Storeman.

Charlie has a son in Canada, a daughter in East Africa and another daughter in Sussex, and he says he is now prepared to acknowledge Anno Domini and settle in Sussex with his daughter and to follow his hobbies of stamp collecting and gardening.

Now that the Astrophysics group at Culham is to form part of SRC, we welcome another local correspondent to the editorial board of Quest.

W. M. Burton is a Senior Scientific Officer engaged in spectrographic studies of the extreme ultraviolet spectrum of the sun and other stars, carried out by flying special optical instrumentation in stabilised Skylark rockets.

Prior to moving to Culham in 1964, Bill Burton worked at AERE Harwell on atmospheric radiochemistry, and plasma spectroscopy in the controlled thermonuclear fusion project.

four special merit awards for SRC

Four special merit promotions have recently been announced involving scientists in four establishments. The recipients of the awards are in widely differing disciplines, but it is unusual for a Department to receive four such awards.

The award is made at PSO level to research scientists of exceptional quality, and because it does not involve additional administrative duties, the promotion does not interfere with the individual's research work.

Dr. A. O. L. Atkin
Atlas Computer Laboratory

Dr. Atkin has been working over the last four years on congruence properties of the coefficients of modular forms, on congruence subgroups of the classical modular group. More recently he has been working in collaboration with HPF Swinnerton-Dyer at Cambridge on non-congruence subgroups of the modular group, which turn out to have remarkable p-adic properties. Many of the discoveries involved would not have been possible without the use of computers.

Dr. J. W. King
Radio and Space Research Station

Dr. King's research is concerned with the characteristics of the ionosphere, particularly at heights above 300 km, as determined by data obtained with so-called 'topside' sounding satellites in an international programme. His studies have demonstrated the important influence which global air winds, caused by pressure gradients in the neutral atmosphere, have on the ionosphere and he has thus been able to explain significant peculiarities of ionospheric behaviour observed over a number of years.

Dr. N. H. Lipman
Rutherford High Energy Laboratory

Dr. Lipman leads a team of physicists engaged in research on elementary particles using the 7 GeV proton synchrotron Nimrod at the Rutherford Laboratory. His present experiment is to determine the polarization of protons from the decay of the Sigma particle, and is designed to test one of the selection rules believed to apply to 'weak' interactions. He holds a joint appointment with the University of Sussex, as a part-time Reader, where he lectures on elementary particle physics to undergraduate and postgraduate students.

Dr. D. Lynden-Bell
Royal Greenwich Observatory

Dr. Lynden-Bell is currently working on the evolution of galaxies from studies of their formation and dynamical evolution. His current work concerns the theory of statistical mechanics of encounterless systems of stars which have yet to achieve a steady configuration, and the dynamical stability of galaxies.

The first SRC Sports Day did not attract favourable weather and in consequence, the attendance figures were not as good as they might have been. Conditions were not very comfortable for the competitors, but the standards were high and the honours fairly evenly distributed among the competing establishments. We are indebted to Harry Cook and Barry Briscoe for the report and to Robin Butler of RSRS for the photographs.

This, the first of what SRC Sports Association hopes will be many Sports Days, was essentially an exploratory occasion, and was arranged to provide competitive sport for as many of the Council's staff as could attend. It was decided that competitions would be run for cricket, tennis and bowls, the exact nature of the tournaments being left to the organisers to determine in the light of entries received. Both cricket and tennis enjoyed good support but unfortunately the entries for the bowls competition fell away and this had to be cancelled. It is hoped that it can be revived next year and with longer notice many bowlers will be able to participate.

The cricket competition was run on a 'knock-out' basis, with each side batting for a maximum 15 overs and with restriction on the number of overs any player could bowl. Five entries were received, with results as follows:

1st Round RGO (35 runs for 0 wickets in 7 overs) beat RSRS (34 runs for 10 wickets in 10.4 overs)
Semi-finals RHEL (60 runs for 7 wickets in 15 overs) beat RGO (54 runs for 8 wickets in 15 overs)

LO (75 runs for 1 wicket in 10 overs) beat Atlas (74 runs for 4 wickets in 15 overs)

Final RHEL (45 runs for 6 wickets in 13.3 overs) beat LO (44 runs for 9 wickets in 15 overs)
Supplementary Round Atlas (97 runs for 9 wickets in 15 overs) beat RSRS (64 runs for 6 wickets in 15 overs).

The supplementary round was arranged to give all participating teams at least two games during the day. The only 'seeding' resorted to was to put RHEL and Atlas in separate halves of the competition to ensure they played against teams from less familiar establishments.

Two tennis tournaments emerged from the entries received, one for men's doubles and the other for mixed doubles, and to give all players plenty of tennis within the restricted time available both were run on American Tournament lines. Each competition was divided into two, with section winners playing off to decide the overall competition winners. Again, the only seeding adopted was to apportion teams from each establishment as equally as possible in either half of the draw to enable them to mix with other teams as far as possible. Despite a troublesome wind and some initial doubt as to whether the grass courts were ready, both competitions were played off as planned, with the result that in an all-RSRS final in the Mixed Doubles competition, Mr. and Mrs. A. C. Gordon-Smith beat Mr. R. Fitchen and Mrs. F. Horner 6–1, having won their sections with totals of 36 games and 30 games respectively.

Dr. G. A. Wilkins and Mr. R. J. Dickens (RGO) won their half of the Men's Doubles with a total of 24 games and in the final beat Messrs. Butt and Beckwith (RHEL) (22 games) by the score 6–3, thereby ensuring that on this first occasion the awards were distributed around the establishment.

Cups were presented to the winners by Mr. Ray Edmonds, Chairman of the SRC Sports and Social Association, who interrupted his holiday to come along.

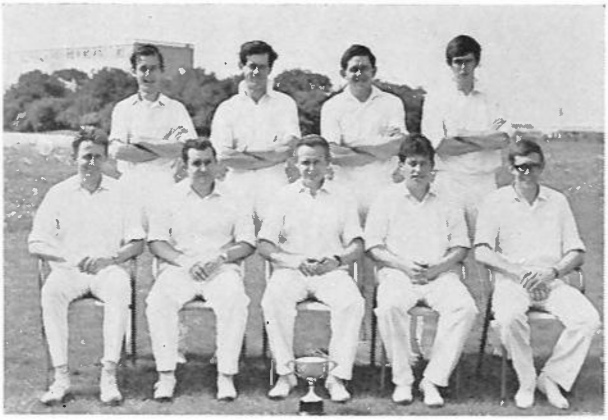
The Sports Social Committee is very grateful to him for doing so and also wishes to thank the staff who helped to run the competitions and so made sure that they went off smoothly, and the London Office Club for giving a magnificent cup as prize for the cricket competition. The Committee hopes that all who took part enjoyed themselves and will come again in future years bringing more colleagues with them. They will welcome any suggestions to improve or broaden the scope of this occasion.

A dour, determined spectator and a quartet of scorers looking after the interests of RGO.

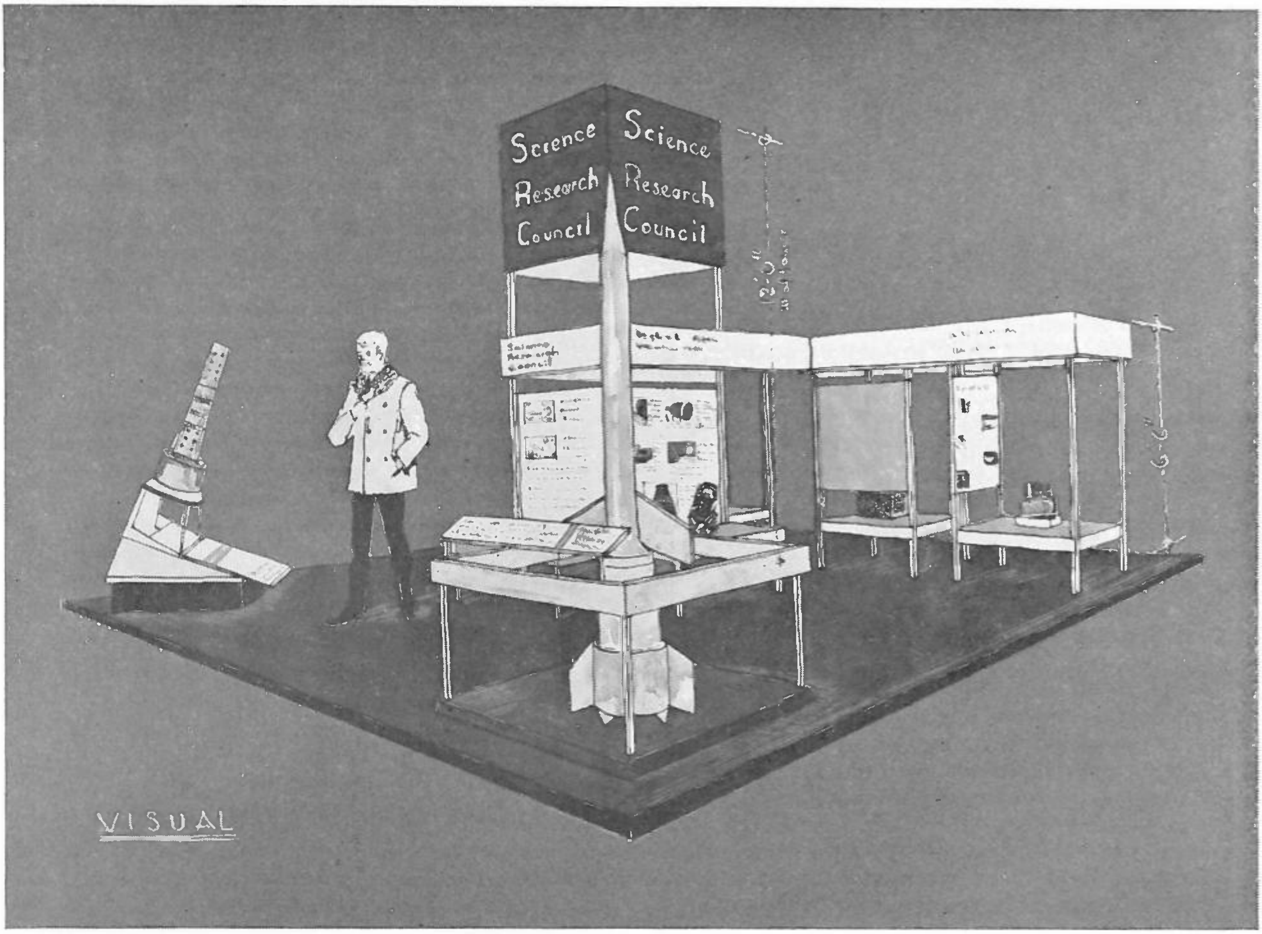
S. Lee and Miss J. Wall of London Office in play in an early round of the mixed doubles. Note the windbreak which has been blown into a horizontal position!.

Ray Edmonds, Chairman of the Sports social committee presents the men's doubles cup to R. T. Dickens. His partner, G. A. Wilkins (foreground) has already changed into warmer clothing.

DOUBLES ALL ROUND
Mr. and Mrs. Gordon Smith (husband in hiding) and Dr. Wilkins and R. T. Dickens, all of RSRS, the mixed doubles and men's doubles winners respectively.



Just so that we could inject a ray of sunshine into an otherwise murky spread, the victorious Rutherford cricket team went home to sunny Berkshire to have their photograph taken. Unfortunately the whole team couldn't be present on the same day, two were on holiday.



Farnborough '68

The theme of the SRC stand was 'SRC and Space Research' and the exhibits illustrated the support given to the national and international space research programmes.

In the National Sounding Rocket section, and dominating the stand, was a Petrel rocket and alongside it a RSRS experiment designed to obtain information about high speed electrons from space.

Experiments flown in the Skylark rocket include one from Culham for solar physics study, and an attitude control unit developed by RAE and Elliott

Automation was displayed to illustrate the degree of sophistication the Skylark rocket has now achieved.

The third vehicle used in the national programme is the Skua rocket and an experiment from University College, Wales was shown as a typical payload. This experiment will be used to further the study of radio absorption in the ionosphere.

ESRO II carried five British experiments and to represent this section, a combined UCL/Leicester University experiment was displayed. This is designed to measure the x-ray emission from the sun.

In the NASA section, a Universities of Oxford and Reading experiment which will be flown in the Nimbus D satellite was shown. This is scheduled for launch some time in 1970. A synopsis of the results of experiments carried in Ariel III was displayed, together with a powered model of this first all-British satellite, which is still operating after more than a year in orbit.

Installation of the first 'D' type ceramic vacuum chamber in a magnet at Daresbury. The individual ceramic sections can be seen making up the curved chamber with its metal end flanges.

Culham Laboratory
When the weather permits, the sheltered quadrangle adjacent to the canteen is popular for alfresco eating.

contributors

W. G. Griffen

'An SRC Astrophysics Research Unit at Culham Laboratory' *page 2*

Senior Experimental Officer, Stellar Group, ARU

J. B. Alexander

'Leopards, Landscapes and 'Royal' Telescopes' *page 6*

Senior Scientific Officer. At present on second tour of duty at the Cape, engaged upon photoelectric photometry.

R. H. Tucker

'Enquiries from the general public' *page 10*

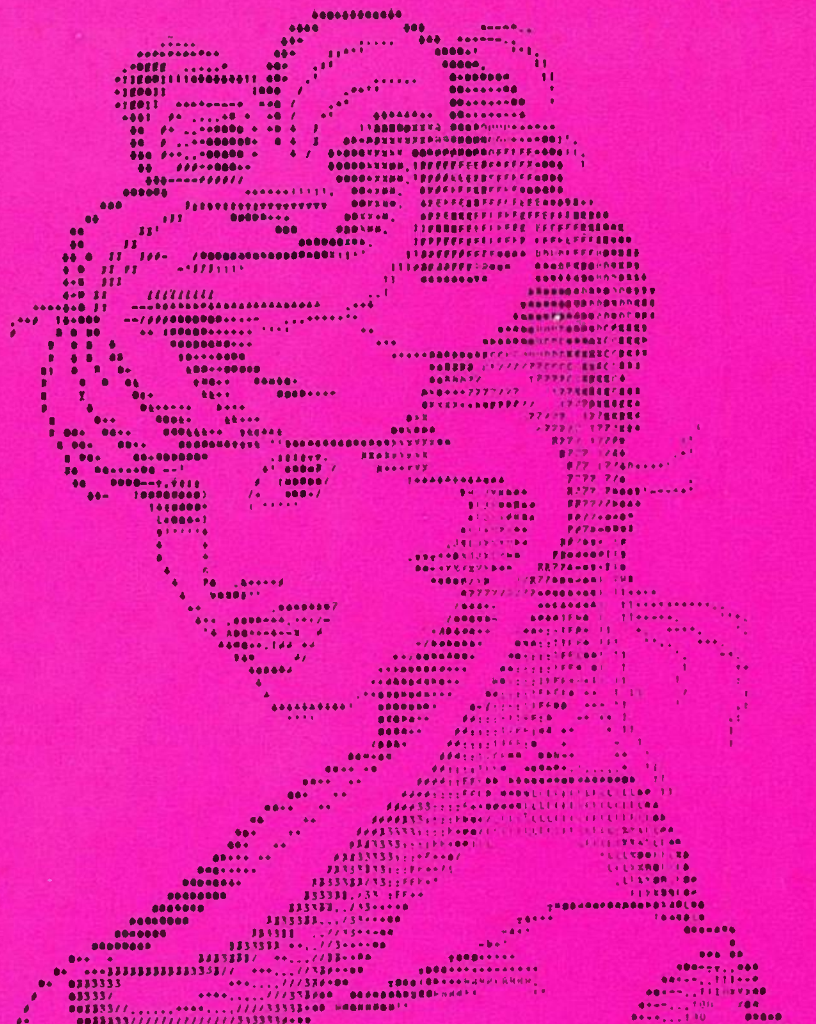
Principal Scientific Officer. In charge of Meridian Department, RGO

J. A. Fox

'A Plain Man's Guide to Accelerator Static Power Supplies' *page 13*

Engineer 1, Rutherford Laboratory. Former power supply group leader at Daresbury and member of CERN 300 GeV study group.

QUEST



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contents

Cover caption.

Beautiful thoughts . . .
A computer's eye view of the well developed peripherals forming the software of its working environment . . . or could it be a mirror image of the 'Beauty with the Brains' picture in the January issue?

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profile

Professor H. A. Brück,

CBE, DPhil, Ph.D, Astronomer Royal for Scotland

The life of the dedicated scientist, although intellectually rewarding, often runs a serious risk of becoming a social desert. The special demands of research and academic life offer little to the extrovert, so that a gradual process of withdrawal is often inevitable.

The subject of our profile may therefore be regarded as being somewhat unique; he has, on the one hand, the task of running the Royal Observatory, while on the other, as Regius Professor of Astronomy and Dean of the Science Faculty at nearby Edinburgh University, he is deeply involved with the education of students and intergrated with the social life of the University. He also has a young and talented family, and these three elements, plus a life-long appreciation of music, combine to fulfil and mellow a career which has been crowded with achievement and incident.

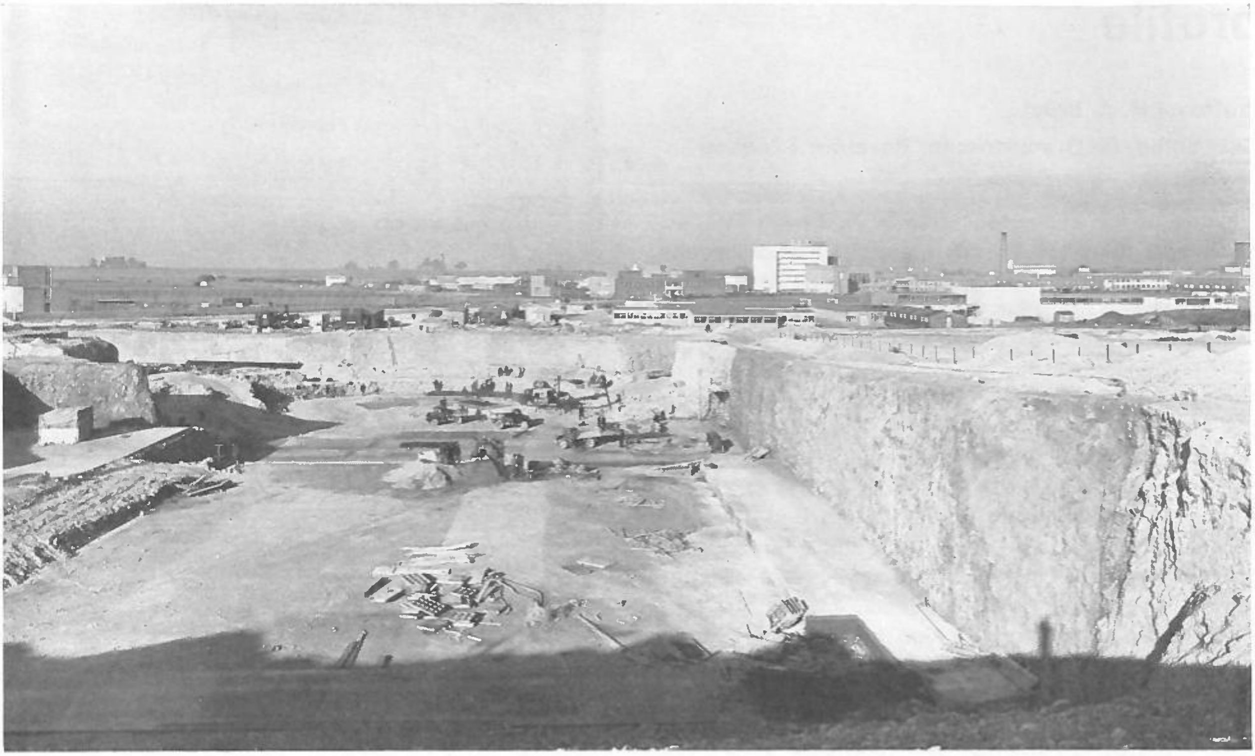
Born in Berlin in 1905 Professor Brück attended three German universities and produced at the age of twenty-two his first doctoral thesis, under Professor Sommerfeld in Munich, on a problem on the then new, wave mechanics; two further doctorates were later to be conferred on him by Berlin and Cambridge universities.

From his Berlin period he recalls Einstein's attendance at physics seminars where the great man seemed often to be half asleep. At a critical moment, however, he would 'wake up' and put a question which cut right to the heart of the subject . . . 'just the kind of question I would love to have put'. But the Professor did have one thing in common with Einstein, 'we both loved sailing and often used to meet on the lakes near Potsdam'.

His Berlin University activities brought him into contact with other famous names such as Nernst, von Laue, Hertz, Planck and Schrödinger whose future movements were to be very similar to the Professor's, in that both obtained posts in England and Ireland in order to get away from the insidious influence of the emergent German nationalists. At the end of the nineteen twenties there existed at Berlin University 'a concentration of genius which has hardly ever been equalled; how sad that politics was allowed to disperse it'.

It was in his student years at Munich that new life had come to astrophysics, and it was the exciting vistas opening up in this field which determined Professor Brück's career. In 1928 he joined the Potsdam Astrophysical Observatory where he stayed until 1936 when the political atmosphere made him decide to leave Germany. From Potsdam he went to the then newly equipped Vatican Observatory at Castel Gandolfo where he worked for a year – with a research grant of £150. In 1937 he secured a position as Assistant Observer at the Cambridge Solar Physics Observatory where he remained for the next ten years to become John Couch Adams Astronomer in the University and Assistant Director of the combined Observatories. In 1947 he was personally invited by the then Irish Prime Minister, de Valera, to take charge of the Dunsink Observatory near Dublin. This old Observatory, once directed by the 'Astronomer Royal for Ireland', had been closed following 'the troubles', and Professor Brück was charged with the task of re-establishing it as an active research centre and part of the Dublin Institute for Advanced Studies. At Dunsink the Professor 'lived like a country gentleman, enjoying a stimulating intellectual atmosphere and involvement in new post-war problems of astronomical research'.

Professor Brück took up his present appointment in 1957, and the ensuing years have witnessed a major expansion of the work, staff and research facilities in the Royal Observatory and the Astronomy Department of Edinburgh University. His interest in questions of stellar evolution and the formation of stars from diffuse interstellar material led to a systematic attack in Edinburgh on problems of data processing and the introduction of new automatic methods of astronomical measurement and computation. And his experience of the effect of the British weather on astronomical observations made him champion the cause of observing stations in good climates such as Edinburgh's Italian station at Monte Porzio.



research at Rutherford

A. P. Banford

Part 1: Origin and growth

'There are therefore Agents in Nature able to make the Particles of Bodies stick together by very strong Attractions. And it is the Business of experimental Philosophy to find them out.'

These words, written some three centuries ago by Isaac Newton, epitomise the prime function of the Rutherford Laboratory, for it certainly is our Business to find out these Agents. The Particles that we are concerned with are known as 'elementary' or 'fundamental' and the study of their properties and interactions constitute the science of high energy physics. The development and present status of the subject has been well covered in Dr. Rand's article in the January 1969 issue of Quest; a complete survey is therefore unnecessary here.

In any scientific investigation, it is desirable to be able to predetermine as many of the experimental conditions as possible, and it is therefore hardly surprising that almost all elementary particle physics research is carried out with controlled sources of particles, which is what particle accelerators are. These devices, commonly but erroneously known as atom smashers, are large, complex and expensive. It should be realised that accelerators are only particle sources, and that the high energy physics can only start when the accelerator has become operational. At the Rutherford Laboratory, the major accelerator is Nimrod, a 7 GeV proton synchrotron, which became available for high energy physics experiments in 1964. The remainder of this article will be devoted to an account of the setting up of the Laboratory, the design, construction and commissioning of Nimrod, and the preparations for the first experiments. Part 2 will deal with the achievements of the past five years and will attempt a look ahead.

The Rutherford High Energy Laboratory came into formal existence 12 years ago, though its origins can be traced back to the early 1950's. At that time, experiments with the first artificially produced pions (π – mesons) had shown that these particles played a central role in the nucleon – nucleon interactions – that is, the system of forces that bind atomic nuclei

heading photograph is a view looking North of excavations for Nimrod, in the background AERE Harwell.

together and which determine the details of nuclear structure and many other phenomena. United Kingdom workers in this field needed a high quality source of pions. The first step towards providing this would be to build a new machine capable of accelerating protons to an energy of several hundred MeV: pions being produced when such protons strike a suitable target. Existing accelerators in this energy range (synchrocyclotrons) had external beam intensities and other characteristics which severly limited the scope and precision of the experiments. Discussions among university physicists were initiated by the Atomic Energy Research Establishment, Harwell, and a decision was taken to build a 600 MeV proton linear accelerator. A group of accelerator designers was assembled, and a site was selected to the south of AERE and outside its security fence so as to facilitate visits by university scientists.

It was realised from the start that the 600 MeV linac would be a formidable undertaking. The machine itself would be 900 feet long and would require almost a hundred megawatts of radio-frequency power at 200 and 400 MHz. Valves capable of delivering such outputs were not then commercially available, and had therefore to be specially developed. There were also many unknowns associated with features such as beam focussing, accelerator control, dimensional stability and manufacturing techniques, since the only other proton linac then working was a comparative dwarf of 32 MeV. Nevertheless, by 1955 the detailed design was far advanced and the construction of buildings and machines got under way.

Then two events which completely changed the picture occurred in quick succession: a newly-developed method of beam extraction for synchrocyclotrons so improved their performance as to put them into the forefront of pion physics; and experiments on the 6 GeV Bevatron in California showed that artificially produced strange particles (hitherto seen only in cosmic rays) exhibited properties not only excitingly novel but also likely to be of great importance in explaining the basis of the structure of matter. It was realised that resources at Harwell should be re-allocated so that the research facilities that would eventually be made available would be better suited to the changed needs of the users. Accordingly, it was decided to terminate the proton linac at the 50 MeV point; it could then be used for nuclear scattering and reaction studies in an energy region in which little work had been done. This decision enabled a large fraction of the design group to be switched to a detailed study of various types of accelerator capable of reaching energies of several GeV.

It soon became clear that the new machine should be a proton synchrotron, a type of accelerator of which a few examples were already in existence, the oldest (now closed down) being at Birmingham University. In a synchrotron, the particle beam is bent round into a circle by the application of a magnetic field, and, as the particle energy increases during the acceleration process, the field strength is also increased so as to keep the radius of the circular path constant. (This is in contrast to a cyclotron in which the field is constant and the particles move outwards on a spiral as their energy increases). The field has to be provided only over an annular region; the accelerator electromagnet is therefore in the form of a ring, the diameter (determined by the particle energy and the magnetic properties of steel) being about 150 feet. The choice rested between two types of synchrotron, differing in the method of focussing used to keep the beam together in the face of disturbing influences such as magnetic field inhomogeneity, and scattering by residual gas in the vacuum chamber. In a weak-focussed or constant gradient machine the magnetic field is shaped so as to provide both horizontal and vertical focussing at all times. In the alternative strong-focussed or alternating gradient system, there is a periodic change between strong horizontal focussing with vertical defocussing, and the reverse. This gives an overall focussing effect that is stronger than in the constant gradient system, with the result that the magnet can be made more compact and therefore more cheaply. The alternating gradient system does have its drawbacks, notably the need for much greater constructional accuracy and more trouble from resonances (the disastrous build-up of beam oscillations caused by repetitively encountering magnetic disturbances). Although the principle has been successfully applied to later machines (e.g. the 28 GeV CERN PS and NINA), there was not sufficient confidence in its suitability for a high intensity machine at the time when it became necessary to freeze the main parameters. The project chosen, in early 1957, was a 7 GeV weak-focussing proton synchotron, soon named Nimrod after the mighty hunter of Genesis.

It had always been the intention that the major users of these new research facilities would be teams of visitors from university physics departments, since it was recognised to be financially impracticable for individual universities to acquire and maintain their own large accelerators. Since the scale of these centralised research facilities had now grown considerably beyond that initially envisaged, it was felt to be no longer an appropriate responsibility for the Atomic Energy Authority. In February 1957, it was announced that a new body, the National Institute for Research in Nuclear Science, was to be set up. This was duly done, with Lord Bridges as the Chairman and with representatives of the universities, the UKAEA, the UGC, the DSIR, and the Royal Society on the Governing Board; after an appropriate period the Institute became the employer of the few hundred Authority staff engaged on the accelerator projects.

This period of organisational change also saw the erection of the PLA and the beginning of the civil engineering work for the building that was to house Nimrod. This is 200 feet in diameter, and since it is sunk below ground level for radiation shielding reasons, its construction involved the removal of some 4 million cubic feet of chalk which was subsequently formed into an artificial hill.

The PLA produced its first full energy beam in July 1959, and became available to nuclear physicists the following April. After a further two years it was operated round the clock, and each successive year's operation has outdone the last in terms of annual operational hours and reliability. Special facilities such as a polarized proton source and time-of-flight instrumentation helped to make this machine into a versatile research tool. There are, however, certain fundamental disadvantages associated with a proton linear accelerator and as a result of recent developments in tandem Van de Graafs and cyclotrons, it can no longer be regarded as truly competitive. It is scheduled to cease operation in October of this year. The opportunity will be taken to survey its achievements in a special article, and for this reason the remainder of the present article will be confined to Nimrod and associated projects.

In addition to settling the dimensions of the building, the freezing of the main parameters of Nimrod in 1957 enabled detailed design work to begin. It had been established that the ring magnet would be built in eight sectors or octants, each separated from the next by a straight section which would be used for beam injection, the radio-frequency accelerating unit or for other purposes. The injection energy was chosen as 15 MeV, the magnet pulse repetition rate as 25–30 per minute and the beam intensity aimed at was 10^{12} protons per pulse.

The machine chosen as injector was a linear accelerator, similar in principle to the 50 MeV linac, but differing in a number of detailed respects on account of being designed as a synchrotron injector rather than as an accelerator in its own right. It consists basically of a horizontal copper cylinder 44 feet long and $5\frac{1}{2}$ feet in diameter which is electromagnetically resonant at 115 MHz. 48 drift tubes spaced along the axis shield the protons from the radio frequency electric field at times when it would have a decelerating effect; the drift tubes also contain electromagnetic quadrupole focussing lenses. The injector produced its first full energy beam in 1961, and since that time there have been substantial improvements in intensity, energy spread and optical quality.

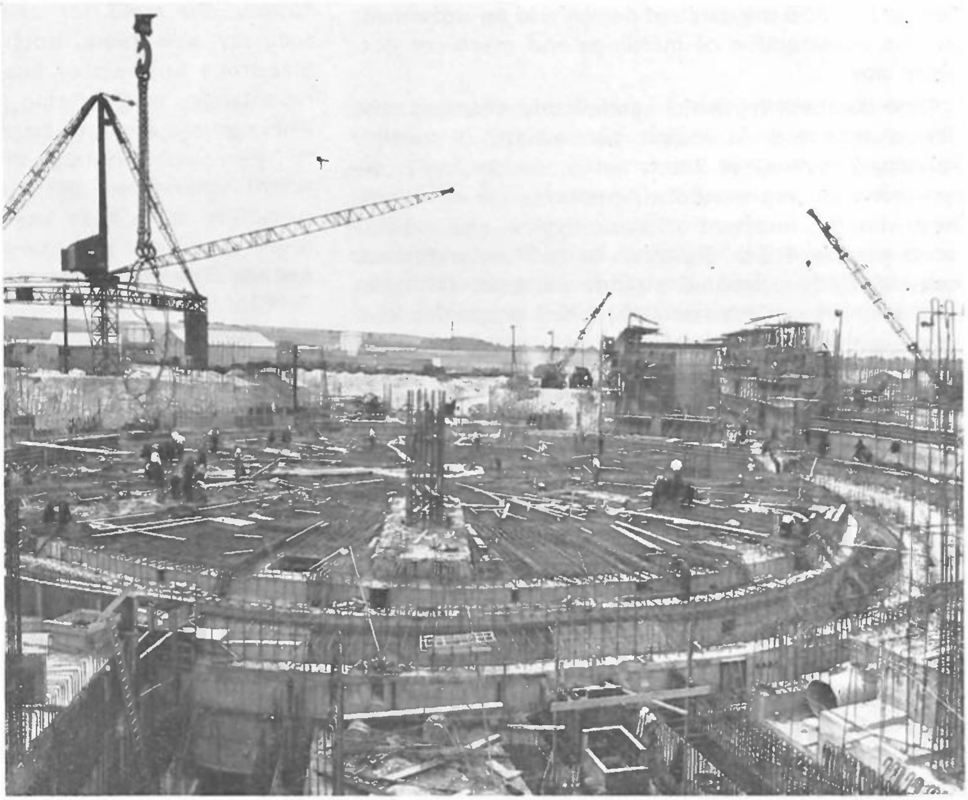


fig. 2
July 1958. Construction of the 160 ft. dia., 15 ft. thick, 14000 ton magnet bearing monolith has almost reached final floor level. The walls of the magnet room have been started and those of the injector room (right back ground) are more advanced.

The magnet design chosen involved building up each octant from forty-two magnet blocks, each weighing twenty tons, the approximate dimensions being ten feet square by one feet thick. Each block is a multi-decker sandwich of a half inch and a quarter inch thick steel plates, this laminated construction being necessary to avoid any current losses since the magnet is pulsed. The plates were carefully annealed and randomised in order to make all the blocks as alike as possible, and, after stacking and clamping together the requisite number, the throat aperture was machined out. When the production process was in full swing, magnet blocks were arriving at the Laboratory at the rate of one a day. They then underwent a detailed dimensional and magnetic survey, the results of which determined which of the 336 possible positions each block would occupy. The actual installation of the blocks in the magnet room was done in a carefully predetermined order so that the concrete monolith on which the magnet rests would be evenly loaded to minimise the possibility of tilting.

The powering of the magnet involves generating current pulses of over 9,000 amps at 14 KV; since this implies power surges of the order of 120 MVA (i.e. roughly equal to the power consumption of the city of Oxford), it is impracticable to have a direct connection to the public supply system. Some form of energy storage is needed, and the system chosen consists of a double motor-flywheel-alternator unit connected to the magnet energising coils by a system of transformers and grid-controlled mercury arc converters. These converters function as rectifiers when the magnet current is rising during acceleration, and as inverters when the magnet is being de-energised in readiness for the next cycle. During this period, energy previously fed into the magnet is being recovered and returned to the rotating plant. Some power is lost in resistive heating; this causes a 4% variation in the nominal 1,000 r.p.m. shaft speed of the rotating plant and the 10 MVA needed for 'topping-up' is what the electricity mains see as the load. The alternating stresses set up as a result of the continual pulsation imposes a severe duty on the rotating plant. There have, in fact, been two occurrences of mechanical failure in the alternators which have put Nimrod off the air for periods of months. Similar troubles have plagued other proton synchrotrons and consideration is now being given to replacting the rotary plant by static devices. (See D. A. Fox's article in the October, 1968 issue of Quest).

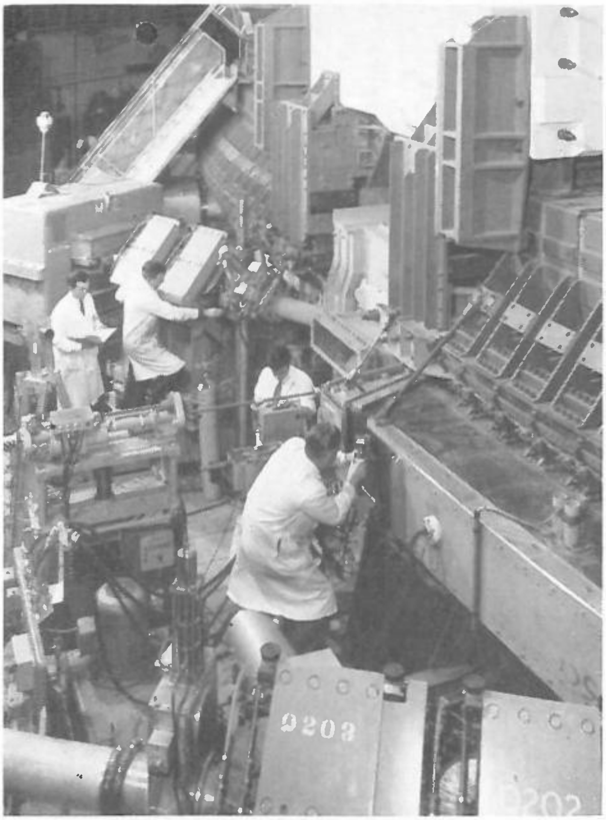


Fig. 3
April 1964. Final checks on the high energy beam lines emerging from Nimrod.

The component of Nimrod that gave most trouble was the vacuum vessel. This is a double-walled structure of glass fibre reinforced epoxy resin. The outer vessel is assisted in its task of withstanding almost all the pressure differential by being sandwiched between the magnet and the pole pieces, which are specially shaped to give the required field gradient for focussing. The material for the outer vessel is chosen mainly for its mechanical strength while the inner vessel, having to withstand a negligible loading, is made of a resin with good vacuum properties. Considerable difficulties arose during manufacture mainly due to uneven wetting of the glass cloth by the uncured resin and in ensuring even curing of such a large and geometrically complex unit. Vacuum testing at Rutherford Laboratory proved to be a time-consuming process. Many small leaks had to be found and rectified, a large fraction of these being due to the fact that about 10% of the glass reinforcement fibres were hollow instead of being solid. The meticulous attention paid to locating and correcting all such faults before the vessel was installed has proved to have been well spent. Not only has the vessel been trouble-free in service, but also the good pressures achieved have contributed significantly to the final beam intensities achieved, by minimising the loss of protons due to scattering by residual air along the 100,000 mile acceleration path.

The above items of hardware plus many others were being assembled during the early 1960's, which naturally was a period of intense activity and interest for the many people who were seeing the ideas and decisions of past years coming to fruition. Each unit had to be coaxed into operation, and much midnight oil was burned by many groups of people each intent on ensuring that their particular component would not be the last to be ready. The first occasion on which everything worked properly at the same time was in August 1963; the design energy of 7 GeV had been reached with a beam of about one-hundredth the design intensity. The ensuing twelve months were taken up by detailed investigations of beam behaviour, improvements to machine reliability and stability, and the long process of winning many small improvements in beam intensity. The design value of 10^{12} protons per pulse was finally reached in September 1964 and has subsequently been exceeded. A limited amount of experimental high energy physics was possible in early 1964, and a full schedule operated from the middle of that year, which also saw the official inauguration of Nimrod by Mr. Quintin Hogg, the then Minister for Science.

During the design and commissioning phase of Nimrod, the prospective users had been making their own preparations. In addition to assembling the particle detectors and targets that constitute the experiment proper, they shared with the machine builders the problems of the beam lines. These beam lines can in some cases be over 200 feet long. They are built up from components such as quadrupole lenses, beam bending magnets and velocity separators, and they serve two inter-related purposes – to filter off particles of unwanted species or energy and to guide the wanted particles to the experimental position in as compact a form as possible.

The stage was now set for the experimental high energy physics programme to get under way. Some organisational changes were also imminent as a result of the Trend Committee's Report on the organisation of civil science. These matters will be dealt with in part 2 of this article in the next issue.

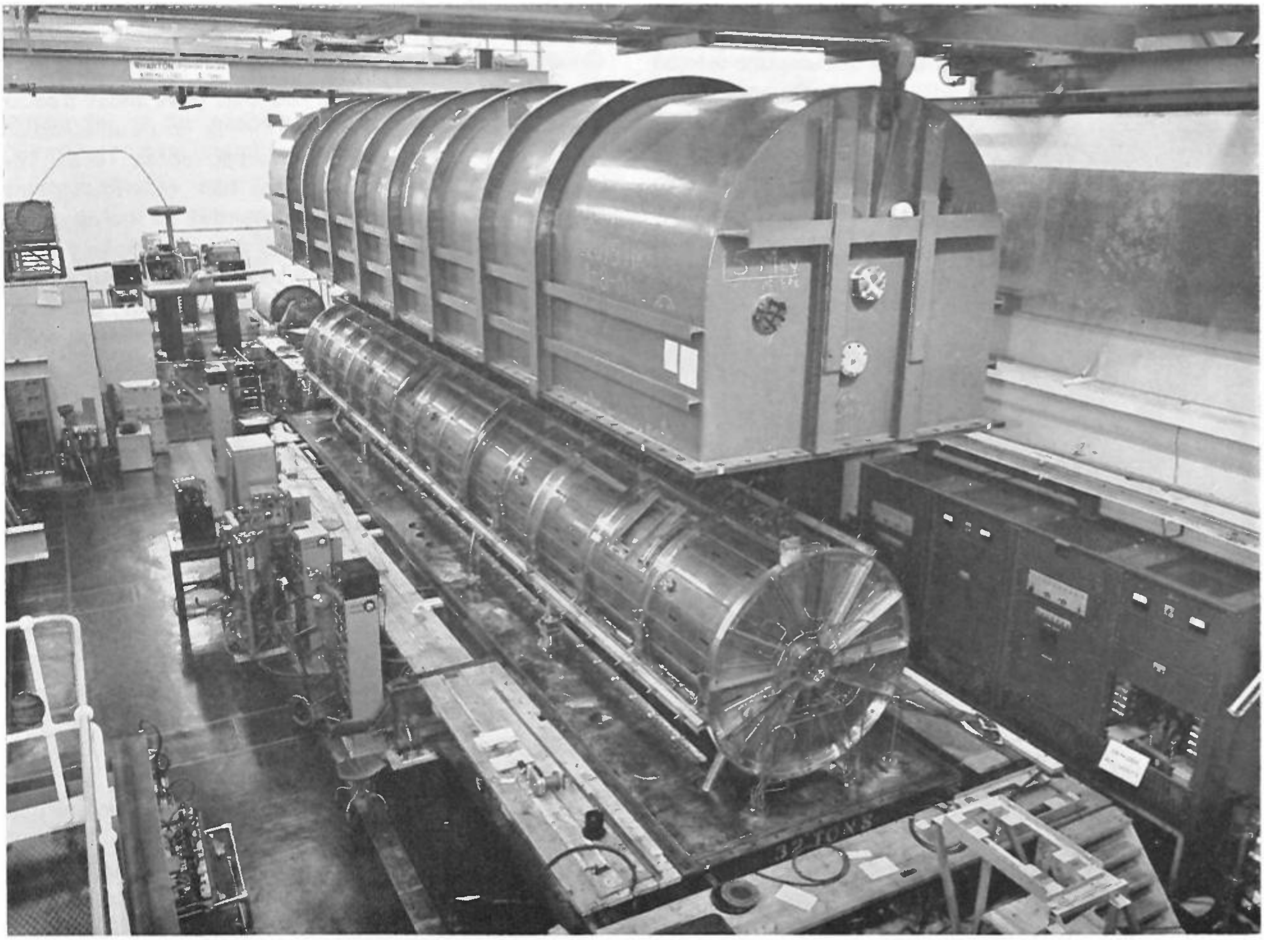


Fig. 4. Injector with lid of vacuum vessel raised to show the copper liner in place. This view is from the output end; the pre-injector can be seen in the background.

the old way

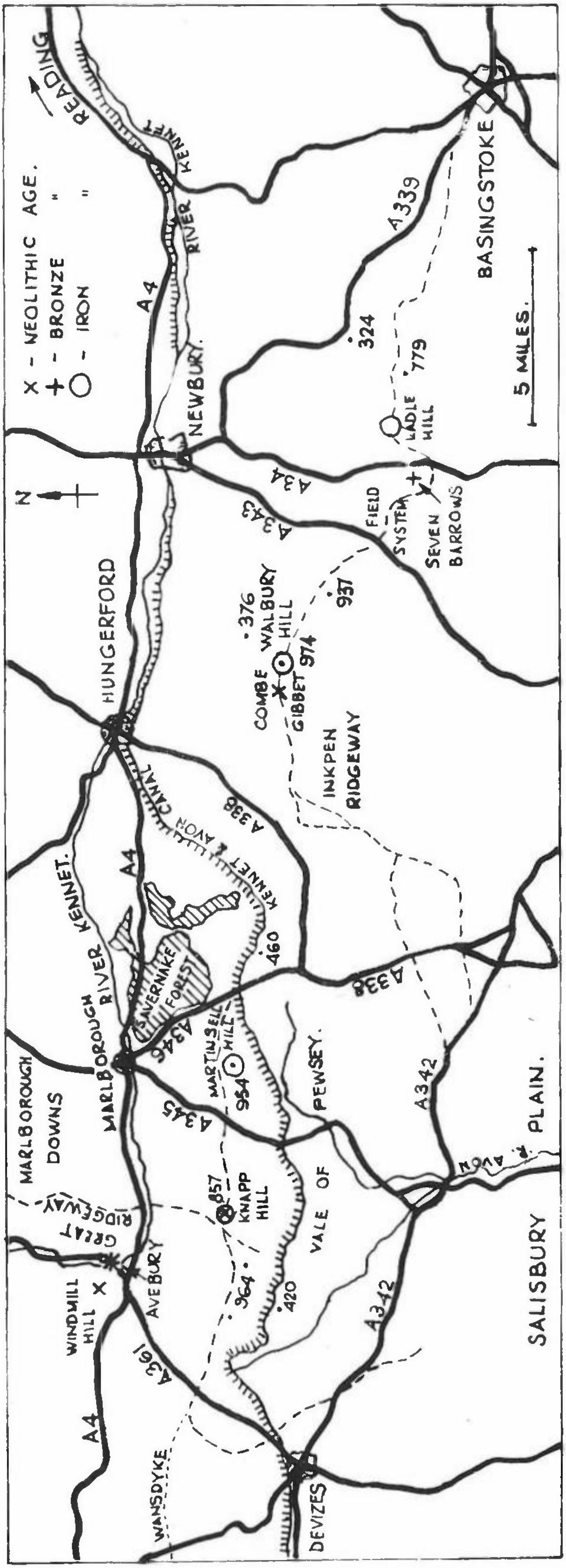
J. D. Davies

For the last 3,000 years of our English pre-history most of the people lived on the chalk uplands of Wessex with the plateau of Salisbury Plain as their 'megapolis'. Their relics today are of great interest and some even of use; in fact the Great Ridgeway, which pases one mile south of the Rutherford Laboratory, is being made a linear National Park.

Uplands Wessex was hemmed in by an almost continuous expanse of clay forest impossible for pre-historic man to clear easily and with the added dangers of wild animals and epizootic disease. However the light soil of the downs, which nowhere top a thousand feet, resulted in light woodland and patches of scrub or gorse; these could be easily cleared and kept under control with grazing beasts. Thus the Neolithic or New Stone Age started here, circa 3500 BC, with the infiltration of long-headed, 'Mediterranean people who brought with them agriculture and the domestication of cattle, sheep and dogs. There was probably little competition with the indigenous Mesolithic hunters and fishers and eventually their cultures united to form the economically self-sufficient Secondary Neolithic.

Our first visible monuments date from this period and are chiefly concerned with religion and mass burial of the dead in imposing, earthen long barrows. The circular monuments with or without stone settings known as henges and the causewayed camps used for periodic assemblage are peculiar to Southern England. Associated with the former are the mysterious cursuses, pairs of parallel banks and ditches often several miles long.

About 1800 BC immigrant bands of the round-headed Beaker Folk (named after their characteristic pottery), began infiltrating and invading our eastern and southern shores. Although aware of metal, they were probably sub-Neolithic. However they assumed the position of a dominant minority, imposing a cultural unity on the existing population and harnessing local resources to build the many stone circles, standing stones, avenues, stone rows and above all, to develop the principle henges, notably Avebury and Stonhenge, to the originals of their present form. Their most obvious feature was their insistence on individual burial, with grave goods, under round barrows and cairns. However



what is more significant, to the writer, is the change from worship of a mother-goddes to that of warrior gods, possibly brought over by the later Warrior Culture of the Battle Axe.

The rise of the Mycenæ empire with its glorification of the chieftain class created a social market for the gold, tin and copper of Ireland and for the industrial activities planted there from Iberia. The Bristol Avon–Salisbury Plain–Hampshire Avon formed a vital part of the trade route and this resulted in the temporary and almost fabulous enrichment of local chieftains and mercantile aristocracy. Incapable of such themselves, they stimulated artisans and craftsmen to bring in the brilliant early Bronze Age about 1500 BC.

Population pressures on the Continent (and later Julius Caesar) probably cause the many, complex waves of Celts that, between 600 BC and the arrival of the formidable and war-like Belgæ and Veniti in 60–50 BC started the English Iron Age. Their outstanding relics today are the many fortified sites, often on the tops of hills, whose lines of circumvallation rose from one to three or even more to overcome the range superiority of slings over spears. However, land hunger and the use of iron ploughs of improved design lead to the clearing of forests and a move away from the downs.

Contributing to the dominance of the Wessex uplands were its excellent communicatons formed by the three river routes of the Thames and the two Avons. The land routes followed the chalk or limestone belts that are flung off or touch the central area. Thus the Harrow or Hardway, follows the North Downs from the Kent coast to Stonehenge. The Great Ridgeway lies on the North Berks Downs to the Thames gap in the chalk at Goring and then becomes the Icknield Way on the Chilterns. Another major route follows the Jurassic Zone on the hard limestone from the Cotswolds to Yorkshire. Bronze-Age trade goods provided the first concrete evidence of the actual location of tracks; those used in early Iron Age can often be traced in the field e.g. where they connect hill-top forts, and there is written evidence in the Anglo-Saxon land chronicles.

As a contribution to increasing outside leisure activities, a network of long-distance paths is being established throughout the country. In the Wessex area these tend to follow the ancient trackways that were in continuous use from the ancient neolithic farmers to the sheep drovers of the nineteenth century. These tracks lie on the watersheds along the crests of chalk ridges and pass through relatively unspoilt and lonely country. They link together country-wide successions of the great prehistoric earthenworks as well as other habitation sights and the fading outline of what were their cultivated fields. Field systems can be traced back to the late Bronze Age and from the ground their appearance now ranges from the banks and ditches of cross-dykes and ranch boundaries to the slight terracing found on slopes too steep for present day cultivation; the latter were formed spontaneously by the method of ploughing used then.

The sections of Ridgeway track have been long enjoyed both for superb walks and for their archaeological and ecological interest; the Inkpen or North Hants Ridgeway starts near Basingstoke and then goes west along the chalk escarpment overlooking the Kennet Valley before bending south-west towards Salisbury Plain. The other is called after the Wandsdyke, since that huge and mysterious bank and ditch follows the track for several miles east from Devizes, until the latter takes to another escarpment high over the Vale of Pewsey. It is very probable that these two tracks formed a branch of the Harrow Way that lead to the Marlborough Downs and Avebury and then on to Salisbury Plain. The creation of the Royal Forest of Savernake caused the route to be lost as it crossed the water divide between the Kennet and Hampshire Avon near the village of Burbage.

If the two tracks were re-linked and recognized as a long-distance route, then this 'Old Way' would form what could accurately be described as the finest walk in southern England. Accordingly the chairman of a local group of the Ramblers' Association persuaded fellow physicists in the K12, Birmingham–RHEL, team on Nimrod to attempt the 50 miles between Devizes and Basingstoke. As our K12 group leader was worried he might have the word 'group' deleted, the first weekend in February was selected for its absence of machine running and for possibilities of favourable weather.

So a sceptical wife left Chris Adams, John Davies, Geoff Greyer, Mike Hotchkiss and Tom McMahon at Devizes early (?) on the Saturday. Within a few miles it became evident that the group could be split into those having legs longer or shorter than 31 inches; the former were always half a mile per hour faster but the leader had short legs and delayed shouts of 'wrong . . . way' somehow kept the party together.

A heavy hailstorm terminated the efforts of two members on Saturday evening and a bull nearly finished off the remainder as they struggled towards their camp on Ham Hill – we hadn't noticed in the gloom that the fence twixt us and the bull had petered out.

Jim Homer in his rugby boots augmented the battered remnants in the brilliant sunshine of Sunday. With ten miles to go, blisters finally defeated Mike who hitch-hiked to Basingstoke to collect the rescue car and then acted as cheer leader at each road junction.

With four miles to go, Tom, blister-free, way out in front and going like a bomb, decided that there was no pleasure in going on alone along a well-known track in the gathering gloom and he too retired. This left Jim to encourage John to finish in the dark, ten minutes before it began to snow heavily – however he had cheated by having a tolerant wife to ferry him home the previous night.

This 'Old Way' will amply repay the great amount of work required to make it into a long-distance route. Where signposted as a right-of-way, it was crowded; elsewhere we managed to walk seven miles without crossing a road or seeing a single person. As a final observation the two 'finishers' were the only ones not to suffer from blisters and only they wore ordinary shoes.

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council commentary

The big subject at the March Council meeting was the NP Board's policy review. The Secretary of State for Education and Science, Mr. Edward Short, with Mr. D. W. Tanner his private secretary, attended the meeting for the discussion of this item. The NP Board re-confirmed its conviction that while the present facilities would provide for first-rate research for some years ahead, the 300 GeV or some similar machine must be the basis of any satisfactory high energy physics programme in the 1980's. Although the Board had to plan within a falling proportion of the Council's funds, its plan provided for joining the 300 GeV project if the Government's decision were reversed, the funds being found mainly by closing down Nimrod in six or seven years' time, and by a reduction in the total number of experimental high energy physicists and nuclear physicists supported in the universities. An alternative plan was provided in case the Government's decision were not changed. The effect of the first plan on the work and staff use of the Rutherford Laboratory was discussed, and the Council was also glad to hear that the Chairman would visit the Laboratory, and that in the course of the visit he intended to discuss with the staff the problems which participation in the 300 GeV project might raise.

The April meeting was a long and varied one. The Council, exceptionally, agreed to receive a delegation from the Staff Side of the SRC Whitley Council, to present their views on the proposals to phase out NIMROD and reduce the staff of the Rutherford Laboratory, should the UK decide to join the 300 GeV project. The Staff Side, leaving aside scientific questions as being wholly the Council's responsibility, presented a challenge to the Nuclear Physics Board's plan on other grounds.

The next item was the consideration of the financial Forward Look for 1970–1975. As approved by the Council this shows the alternative NP programmes with and without the 300 GeV, no decision between these two being necessary for a further year. The programme shows a rather higher proportion than in recent years of expenditure on large projects to provide for the needs of the future, and there is further development of the policy of special encouragement of selected fields of research. In this connection the Council also considered the UST Board's revised policy review, which besides dealing with purely UST matters, made recommendations on several matters of general Council policy, such as the selection of fields of work for special encouragement, and the provision of grants for more ancillary professional and technical posts. These will be more fully reported in the Council Annual Report.

Professor Hoyle introduced the full review of optical astronomy in the southern hemisphere which had been carried out in 1968 under his chairmanship. The recommendation, accepted by the ASR Board, would provide for an impressive and exciting programme within a reasonable expenditure. Facilities in Australia would be concentrated at the site of the Anglo-Australian telescope, and in South Africa and it was hoped that a good programme could be arranged in collaboration with the CSIR (South Africa). At the March meeting, exploratory negotiations in Australia and South Africa had been reported. The Council was informed that these were proceeding well, and authorised their continuation.

Large individual items approved by the Council at the April meeting were the completion of development of the Stage 5 (star-pointing) stabilisation of the Skylark rocket, the total approval now being £705,000; necessary spares for the Nimrod magnet power supply, costing £290,000; and grants totalling £330,000 to Imperial College, Reading and Oxford Universities for experiments in satellites HEOS A-2, Nimbus-D and Nimbus-E. The Council also approved at the Rutherford Laboratory the design study costing £50,000 of a high field bubble chamber and for the Radio and Space Research Station, equipment costing £60,000 for a new collaborative programme with the GPO on radio-meteorology and millimetre wave propagation. The Council welcomed this collaboration, one of the first to be undertaken under the policy that establishments should devote more of their allocated resources to work of practical application.

TRIUMF on the PLA

W. D. Allen

The Rutherford High Energy Laboratory is known chiefly for its 7 GeV proton synchrotron, Nimrod. Less conspicuous, but widely used by many university teams, is the Proton Linear Accelerator, referred to locally as the PLA. (The appellation 'Ramrod' was fiercely resisted by the PLA community). The PLA produces beams of protons of energy 30 MeV and 50 MeV, and has until six months ago been exclusively used for nuclear physics. During May–October 1968, however, an experiment was mounted which differed in many respects from normal. For one thing, it was an experiment in atomic physics; for another, the stripping cross sections sought were of interest because they were the basic parameter in a machine magnet design; for a third, it was carried out by a team of Canadian visitors. A brief account of the motivation of the experiment, and of the use of the PLA to achieve a rather novel result, may be of interest.

meson factories

It has been known for 20 years that beams of protons in the energy range 200–500 MeV have sufficient energy to produce mesons from target material: the period 1948–56 saw many experiments reported on meson and proton scattering in the energy range of a few hundred MeV. After 1956, high energy physics raised its sights with the advent of machines in the range of thousands or ten of thousands of MeV, and the range we have been speaking of has been relegated to the realms of classical high energy physics. Now the cyclotrons of 'classical' high energy physics were relatively low current machines: an extracted beam of one microampere was regarded as good. If, howeved, we had not one microampere but one thousand microamperes in the incident beam, then one would have a powerful machine for a wide variety of purposes. Thus, one could repeat, with much greater precision, the 'classical' experiments on proton and meson scattering in this energy region: and one could, with a high flux of relatively slow pions, produce beams of relatively slow muons which would be far more intense than any existing source. In addition, however, a 500 MeV beam if brought to rest in a solid will liberate about 25 neutrons for each incident proton, so that one would have a powerful neutron source, either in terms of total flux or in terms of a pulsed source: and so on. The case for a multi-purpose facility, described in popular literature as a meson factory, is impressive (see, for example, Physics Today, Snell & Zucker 1963 or Rosen 1968).

but what kind of machine?

The last sentence is of course a subjective judgement. The case may be impressive to some, but the fact is that until the last few years, no proposal has been funded. There are various reasons for this, not the least being the fact that a multipurpose powerful machine is very expensive. Another consideration has been the fact that machine physicists have been divided in their advocacy as to what machine to build. Cyclotrons in general suffer from the major disadvantage that efficient beam extraction represents a diffcult problem. In a cyclotron, the ions execute a spiral path in a magnetic field, being accelerated twice per revolution, i.e. each time they pass the edge of an electrode appropriately called the Dee, carrying radiofrequency power. In the beginning, the gain of energy per turn is large compared with the particle energy, and the separation between successive turns is large. When the particle energy is high (several hundred MeV) the relative energy gain per turn is small. The turns of the spiral are therefore close together and it is difficult to prise them apart in such a way as to extract the beam without disturbing the preceding orbits. In practice, this means that one can get about half the beam out: the remainder is deposited in the extraction system. For a high power machine, the radiation problem that this poses is formidable. An attempt to avoid the problem, the Separated Orbit Cyclotron, originally urged by F. M. Russell of the Rutherford Laboratory, has been thoroughly studied, but has found no sponsors except for a small scale test model at Oak Ridge.

The linear accelerator suffers from no such problem: the beam, accelerated in a straight line, comes straight out through a thin window. Here however the problem is different: the radiofrequency power driving the accelator is very high, and the valves supplying the power are normally operated with a low duty cycle (i.e. the ratio of 'on' time to total time is small). The consequence is that the objective of a high mean current is difficult to achieve.

Despite these difficulties, two 'meson factories' are in the course of construction. In Zurich, Switzerland a special type of ring cyclotron is going together, while in Los Alamos, New Mexico, a meson facility is being developed from a linear accelerator with a 6% duty cycle. A third project, the Intense Neutron Generator at Chalk River, a linear accelerator with 100% duty cycle, aiming at 65 mA at 1,000 MeV, has recently been turned down.

TRIUMF

There is, however, an alternative to the normal type of cyclotron which, while accepting a rather lower mean current, neatly sidesteps the problem of extraction. This proposal originated in Los Angeles, and has been taken up by a group of Universities in Western Canada, who have given it the acronym TRIUMF – Tri-University Meson Facility. The proposal is this. Hydrogen (neutral) atoms can lose an electron to form a proton; they can also attach an electron to form a negative hydrogen ion. The 'glue' that holds the electrons on is relatively weak, so that when the ion passes through matter at high energy, for example a thin foil, it loses both electrons and becomes positive – a principle long in vogue in tandem electrostatic generators. In a cyclotron accelerating these ions, the particles are deflected towards the centre of the machine by the magnetic fields: when the sign of the charge on the ion changes, the force on the particle reverses in direction, so that the (now positive) ions are actually pushed out by the magnetic field. The stripping by the foil is effectively 100% efficient: the beam is only very slightly scattered by passage through the foil, and therefore emerges from the machine without loss. Extraction is therefore approximately 100% efficient, and – relatively speaking – no radiation problems arise.

In addition, however, to the modesty of the current – 100 microamperes is aimed at in TRIUMF – a second problem arises. The force that deflects the negative ion in the cyclotron magnetic field is the force on the attached electron: and, as we have said, the glue holding this electron to the residual neutral atom is relatively weak. There comes a time, therefore, when the forces of deflection are such that the electron is prised off the atom, which is thenceforward lost to the system. By suitable design, the system can be organized to give a maximum ion energy of the 500 MeV. However, a knowledge of the electron loss cross section; i.e. the rate of loss of particles of adequate energy in a known field, is an important factor in the machine design. This 'stripping' cross section can be estimated theoretically, but not with high accuracy; it has been determined experimentally on the Los Angeles cyclotron, but again not with with accuracy. Since the machine performance (in TRIUMF) and the magnet design depend on this cross section, an accurate determination was essential, and, soon after the project was funded, a request was made for a fresh experimental determination at the RHEL.

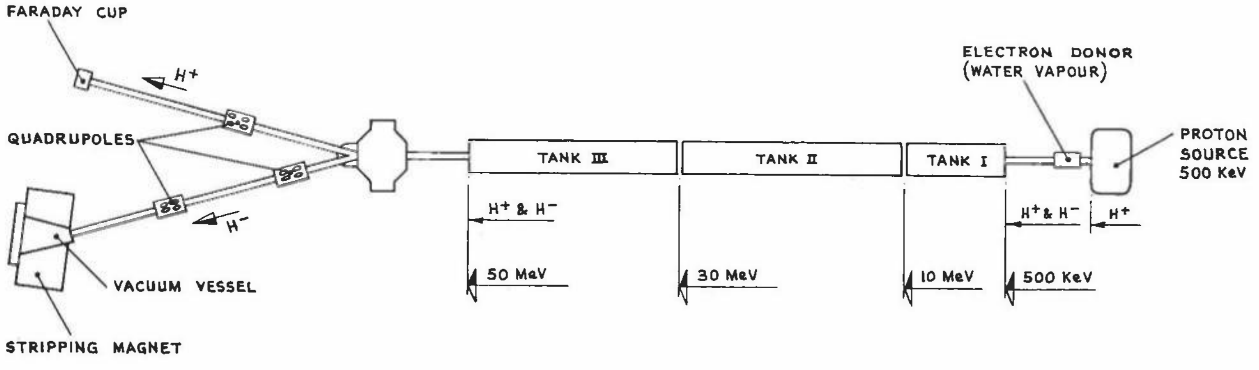


Fig. 1. Schematic of the PLA with the experimental layout for the TRIUMF Experiment

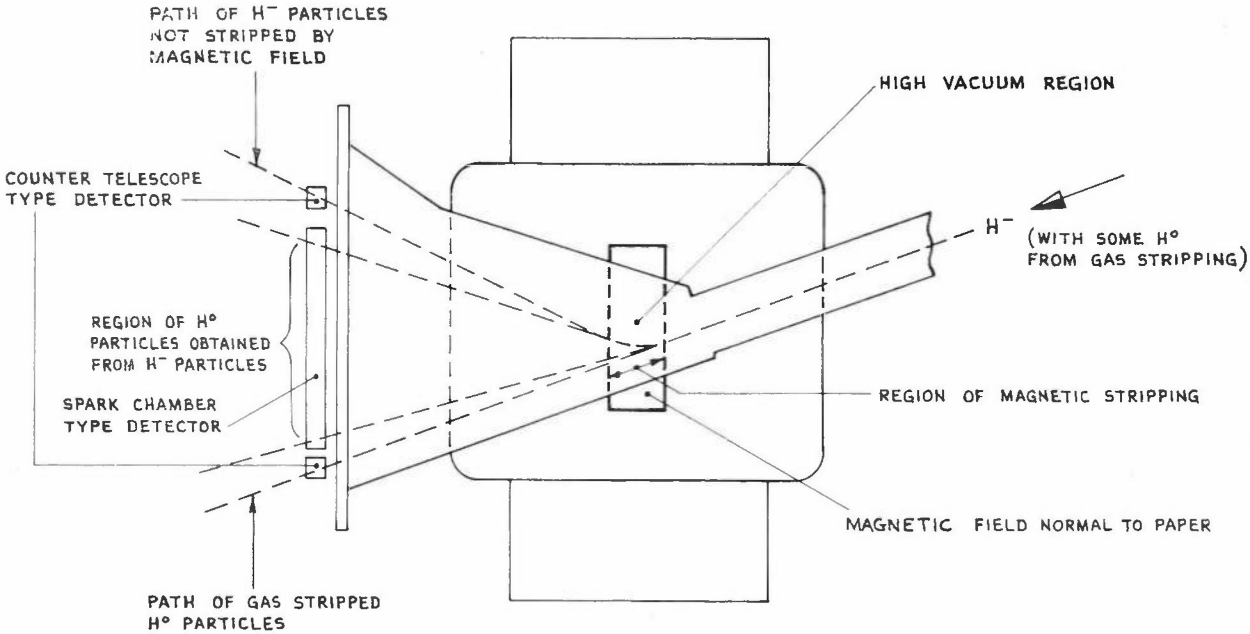


Fig. 2. Schematic of H– Stripping Apparatus

PLA experiment

Ideally, one could seek to carry out the test with a beam of 500 MeV negative hydrogen ions in a magnetic field of 6 Kilogauss maximum. Since no such beam is readily available, an alternative is to establish the stripping of a 50 MeV negative ion beam in a magnetic field of at least 20 Kg: in principle, the determination at one magnetic field only is necessary, as the uncertainty in the theory is mainly in the parameters chosen. In the PLA, negative ions are accelerated as easily as positive, by virtue of the linear path and the fact of the alternating character of the accelerating voltage – provided that enough negative ions can be produced. The injector of the PLA operates (Fig. 1) at 500 Kilovolts, and passing this beam through carbon foils was expected to give enough negative ions for the experiment (i.e. about 10^5 per second). In the event, the carbon foils burnt out too rapidly; however a tube carry water vapour proved sufficient to yield an adequate negative ion beam. The attraction of the method was that, apart from the mechanics of inserting or withdrawing the tube, no change in the operation of the accelerator was required, so that the TRIUMF experiment was scheduled for the machine with effectively no interference to the nuclear physics programme.

The intelligent reader who has struggled thus far will be justified in wondering how the claim of 100% efficiency in stripping electrons from negative hydrogen ions by passing through a foil, can be reconciled with this reverse assertion: the **production** of H– ions from protons by passing through foil or vapour.

It all depends on the proton velocity. At 12 KeV energy, a proton has the same velocity as an atomic (orbital) electron. As the protons of this energy pass through matter, many electrons, initially attached to stationary atoms in the matter, execute a sort of 'excuse me' dance and switch their attachment to the fast protons, which become fast neutrals. If this happens twice, one has a fast negative hydrogen ion. A 12 KeV, two in a hundred fast particles is a negative hydrogen ion. At 500 KeV, the proportion is very much less, but still adequate: at 500 MeV, all the fast particles are protons.)

The rest of the experiment was straightforward (Fig. 2). The beam was bent into a spare experimental area and passed between the jaws of a large magnet (22 Kilogauss maximum) borrowed, with modifications, from Nimrod. This bent the ions through an angle of about 30° in a path of some 12 inches. A small fraction of the ions were stripped en route, and the resulting fast neutral atoms – still, of course, retaining their 50 MeV

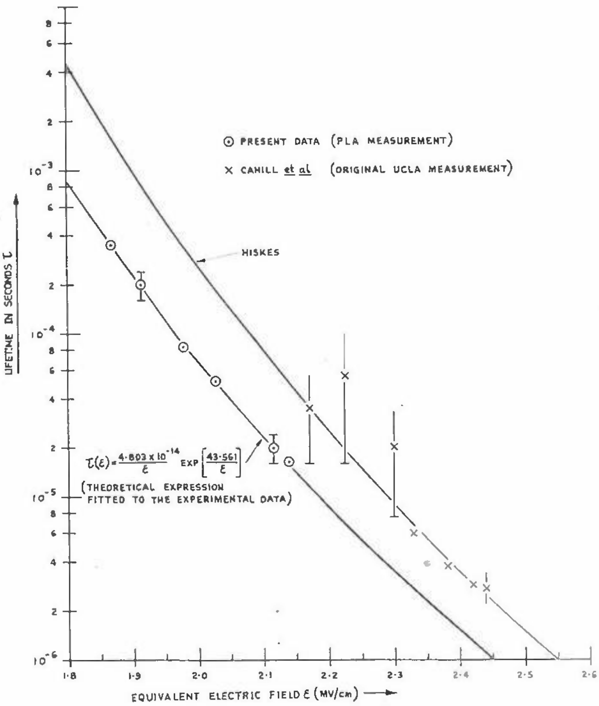
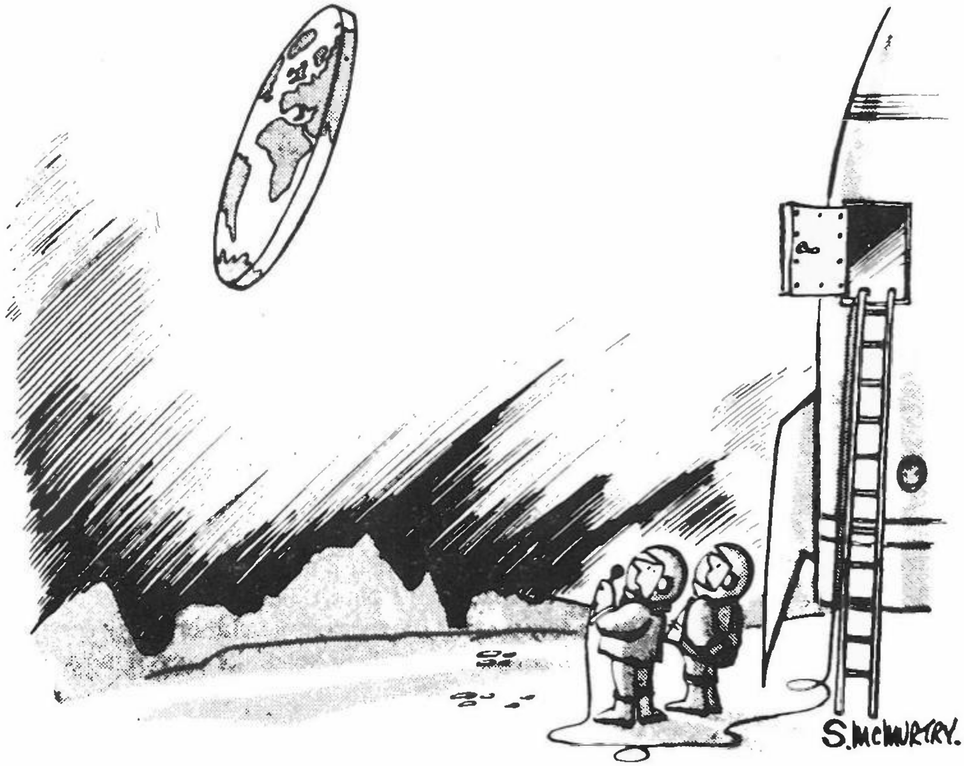


Fig. 3

energy – were detected by an extended spark chamber system borrowed from the PLA spectrometer. The ratio of the number of ions recorded in the spark chamber to those in the counter telescope gave the stripping cross section required. The results are exhibited in Fig. 3, where the ordinates are in terms of time for stripping in the field, i.e. related to the electron loss cross section, and the abscissa is the electric field in M.V/cm, equivalent to the deflecting magnetic field. The curve marked 'Hiskes' is one of the original theoretical estimates, which appeared to agree with the original measurements, shown by crosses, taken at the Los Angeles cyclotron. The other curve and the theoretical expression shown is of the same form, but modified to fit the points taken on the PLA, shown by circles and dots. Although the two curves might appear close to each other, the scale is logarithmic, so that the PLA figures for the stripping cross section are one-third smaller than the previous values.

The outcome? That the TRIUMF magnet needs to be slightly larger than originally expected. However, it can now be designed in the confidence that the parameters on which the design is based are firmly established.



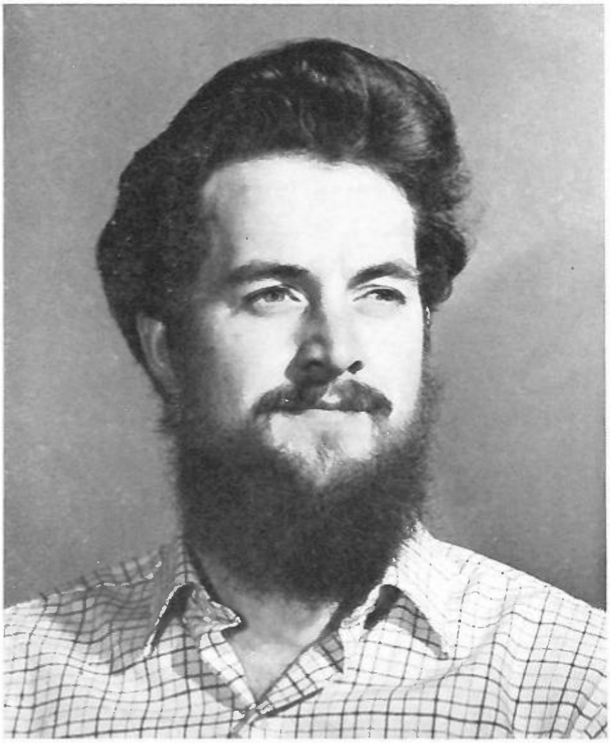
"Hello earth . . . look, I'm not quite certain how to put this . . ."

with acknowledgement to Times Educational Supplement

people and their pastimes

motorcycle sprinting

E. N. Walker
RGO



Beneath, and almost part of you is the machine, a throbbing 1,000cc twin cylinder Vincent, barking a raucous percussion into the grid area cacophony, but sounding very sweet to ears tuned by anxious experience to detect this one note from a full orchestra of almost identical instruments.

In front stretches the course, a strip of tarmac, a seafront promenade, or a disused aircraft runway.

The right hand tweaks the throttle spasmodically and the body vibrates to the answering rise and fall of engine revs. A signal . . . 'go when ready' . . . left hand claws down the goggles and grips the clutch lever, toe of right boot lifts gear into first. Slide back in seat; rev to seven thousand; exhausts blast staccato flames into the inferno of sound; smoothly release clutch lever.

Front wheel paws the air, rear wheel fights for grip, fails and spins crazily, bites, and you're away. 100 yards out and 80 on the clock, rev. counter shows seven thousand, hand and foot co-ordinate to flick into second gear. Revs die then swing up again to seven thousand; into third and again to seven thousand; 110mph now, the engine note, muted by the speed, is sweet and regular.

If its a half-mile sprint, the throttle stays open in top gear and you cross the line at about 135mph; if its a kilometre run, then you'll be at 140 plus. At this speed the wind blast is like a physical blow, differing only from a punch on the jaw in that the whole of the body suffers the same treatment. The air pressure is so great that cheeks flap like paper. Once over the line, the right wrist, which is holding the throttle open, eases back, and if the run-out distance is short, there are anxious moments of swift gear changing and hard braking.

You've just covered a quarter of a mile in thirteen seconds, or a half-mile in about twenty seconds; you've worn a visible amount of rubber off the rear tyre, but you MIGHT have made the fastest time of the day, which would really make the journey worthwhile. But whether you have won or not, you are still alive, so you return to the paddock hoping to do better next time. That's what sprinting is all about . . . a man/machine combination against a clock calibrated in one thousandth of seconds.

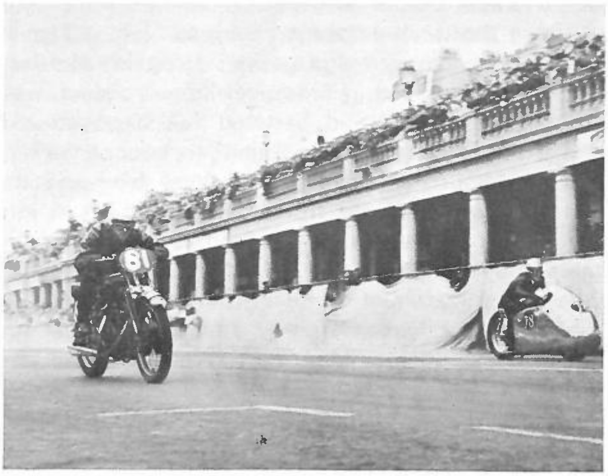
Motorcycle sprinting must be the least commercialised of all the mechanised sports. An almost complete lack of cash prizes, coupled with a truly competitive attitude and the friendly cooperation of organisers and competitors, makes for a very amicable sport. There are, of course, varying degrees of involvement: on the one hand there are the professionals, probably dealers, whose commitment is almost total, they use their success at speed events as advertising. Their specially prepared machines wear flat tread slick tyres and drink £25 per gallon high explosive fuel at a rate of two miles to the gallon. These men are the fastest on two wheels in the world; speeds of up to 200mph are attained for a standing start kilometre; a standing start quarter mile will be covered in ten seconds, with a terminal speed of 135mph.

To illustrate the sort of speed involved, imagine a man travelling at 140mph in an 'E' type Jaguar. He pases an expert motorcyclist as he drops the clutch on a standing start sprint. The dot in the rear view mirror recedes for about a quarter of a mile, but at 0.6 of a mile, nineteen seconds after passing the stationary bike, it flashes past the Jaguar and **leaves** it at up to 50mph in excess of the speed of the car.

At the other end of the scale there are the hundreds of enthusiasts who, like the author, compete in standard production machine events. Here, the machines must be fully equipped for the road, with lights, dynamos, mudguards, etc. Engine tuning is permitted, but special fuel, super-chargers, special tyres, etc, are out. The speeds are in a different order to those of the experts, but competition is none-the-less keen. The author, with his own machine has consistently clocked times of under 13.5 secs. for quarter mile events, and has a 'best time' of 13.06, which has been bettered by very few people in the world on production machines.

For anyone wanting to take part in a motorised sport, motorcycling is probably the cheapest ticket; even so, it is still a fairly expensive hobby. Entry fees usually cost £1 and £5 for petrol for the day; all for a total of six runs, which, if they take much more than thirteen seconds, means that you've wasted your time. Add to this the cost and time of tuning the machine, frequent tyre changes and special clothing . . . not to mention the cost of buying the bike in the first place. The prizes, if you are lucky enough to win them, won't help the exchequer one little bit, they usually consist of an engraved trophy or a pint tankard!

The author has tried motorcycle sprinting, road racing, hill climbing and sidecar racing (as a passenger). Having been terrified on a wet, sheepdung-covered potholed hill in Westmorland in a hill climb event, and crashing heavily in a solo motorcycle race at Cadwell park, he decided that these events should be left to the more heroic element. For those who need the occasional adrenalin injection however, passenger riding in a racing sidecar can be recommended above all else. Not for them the impersonal battle with a clock; instead, the deathly hush of the starting line, desparate pushing to start and the frantic grab and scramble to get aboard. Once on the move and in the race proper, all connection with sanity is severed. The cosy environment of modern society is replaced by a hard, bucking platform which seems determined to throw you off or beat you to a jelly. One's path is defined by a tortuous strip of concrete, spinning past at speeds up to 120mph. When it bends to the left, it is imperative to lean out as far to the left as possible in order to keep the sidecar wheel on the ground, or at least as close to it as possible. In this precarious manner one rounds corners at three figure speeds with one's rear end literally scraping the ground. With right hand turns, one has to lean over the rear of the bike in an effort to keep the rear wheel in contact with the ground. The vibrations of the engine and frame are transmitted through the ribs to the viscera, and within inches of one's ear, the driving chain wines a tortured protest with the recurrent snatch, jerk, snatch, jerk as the power is fed on and off. The nostrils are assailed by the smell of burning rubber as the rear tyre slides around the corners. It is necessary to anticipate these abrupt changes of direction and to shift one's weight at precisely the right time, but little or nothing can be seen of the course, so one has to rely on the experience gained from trial runs. Even on the straights, when prone on the floor of the chair, the roar of the engine and howl of the wind combined with the view through the transparent nose cone as the road rushes up at 120mph only three inches from one's face, makes for an environment which defies description; experience is the only teacher here.



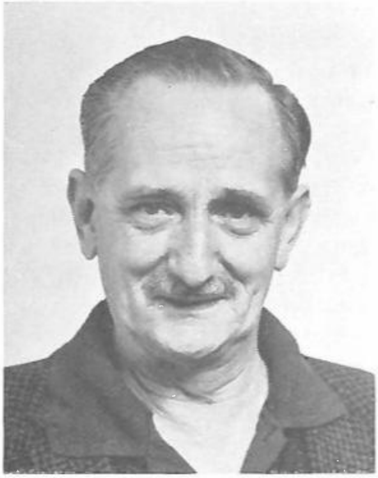
One hundred yards out from the start, 80 mph on the clock and into second gear.

This is total commitment in the grand manner, indeed it's no place for anyone **but** the totally committed; if one should hesitate, even for a fraction of a second, to lean either to right or left, then you will assuredly crash.

Why do it . . .?, well there are probably as many answer as they are competitors. No doubt a Freudian would find evidence of overt sexuality; an Adlerian would suggest a power complex; and the riding of a shiny, black solo motorcycle would offer considerable scope to any student of Jung's archetypal symbolism.

For my own part, I would suggest that there **are** no words to explain why . . ., the same urge makes people climb mountains, sail boats, grub around in potholes, etc. In fact it's all a part of living life to the full; a life which might be much safer if you didn't indulge in such pastimes, but, oh so very dull.

Bill Stewart joined the staff of the Royal Observatory Edinburgh as a Handyman in 1960, at a time when the Observatory was expanding rapidly. He became a Driver/ Handyman for a time, but reverted to his old grade when the transport situation became more stabilised. Now, at the age of 67 years, he is a Nightwatchman, a job he hopes to keep until he becomes an 'elderly citizen'.



a day on the river

W. D. STEWART

Come with me along the left bank of one of our famous Border rivers on a bright early morning in early October. The air is cool after a sharp night frost which has dusted the earth with a fine silvery powder. On our right the ground, which slopes sharply away from the bank, has been planted in alternate strips of Larch and Douglas Fir, the dark green in sharp contrast with the gold-bronze of the Larch can be seen for quite a distance away. On our left, the mainly arable ground is divided into a patchwork of fields of various shapes and sizes, blending into the range of rolling hills that forms the sky-line. October is a time of colour in the country and here we find it at its best; hawthorn and rose-hips glisten dark red and the bright rowans contrast with jet black elderberries which hang like bunches of small grapes.

Walking along a rough track leading from the main road, we come to a hut and seated in its open door are two men, lean and weatherbeaten, who are gazing intently at the river; they are boatmen, or Ghillies, who, in the season, earn a living by imparting some of their long inherited fishing skills to the visiting city dwellers.

They both have old Border names; James Anderson and Peter Young, and we find them discussing their 'Gentlemen' for the day. In a heavy brogue Jim says 'Ah've got a Mr. McArthur, he's a whusky traveller frae Glesca', Pete, 'Ah aye kent ye was yin o' the Lord's annointed, Ah've got a lawyer frae Edinburry, he'll no be that hot; he's a Mr. Naysmith'. Jim acknowledged this with a slight grin and said no more.

The two men have been friends since their school-days and started work as young gamekeepers, until the youthful call to adventure made them apply to enlist in the Regiment. Pete was bitterly disappointed when the army doctors discovered an astigmatism in his left eye and pronounced him unfit. This did not prevent him from becoming an expert with the twelve-bore shotgun, and he was a regular winner at clay pigeon shoots in many parts of Scotland and over the Border. Jim was accepted and served with distinction for full term of twenty-one years, rising to the rank of Colour Sergeant.

Down the track comes a blue-grey 'Jag', which is expertly manoeuvred and parked alongside the hut. The owner, dressed in faded corduroy trousers, well worn sports jacket and battered felt hat, gets out and with a cheery 'Good morning' announces the fact that McArthur had arrived. Jim takes over and the gear is soon offloaded from the car and taken into the hut. A small hamper of food is placed on the table and the tackle and rod taken out to the boat, where in a matter of minutes, it is 'set up', the line run out and a leader expertly attached. 'What's the killer today' queries McArthur. 'Well ye could dae waur than pit on a Hairy Mary, no ower big' replies Jim. 'OK, you're the doctor', and from a well stocked box, Jim selects his 'flee' and with a style of his own, attaches it to the leader.

Meanwhile, Mr. Naysmith had arrived, driving a mud-stained Cortina, which he parked alongside the other car. A quiet 'Good morning, gentlemen' seemed to imply that he was not one to waste words. Pete gave him quick service and in a short time, both boats were ready for the day's fishing.

The two men tossed for first drift and Jim pushed off quickly with McArthur into quiet water and allowed the boat to drift slowly downstream. McArthur wasted no time and was soon flicking a lovely long line across the river. After about twenty minutes, with a splash and a hefty pull he was playing a fish that took about eighty yards of line with its first rush. 'Rush and Recovery' soon subdued it, however, and it was brought alongside and expertly netted by Jim, who gave it the 'last rites' – a sharp blow on the head with a small wooden baton called a 'Priest'. On the scales it showed eighteen and three-quarter pounds. 'A beauty' grinned McArthur, 'a gey guid fish' agreed Jim, stowing it carefully in the bottom of the boat. McArthur reached into his bag and brought out a bottle of whisky and a tumbler. Removing the foil and cork, he poured about four fingers and handed it to Jim who downed it in a oner. Returning the glass, he remarked appreciatively 'By, that wis a stiff yin'. McArthur poured again and with a muttered 'Cheers' followed Jim's example. After a moment's attention to the line, McArthur began to cast again and soon hooked another, lesser specimen, which received the same treatment and fiery blessing, before Jim turned the boat upstream for lunch.

In the other boat, poor Pete was getting a rather thin time. Naysmith had made it plain from the outset that he did'nt need any advice on the selection of flies. I've been advised to try a 'Jock Scott' he said, to which Pete replied with a non-committal 'fair enough'. Naysmith began to cast, first rather awkwardly and then with a steady swing, but he achieved no success. After an hour's fruitless casting, Pete remarked, 'Ye could try anither flee'. Despairingly, Naysmith agreed and turning back the lapel of his coat, Pete selected one of three which weer stuck into the cloth; 'try that yin' he said and quickly tied it on.

The fly was very similar to the one chosen by Jim and was one of Pete's own dressing. Within about ten minutes the fly was taken strongly by a good fish which took Naysmith by surprise. He attempted to rise to play it, but was curtly ordered to 'sit doon and let it rin'. After a lot of vocal help, Naysmith brought the fish in close to the boat for Pete to net. 'My first salmon' he exulted, 'Ah thocht as much' grunted Pete, and after a pause, 'ye micht 'ave tellt me ye wis a beginner'. 'I'm sorry, I should have said so' apologised Naysmith, 'I did'nt think'.

Pete was slightly peeved by the non-appearance of the 'dram', but did not let it show. A somewhat subdued Naysmith started fishing again, but not for long; as Jim's boat passed them, Pete turned in behind and followed them to the hut, where the boats were run up onto the shingle and the catch taken in for inspection.

McArthur opened his hamper and set out food and cans of Bass Export for each man. 'Right lads, dig in' he invited, and they fell-to, Naysmith included and he seemed to become more amenable as the meal progressed. There followed a pleasant hour, talking about fishing, shooting and the countryside in general; Naysmith listening intently, but saying little, leaving the conversation to McArthur who was a good talker and seemed to have a good knowledge of the countryside.

After lunch, Pete was first back on the river, followed after a short interval by Jim. Naysmith soon hooked, but lost a small fish, then landed an acceptable ten-pounder. McArthur landed one about twelve pounds in weight, but a chill wind had sprung up and with it, the fish evidently decided to seek other, more sheltered water, because neither men had any more luck and shortly, by mutual consent, they decided to call it a day.

On arrival at the hut, the rods were 'taken down', the catch packed in polythene bags and, with the gear, stowed in the boot of the cars. As this was being done, McArthur turned his back, extracted a pound note from his wallet, folded it neatly, and on shaking hands with Jim, deftly palmed it. He answered Jim's thanks with a grin, slid under the wheel of his car and was off. Naysmith was equally appreciative and dexterous and he moved off leaving Pete in a slightly astonished state. Thus ended a routine day in the lives of two of my friends.

newsfront

Knighthood for the Chairman

Professor B. H. Flowers, FRS, receives a knighthood in the Queen's Birthday Honours List.

OBE

Professor I. N. Sneddon, member of the UST Board and the Computing Science Committee.

BEM

G. E. A. G. Barnett, Senior Scientific Assistant, RSRS.

BRITAIN FIRST TO ACCEPT CERN CONVENTION CHANGES

MEYRIN-GENEVA : CONTINUING A TRADITION ESTABLISHED IN 1954 WHEN THE U.K. WAS THE FIRST MEMBER STATE TO RATIFY THE CONVENTION ESTABLISHING THE EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH, THE BRITISH DELEGATE HAS DELIVERED TO THE DIRECTOR-GENERAL OF CERN THE OFFICIAL NOTIFICATION THAT BRITAIN HAD ACCEPTED THE AMENDMENTS TO THE CONVENTION PROPOSED BY COUNCIL.

THE EXISTING CERN CONVENTION EXPLICITLY PROVIDED FOR THE ESTABLISHMENT OF A FUNDAMENTAL NUCLEAR PHYSICS RESEARCH CENTRE NEAR GENEVA WITH TWO ACCELERATORS SERVING AS PRINCIPAL EXPERIMENTAL TOOLS - A SYNCHRO-CYCLOTRON OF 600 MEV AND A PROTON SYNCHROTRON OF MORE THAN 10 000 MEV (CURRENTLY CAPABLE OF 28 000 MEV).

FOR EUROPE NOW TO PROCEED WITH ITS PLANS FOR A 300 GEV PROTON SYNCHROTRON WITHIN THE FRAMEWORK OF THE SAME ORGANIZATION, THE CONVENTION NEEDS TO BE MODIFIED - REQUIRING THE ACTIVE AGREEMENT OF ALL THE PRESENT 13 MEMBERS. THE REVISIONS TO BE RECOMMENDED TO GOVERNMENTS WERE AGREED BY COUNCIL IN DECEMBER 1967.

THE REVISED CONVENTION PROVIDES FOR THE SETTING UP OF OTHER LABORATORIES CONTAINING ONE OR MORE PARTICLE ACCELERATOR AND ASSOCIATED EXPERIMENTAL EQUIPMENT EACH WITH ITS OWN DIRECTOR-GENERAL RESPONSIBLE TO A COMMON COUNCIL IN TURN ADVISED BY A COMMON SCIENTIFIC POLICY COMMITTEE AND FINANCE COMMITTEE.

BRITAIN IS NOT ONE OF THE SIX COUNTRIES (++) WHO HAVE ALREADY STATED THEIR WISH TO PARTICIPATE IN THE 300 GEV PROJECT. THEIR BEING FIRST TO AGREE THE CONVENTION CHANGES DOES, HOWEVER, DEMONSTRATE THE ACTIVE SPIRIT OF COLLABORATION THAT IS IN EVIDENCE AT CERN.

(++) LETTERS OF INTENT HAVE BEEN RECEIVED FROM AUSTRIA, BELGIUM, FEDERAL REPUBLIC OF GERMANY, FRANCE, ITALY AND SWITZERLAND.

EDWIN N. SHAW
CHIEF-INFORMATION OFFICER
CERN GENEVA

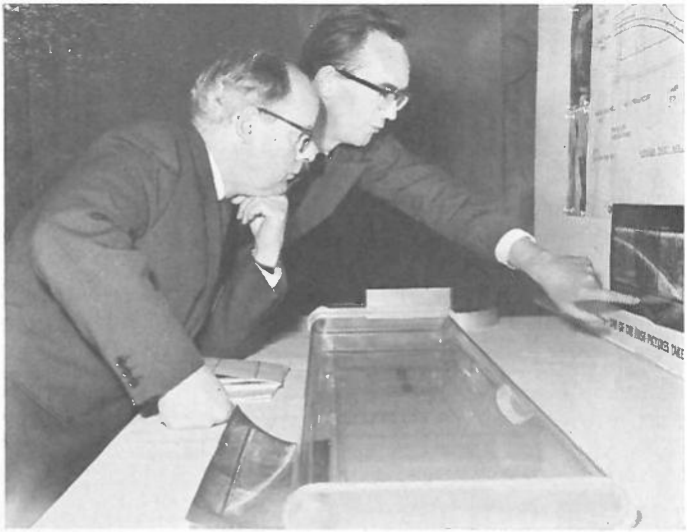
The picture shows (r) Mr. J. Cemow, Head of the Nuclear Physics Division with the Director-General of CERN, Professor B. P. Gregory.

Lord Halsbury listens intently while Dr. David Thomas, Group Leader of the High Field Bubble Chamber Group describes an aspect of the Applied Physics Division's work.

Mr. B. Jones of the ARU Division, Culham, describing solar physics results to (l to r) Mr. Hosie, Professor Hoyle, and Dr. Gavin.

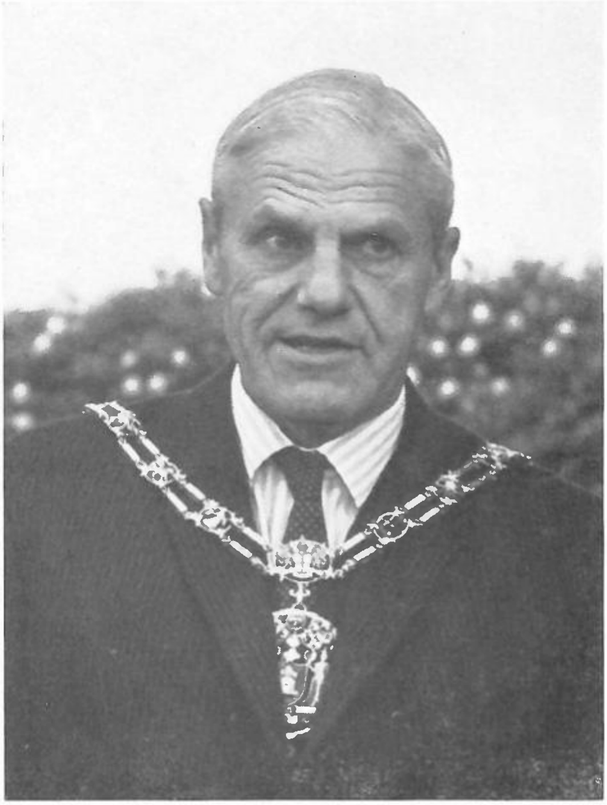
Dr. Francis (l), Lord Halsbury, and Professor Gunn, deeply interested in an explanation of the function of the High Energy Bubble Chamber, given by Dr. David Thomas.

Tea Break
Groups of Council members talking to laboratory staff during a break for tea in the PLA conference room.
In the background, the Chairman can be seen talking to Dr. Pickavance and Dr. Gavin.



Dr. Francis, the Secretary of the SRC, being shown one of the first pictures to be taken of an event in the new 1.5 metre bubble chamber. Explaining the print is Dr. P. R. Williams, Head of the Bubble Chamber Group.

Whatever else it may look like to the uninitiated, the object in the hands of J. R. Stokoe of the Engineering Design and Development Department, is the tailpiece of the liquid hydrogen target.



The Astronomer-Royal wearing the badge and chain of the Master of the Worshipful Company of Clock-makers, at the garden party held in the grounds of Herstmonceux Castle on June 6th. Sir Richard is this year's Master of the Company and is the fourth Astronomer-Royal to be so honoured.

Photo David A. Calvert

Atlas support for Atlas

Manchester University's Atlas computer was damaged by fire on the evening of Sunday May 4, but a very swift first-aid programme was arranged between Professor Sumner of Manchester and Dr. Howlett of the SRC's ACL, whereby at least part of the Manchester work could be continued until repairs could be effected.

A telephone call to Dr. Howlett on the Sunday night produced quick results and on Monday it was arranged to allow one hour in twenty-four for the University's work, and a full eight hours on Saturdays.

The first programme was run through within twenty-four hours of the fire and the results available at Manchester on the following morning.

contributors

A. P. Banford, B.Sc.
'research at Rutherford'
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Head of the PLA Division, RHEL,
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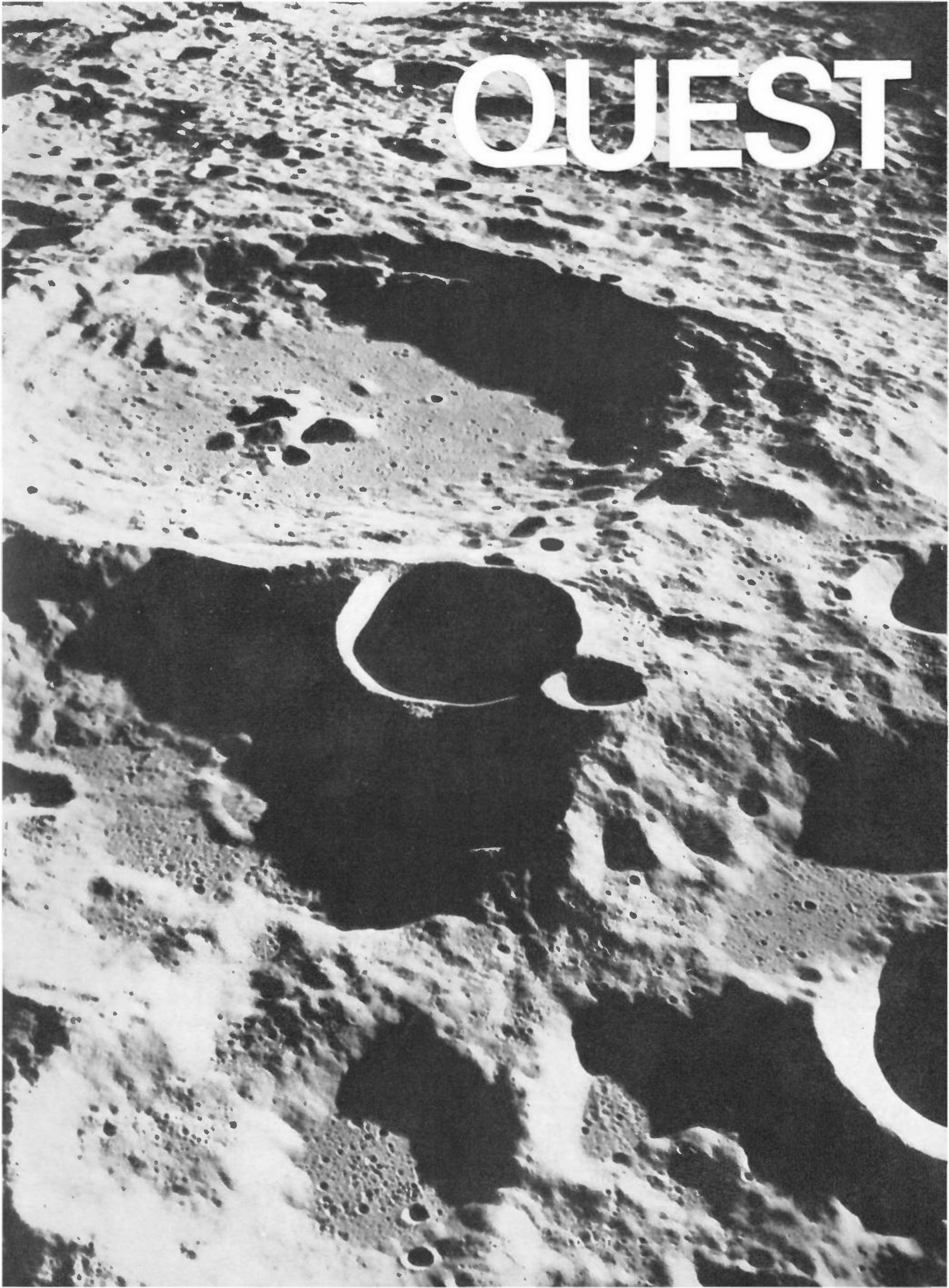
QUEST

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QUEST

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contents

Cover picture of the Moon surface shows International Astronomical Union crater number 308, 80 km in diameter (location 179 degrees E long. and 5.5 degrees S lat. photographed from Apollo 11 during the ascent of the lunar module to rejoin the command ship in orbit on July 21.

We are grateful to the United States Information Service for providing this photograph and those on pages 11, 12 and 15.

'I stopped playing football when the bruises began to take too long to heal . . .', but Dr. Saxton had a longer run than most scientists can expect and might easily have become as well known in the field of sport as he now is in the world of radio wave research.

Born in a small Leicestershire village in 1914, he went to school in Castle Donington and at Loughborough Grammar, where he captained the soccer team and also played in Midlands' Public Schools representative football. Going up to University didn't deter him and he played at centre-forward for Imperial College, and later captained the National Physical Laboratory team, before the recalcitrant bruises persuaded him to accept first the position of Treasurer and then Chairman of the NPL Sports Club.

In 1933 Dr. Saxton went to Imperial College with a Royal Scholarship where he obtained a first-class honours degree in physics and was awarded a Governor's prize. He stayed on at Imperial until early 1938 as a Demonstrator in the Physics Department and studied artificial radio activity produced by slow neutrons. After leaving Imperial College he joined the Radio Division of NPL, where his first work was with Dr. J. S. McPetrie on the propagation of very high frequency radio waves and this kind of research work has loomed large in much of his professional career. It was thus not surprising that during the second world war he should be engaged on wave propagation work closely related to radar and microwave communication problems.

The post war years saw a wide and rapid expansion in the use of very short waves for broadcasting, including television, and point-to-point communications. This resulted in close collaboration between the Radio Division of NPL and the BBC and Post Office, involving an expansion of the propagation research under Dr. Saxton. As these studies developed, it became increasingly clear that a better understanding of the relationship between meteorology and radio wave propagation was required – the subject now known as radiometeorology – and that in particular, research on the fine-scale radio refractive index structure of the troposphere in relation to the weather was essential. Work in this field was continued at the Radio Research Station when it was established as a separate laboratory of the DSIR at Ditton Park in 1956.

In 1954, Dr. Saxton attended a session of the Administrative Staff College at Henley-on-Thames, and in 1961, eighteen months after being appointed the first Deputy Director of RRS, he accepted an invitation to become a Visiting Professor of Electrical Engineering at the University of Texas. He spent a most enjoyable academic year in America and although the University exacted a full pound of flesh in the way of teaching assignments, he did find time to enjoy the wide open spaces and frontier life and also to return briefly to an earlier research interest in microwave di-electric studies of polar liquids.

He resumed his duties as Deputy Director at RRS but in 1964 was back once again in the United States: this time as Director of the United Kingdom Scientific Mission and Scientific Counsellor at the British Embassy in Washington. He was no stranger to UKSM, for he had been there for short periods in 1945 and 1950 as a Liaison Officer in radio physics. He found this new work a rewarding experience and he particularly appreciated the involvement in science policy; but whether to try to be a scientific diplomat or a diplomatic scientist, that was the question! History then repeated itself, for in April 1966 Dr. Saxton again returned to Ditton Park to be appointed, in succession to Mr. J. A. Ratcliffe, Director of what had in his absence become the Radio and Space Research Station.

Dr. Saxton is keenly interested in fostering collaboration between RSRS and the universities and is

profile

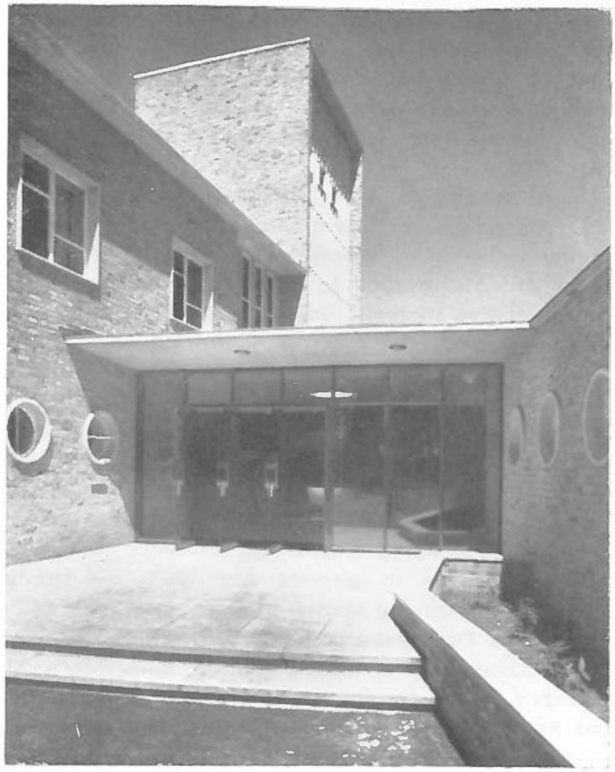
Dr. J. A. Saxton, Director

Radio and Space Research Station

himself a Visiting Professor of Physics at University College, London. He is also very active in international scientific matters and is at present chairman of Commission II (on radio and the non-ionized atmosphere) of the International Union for Radio Science (URSI). His interest in promoting the effective use of the results of scientific research has sustained an association over many years, which still continues, with the work of the International Radio Consultative Committee (CCIR) of the International Telecommunications Union.

A Fellow of the Institution of Electrical Engineers, Dr. Saxton has several times been a member of Council and of specialist committees, and will be the Chairman of the Electronics Board for the 1969–70 session.

Dr. Saxton lives in a large old Victorian house in Teddington, where he indulges his interest in music through a hi-fi stereo installation. Fortunately, Mrs. Saxton is a keen gardener, so that his enjoyment of the music is not marred by a conscience over encroaching weeds. His son followed his example by going to Imperial College to study electrical engineering and his daughter, who spent some time in the UST Division of the London Office, is a graduate in languages at Exeter University and is now with the Inner London Education Authority of the GLC preparing to be a Careers Officer.



RRS (now RSRS) main entrance in 1956.

guest column

A new, regular feature written by outside contributors who have an interest in SRC affairs. Our first 'guest', Brian Southworth, is known to many readers. He is editor of 'CERN COURIER'. Previously he edited 'Orbit', former house journal of the Rutherford Laboratory.

down with national laboratories

Writing a Guest Column suggests that I am no longer a member of the SRC household. This I accept as only partially true because by participating in the work of CERN-Meyrin I am participating in the work of the SRC. There are obvious distinctions of course. CERN-Meyrin is not a laboratory operating under the Science Research Council in the sense of Atlas, Daresbury or Greenwich, but nevertheless it receives a sizeable proportion of its money and scientific manpower via the SRC.

CERN-Meyrin is part of the physics programme of the UK and, in a way, a very economical part in that, thanks to the financial and scientific participation of eleven other European countries, it gives British scientists access to experimental facilities which they could not otherwise have. In no way is anyone coming to CERN-Meyrin lost to British science. I certainly don't feel that I have emigrated . . . and I still have a right-hand drive car and wear Marks and Spencer's underwear like every true-born Englishman.

I have been careful to write 'CERN-Meyrin' because, from the beginning of October, there will probably be a CERN-Doberdo or a CERN-Drensteinfurt or wherever, to house the huge 300 GeV accelerator, and there is a single exception to what I have written above. When Dr. J. B. Adams accepted the appointment as Director designate of the new Laboratory, he was, as things stand, lost to British science for, as SRC staff are well aware, the UK is the only European country to announce its intention not to participate in the 300 GeV project. J. B. Adams has gone down the drain.

This brings me to the theme, which is not original but is certainly topical, on which I am making some strictly personal comments. These comments are relevant to the particle physics laboratories, Rutherford and Daresbury, but may interest other SRC laboratories – firstly because it is the rapid development of other branches of physics (especially that concerned with seeing stars for, at present, nowhere is the fizz being put into physics quite so much) which is partly responsible for present financial problems in particle physics, and secondly because similar problems may not be all that far off for the other laboratories.

In the context of the 300 GeV project the SRC has been faced with some bitter decisions. For many years, priorities have been laid down by the UK particle physics community itself (as can be seen for example, in the Wilkinson Report of 1965 and in the statements of the UK delegation to the CERN Council) and top of the list has always been the 300 GeV project. The SRC continues to hold these priorities, despite the government decision, and in the light of foreseeable resources faces the painful prospect of reducing expenditure in the national laboratories. In particular, the possibility of running down Nimrod at Rutherford over the next five years has already been announced.

I feel sure that the priorities and the consequent decision are right, but I am not, from a temporarily safe position in Geneva, throwing my friends to the dogs. The important word in the provocative title of this column is the word 'national'. I believe that in a few years time there should be no such thing as a 'national' laboratory in particle physics. In the wake of the abolition of 'national' laboratories could come new life, though in some cases different life, to research centres – not only in the UK. My belief comes both from idealism (it is difficult not to be infected with the European ideal when living in the midst of what has been so magnificently accomplished in this direction at CERN) and from looking for a practical way out of the problems confronting laboratories such as Rutherford.

At the CERN Council meeting in December 1967, Sir Brian (then Professor) Flowers encouraged other countries to consider how all particle physics facilities could be organized on a European basis to secure the fullest use of experimental equipment in Europe. He said that the UK was ready to discuss how to open its national laboratories to full European participation. In the corridors afterwards it was obvious that the enormous practical difficulties involved drowned the general agreement that this was the ideal thing to do.

Since then things have changed considerably as the impact of the start of the 300 GeV project has become clearer. I know from my frequent contacts with all the big European laboratories that the idea of full integration in a European scheme is now much more readily talked about. It was significant that in the 'letter of intent' in which the government of the Federal Republic of Germany declared itself for the 300 GeV in September 1968, there is the statement 'The cooperation of high energy physicists in Europe, being exemplary, permits national and European accelerator projects to be considered today as a single comprehensive programme'.

I have no space to list the difficulties (and I don't want to take the edge off my case) but let me speculate on what the situation could be ten years from now. We could have the 300 GeV just starting physics in the No. 1 European Laboratory. Around it could be perhaps four major centres providing complementary facilities – say CERN-Meyrin for high energy proton-proton colliding beams in the ISR and 25 GeV protons from the PS, Daresbury with a 15–20 GeV electron machine, DESY with high energy electron-electron colliding beams . . . let's leave the fourth open so that any existing laboratory can write its own name in. Other laboratories, and perhaps Rutherford would come into this category, could be 'staging posts' for the major machines and could specialise on some relevant technologies. (Superconductivity, for example, has already a good start at Rutherford.) The important thing is that each machine would be equally accessible for experiments to any European group. Each specialized centre would be working for the total European programme. Each centre would be financed on a European scale and at the top would be a European committee.

Let me sum up the present position with two quotations. The first is from the Wilkinson report where, having recommended a 17% growth rate in expenditure on particle physics, the Committee considered in horror what could be done with only 10% or even 5% saying that they reserved the right while preparing their own gallows to protest at being hanged. The second is 'to be about to be hanged concentrates the mind wonderfully'. Given the foreseeable growth-rate in the UK of only 4% we can assume that our administrative friends have wonderfully concentrated minds to help them overcome the problems of achieving full integration of the European particle physics programme.

council commentary

The May Council meeting formed part of a two-day visit to the Abingdon area, where members stayed at the Cosener's house and visited the Atlas and Rutherford Laboratories and the Astrophysics Unit at the Culham Laboratory. They met many of the staff, and a selection of the work was presented and discussed. Members expressed appreciation of the work, and of the arrangements made by the three Laboratories for the visit. Among the specific items approved at the May meeting were a supplementary grant of £400,000 to Professor H. H. Rosenbrock (UMIST) for researches into the design of multivariate control systems for industry, and up to £66,000 for enlargement of the core store of the computer at the Institute of Theoretical Astronomy, Cambridge.

At the June meeting the nuclear physics appointments that were announced at the time, involving Dr. Pickavance, Dr. Stafford, Professor Ashmore and Dr. Voss, were approved. The Council approved changes in the superannuation arrangements to enable the 35 locally-engaged staff in South Africa to join a new contributive scheme and asked the office to continue their efforts to improve the terms for the five members of staff with more than ten years service. Other matters included discussion of the draft of the annual report for 1968/9, and approval of a supplementary grant of £145,000 for the modifications and repairs to the Mk. I radio telescope at Jodrell Bank, and of a maintenance grant of £129,000 for the Oxford electrostatic generators.

A reorganisation, with an Engineering Board and a Science Board in place of the single UST Board, and with the Council directly undertaking rather more of the general policy-making than hitherto, had been under discussion with members of the Council and senior staff for some time. Specific proposals, still not in full detail, were put to the Council at the July meeting, and accepted, and it was decided to put them into effect on 1st October. The terms of reference and the membership of the new Boards were agreed, as were the broad outlines of the corresponding changes in the London Office.

Another item in July was the UST Board's final report for the session: now therefore the Board's last report. One point that emerged clearly was that the policy of selectivity of support is continuing to develop in the Commitees, (all of which will continue in being in the new organisation). The Council approved nine large grants recommended by the Board, the largest being a grant of up to £200,000 to Drs. Lilley and Dunnill (UCL) for the setting up of an enzyme technology unit. A visual input-output system for attachment to the computer at the Atlas Laboratory was also approved.

The Council noted the satisfactory start made by the Physico-Chemical Measurements Unit. This unit is operated by the UKAEA by arrangement with the SRC, and university workers can have samples examined by methods using the various mass spectrometers, NMR and infra-red spectrometers etc. with which the unit is equipped. Other Research Councils are also showing interest.

The Council considered a report from the ASR Board on the UK-4 satellite. A serious feature was an increase in the estimated cost, and the Board recommended that the project should only be allowed to go forward with a limit of £1.05 million on the total payments to the Ministry of Technology, which is lower than the new estimate, and subject to a scientifically worth-while programme being possible under this condition. After discussion, the Council agreed that the project could go forward on this basis. The Council also took note of the SPGC's plans for the necessary restriction of the number of space research groups that can be supported, in view of the generally reduced flight opportunities in rockets and satellites.

Domestic matters dealt with in July included the granting of increased delegated powers of approval of expenditure, to the Astronomers Royal and to the Directors of the Atlas Laboratory and the Radio and Space Research Station. The Council also noted the progress made on the possibility of an industrial productivity agreement, and the setting up of a pilot study, which, it is believed, will be the first practical study of such a scheme in a purely research organisation.

Finally the Council said goodbye with regret to the three retiring members: Lord Halsbury, Sir Ewart Jones and Dr. Mather.

senior appointments in nuclear physics

Dr. T. G. Pickavance, CBE, appointed Director of Nuclear Physics with responsibilities for all the Council's nuclear physics interests, including the Rutherford and Daresbury Laboratories.

Dr. Pickavance, who lives in Oxford, is married with three children. He read Physics at Liverpool University and later did post-graduate work there under Sir James Chadwick. From 1939 to 1946 he worked in Liverpool on nuclear problems as a member of the atomic energy project ('Directorate of Tube Alloys' from 1941), and in 1943 became a lecturer in physics. He joined the AERE, Harwell, in 1946 as a leader of the Cyclotron Group, and was appointed Deputy Head of the General Physics Division in 1955. In 1957 he was appointed Director of the Rutherford High Energy Laboratory. In 1968 he was made a Fellow of St. Cross College, Oxford, by special election.

*

Professor Alick Ashmore, appointed Director of the Daresbury Nuclear Physics Laboratory to succeed Professor Merrison.

Professor Ashmore, who will take up the appointment in mid 1970, is married with five children. He graduated in Physics in 1941 from Kings College, London, obtaining his PhD at Liverpool in 1958 and Fellowship of the Institute of Physics in the following year. From 1947–1959 he was Lecturer and Senior Lecturer in Physics at the University of Liverpool and from 1960–1964 was Reader in Experimental Physics at Queen Mary College, University of London. He was appointed Professor of Nuclear Physics at the same College in 1964 and has been Head of the Physics Department there since 1968.

*

Dr. G. H. Stafford, appointed Director of the Rutherford Laboratory (where he had been Deputy Director since 1966) to suceed Dr. Pickavance.

Dr. Stafford lives in Abingdon and is married with three children. He graduated in Physics at the University of Cape Town in 1939 and obtained his PhD at Cambridge in 1950. From 1951–1954 he was Head of the Bio-physics Sub-Division at the Council for Scientific and Industrial Research, Pretoria. From 1954–1957 he worked in the Cyclotron Group of the AERE, Harwell and became Deputy Head of the Group in 1957. He subsequently transferred to the Rutherford Laboratory as Head of the PLA Group. Dr. Stafford has published over 40 papers and reports, mostly in nuclear and high energy physics.

Dr. R. G. P. Voss is acting Director of DNPL until Professor Ashmore takes up his appointment. Dr. Voss, MA, DPhil, B.Sc Eng, (Natal and Oxford) is head of the Experimental Physics Group at Daresbury Laboratory. A member of the Institute of Physics and of the Physical Society, his main interests lie in High Energy Physics and the equipment used and in Accelerator construction.

recognition for research

Original research work of a very high standard has earned special promotions for three scientists and an engineer from SRC. The promotions were among twenty-six recommended by a special panel which reviews each year the work of scientists conducting research work of high calibre in Government and other public service establishments.

These promotions – to grades which are comparable to the rank of university professor or reader – will allow the scientists to continue their research work without necessarily having the administrative responsibility normally associated with their new grades.

Radcliffe Observatory

Dr. A. D. Thackeray
is promoted to DCSO.

Dr. M. W. Feast
is promoted to SPSO.

Dr. Thackeray has been the Radcliffe Observer at Pretoria since 1950 and has directed the work of the Observatory from that time onwards. Under his direction the Observatory completed the survey of the velocity of southern B stars in such a way as to strengthen greatly the constants of galactic rotation. He has personally made a definitive study of the spectra of certain peculiar stars, particularly Eta Carinae, and has led important investigations on the brighter stars in the Magellanic Clouds and has discovered RR Lyrae stars in them. With Dr. Feast he determined the mass of the Magellanic Clouds (10^{10} times the mass of the Sun) and made an original determination of the distance from the Sun to the centre of the galaxy.

Dr. Thackeray's article on the work of the Observatory appeared in Quest, April 1969 issue.

Dr. Feast has recently made special studies of late type variable stars, and of their kinematics, and has worked extensively on the Magallanic Clouds, making in particular a study of both planetary and diffuse nebulae in these systems. He has worked recently on the abundance of Lithium and its isotopes in stars.

Rutherford Laboratory

Dr. P. K. Kabir
is promoted to SPSO.

Mr. J. A. Fox
is promoted to Suptg. Grade Engineer

Dr. Kabir's main interest in high-energy physics is in the field of weak interactions. During the last few years he has studied problems arising from the discovery of $K^\circ_2 \rightarrow 2\pi$ decays. He has published a book on the subject – 'The CP Puzzle' (Academic Press, London 1968) – and the comparison of $K^\pm \rightarrow \pi^\pm \pi^\circ \gamma$ decays, analysed by him in collaboration with G. Costa (in Phys. Rev. Letters 18, 429 (1967)), is being carried out by a Rutherford Laboratory team at CERN. His current work is on high-energy electron scattering; he has suggested a method of determining electromagnetic form-factors of nucleons using polarised targets, and also hopes to find tests of the high energy behaviour of weak interactions through this method.

Mr. Fox is the first professional engineer to have received a special promotion. He is studying the dynamic behaviour of European electrical power systems, in conjunction with the appropriate national agencies, to determine the acceptability of a static power supply for the proposed European 300 GeV proton accelerator. This static power supply would use a reactive compensator to eliminate the large motor-flywheel-alterator systems used at present to power proton synchrotron magnets. Similarly, he is engaged in computer studies of possible applications of this power supply system to existing accelerators, and is collaborating with the CEGB in computer studies of the behaviour of steam-turbine governors and time series analysis of CEGB operational tests.

metamorphosis of ust

Changes in the structure of one of the Council's Boards and its supporting Division at London Office will give a number of people fresh work in different offices.

With the setting up of two new Boards, one for Science and a second for Engineering on October 1 to replace the one UST Board, the supporting Division is split into four parts 'Science', 'Engineering', a 'Service Unit for grants and awards' to provide services for all four Boards now existing, and 'Science and Industry Unit'.

Mr. C. Jolliffe formerly Director of UST Division will take over the Science Division and Dr. A. W. Lines, formerly second in command as 'Head of Division', is appointed Director of the Engineering Division. The Science Board, with Professor Kornberg as Chairman, will be responsible for the support of research and post graduate training in biology, chemistry, enzyme chemistry and technology, mathematics and physics (other than nuclear physics, astronomy, space and radio research). It will also be responsible for Atlas Laboratory and for the arrangements for university use of neutron beam facilities and of the services of the Physico-Chemical Measurements Unit. The Engineering Board will be responsible for the support of research and post graduate training in aeronautical and civil engineering, mechanical and production engineering, control engineering, metallurgy and materials, computing science and polymer science.

Policy co-ordination will be the responsibility of Dr. W. L. Francis, Secretary to the Council, assisted by a Standing Policy Co-ordination Committee drawn from all Divisions of London Office. He will have additional staff to do this and also reporting to him will be the Service Unit under Mr. J. F. Hayes and the Science and Industry Unit headed by Dr. W. G. Potter.

Chairman of the Science Board *(see picture on left)*

Professor Hans Leo Kornberg, FRS, became a member of the Council in 1967, after previous service on the Biology Committee. A graduate of the University of Sheffield, he spent two years (1953–1955) in the USA as a Commonwealth Fund Fellow. From 1955, he was a member of the scientific staff of the MRC Cell Metabolism Research Unit, and from 1958 also a Lecturer of Worcester College, at the University of Oxford.

In 1960, Hans Kornberg was appointed to the first Chair of Biochemistry at the University of Leicester and was largely responsible for setting up the School of Biology there. He is known mainly for his work on the nature and regulation of biochemical events in micro-organisms, which was recognised by the award of the first Colworth Medal of the Biochemical Society, and election to the Royal Society in 1965, and by his appointment as CIBA Lecturer for 1968 at Rutgers, NJ. He is a frequent speaker at international scientific meetings, has been a Research Associate at the University of California and at Harvard Medical School; Visiting Instructor at the Marine Biological Laboratory, Woods Hole (1964–1966); and Visiting Professor at Universities in the USA, Europe, Israel and Asia.

Professor Kornberg, who is 41 years old, is married with four children. He lists his recreations as 'cooking and conversation'.

Chairman of the Engineering Board *(above right)*

Professor Hugh Ford, FRS, DSc(Eng), FInstCE, FIMechE, FIM, FCGI became a Member of the Council in 1968. From 1951 to 1959 he was Professor of Applied Mechanics at the University of London Imperial College of Science and Technology and in 1965 was appointed Head of the Department of Mechanical Engineering at the College. He became Professor of Mechanical Engineering earlier this year. In 1963 he was President of the Institute of Metals and he is a Member of the Council of Mechanical Engineers and Technical Director of the Davy-Ashmore Group.

Professor Ford received the Thomas Hawkesly gold medal, the premier award of the Institution of Mechanical Engineers, in 1948 for researches into the rolling of metals and the Robertson medal of the Institute of Metals. His publications include 'Advanced Mechanics of Metals' (1963), papers to the Royal Society and various institutions and articles in both British and foreign journals.

Professor Ford is married with two children and his chief recreations are gardening and music.

sports day

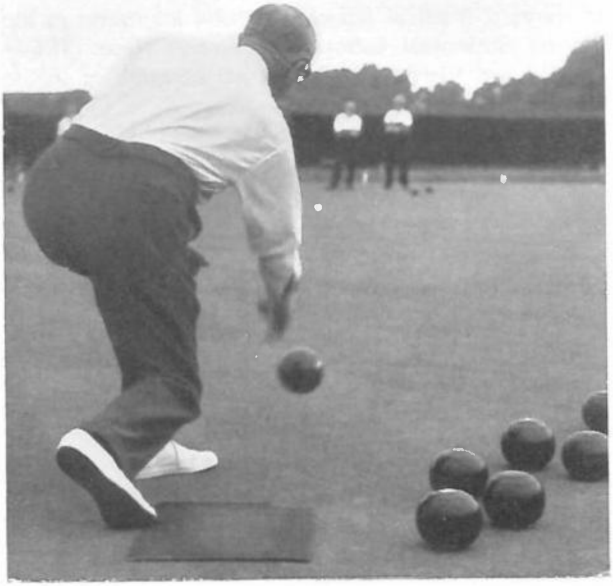


photo R. Butler RSRS

Players and spectators with a predilection for the macabre will recall the inclement conditions for SRC's inaugural Sports Day in 1968 (see Quest, October 1968). In contrast, the photographs this year testify to the vagaries of an English summer. This time it was a great pleasure for everyone to bask in sunshine while enjoying some very entertaining competitions.

The setting was again the Civil Service Sports Ground of thirty acres by the Thames at Chiswick where a well designed new pavilion had been opened earlier in the year to provide plenty of changing rooms and hot and cold showers. Salad lunches and other refreshments were provided unceasingly by the cafeteria, and the bar dispensed cool drinks (hard and soft) all afternoon, except of course during the dry season from 2.30 to 4.30 p.m.

The SRC Sports Association organised an interesting programme. The number of events was doubled: as well as tennis and cricket, we had six-a-side soccer and bowls and more than 160 competitors took part. A morning start ensured time to complete all events.

bowls

The Bowls tournament turned out to be one of the best organised and most exciting events of the day. The games were all played on flat greens, but this did not deter some of our local crown green exponents from trying their hand, and all of them did very well. The organisers are hoping that support for this event will be even greater next year and include some of SRC's crown green experts from the north.

The tournament was won by Mr. Ferguson and Mr. Grindrod of RL, who beat their own colleagues from Rutherford, Mr. White and Mr. Sangster, by one shot, the last possible shot of the match!

cricket

Cricket has always had good support in SRC and the matches drew many spectators. Their interest was well rewarded since the high standard of play made for some absorbing cricket. The tournament was run on a knock out basis and the matches allowed an innings of fifteen overs to each side. The two teams left in at the end of the day were from Rutherford and Daresbury laboratories. In a very exciting final Rutherford, batting first, scored 107 runs for the loss of 4 wickets. Despite fast and keen batting Daresbury fell short of this, scoring 91 for 7 wickets, and Rutherford became SRC cricket champions for the second successive year.

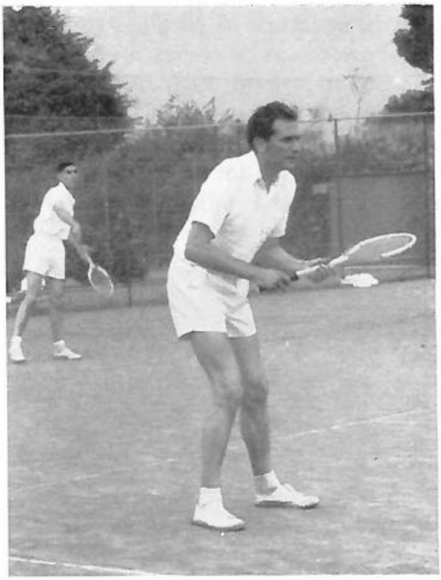
tennis

Despite that 'other tournament' on the same day at the All England Tennis Club, Chiswick attracted seventeen mixed doubles and seven men's doubles pairs who fought hard in the heat and the clouds of red dust they raised from the courts. The games were enjoyed very much by those playing and others watching from deck chairs on the lawn.

With the limited number of courts available this year, both competitions had to be played off without many rests for the players and they deserve credit for maintaining their standards through till 7 p.m.!

Last year's winners of the mixed doubles were not present to defend their title, but Dr. and Mrs. Horner were in good form beating Mr. Powell and Miss Northcott of RGO to retain the cup at RSRS. Dr. Wilkins, although minus the partner who helped him to victory in 1968, formed another unbeatable combination with Dr. Thomas and carried the men's doubles trophy back to RGO.

(picture opposite top left)



photos R. Butler *D. Calvert RGO*

soccer

This late addition to the programme turned out to be a well supported and successful event. Although the teams were limited to six-a-side, each seemed to have twice that number of vociferous supporters. We don't know whether their cheers and all that advice – from the professional to the merely ribald – was an indispensable contribution to the results. Obviously they thought so!

The tournament was won by a very well drilled team from Daresbury who met Rutherford's B team in the final play off, beating them by 12 goals to nil. *(picture above (r) shows the DL team with the cup)*

Lady Flowers was present for much of the afternoon and evening. We were very grateful to her for presenting the trophies and hoped she enjoyed the day. May we also take this opportunity to thank all those anonymous organisers, without whose considerable help we would not have been able to stage such a successful Sports Day.

Sports Day is an excellent opportunity to meet people from other parts of SRC and we hope that many more will come next year. The variety of sports will be extended again; we have particularly been asked to include netball not only for its sporting value but, someone suggested, as a draw for more libidinous male spectators! After that, all there is left to say is that we look forward to seeing you in 1970.

Mr. Ferguson and Mr. Grindrod, RL, receiving the Bowls trophy from Lady Flowers. Facing the camera (l. to r.) are Adrian McLoughlin (Secretary) and Ray Edmonds (Chairman) of SRC Sports Association.

More pictures in 'newsfront'

photo D. Calvert

Professor C. F. Powell

Physicists in many countries will have heard with regret of the death of Professor Powell on August 10 from a heart attack during a holiday in Italy.

Professor Powell was Chairman of the SRC Nuclear Physics Board from 1965 to 1968 towards the end of a distinguished career which started at Cambridge University in 1924 when he read Natural Sciences and spent two years on research at the Cavendish Laboratory in the great days of Rutherford. In 1928 he joined the H. H. Wills Physics Laboratory at the University of Bristol where he was to remain for the rest of his career, becoming Professor of Physics in 1948 and Director of the Laboratory in 1964. He retired from the University in the summer of 1969.

A Fellow of the Royal Society since 1949, Professor Powell was among those who helped to promote the idea of CERN in the 1950s and remained closely associated with the Laboratory. From 1961-3 he was Chairman of the CERN Scientific Policy Commitee and continued as a member until the end of his life.

from CERN Courier, August 1969

His career reached a peak in the 1940s when his work with nuclear emulsions investigating cosmic rays resulted in the discovery of the pion in 1947. This confirmed the Yukawa theory of the strong nuclear force, opened the door to research with pions (which are now, some twenty years later, such 'everyday' particles at accelerator Laboratories) and exposed the mystery of the muon. Around this major achievement was a mass of work on cosmic rays, atomic nuclei, particle scattering which won a world-wide reputation for his Bristol group.

In addition to the Nobel Prize, awarded in 1950 'for his development of the photographic method in the study of nuclear processes and for his discoveries concerning mesons', he received the Hughes Medal of the Royal Society in 1949, the Royal Medal of the Royal Society in 1962, the Lomonosov gold medal in 1967 (the highest award of the Soviet Academy of Sciences), and honorary doctorates at the Universities of Dublin, Bordeaux, Warsaw, Berlin and Padua.

A personal note by Dr. T. G. Pickavance

I became a colleague of Cecil Powell in 1939 when he brought his nuclear emulsions to the Liverpool cyclotron, at the request of Sir James Chadwick, to combine this elegant technique, which he had developed, with what was for those days a powerful accelerator. This collaboration between the Bristol and Liverpool groups was both fruitful scientifically and most enjoyable personally, and developed into a lasting association. Throughout the following years, with the rapid growth of nuclear physics and its social implications, Cecil Powell was of course an outstanding colleague who attained great distinction. He was a convinced and eloquent advocate of the relevance of scientific research to human progress and was a gifted teacher, and his concern for the wider implications of science, outside the laboratory, was expressed for example in the leading part he played in the Pugwash international meetings. But to all of us who knew him well he was above all a warm and generous friend.

Lord Bridges

Lord Bridges, KG, PC, GCB, GCVO, MC, FRS, died on 27th August 1969 at the age of 77. One of the many public duties which he undertook, after his retirement from the Civil Service in 1956, was to be Chairman of the National Institute for Research in Nuclear Science. The Rutherford and Daresbury nuclear physics laboratories were founded and operated by the Institute until they were embodied in the Science Research Council on its foundation in April 1965.

Lord Bridges, one of the most eminent public servants of his time, had a profound influence on the successful establishment and operation of these laboratories as an integral part of British universities' resources for research.

M. H. Jeffery

It is with great regret that we announce the sudden death of Mike Jeffery, Manager of the Anglo-Australian Telescope Project since March 1968. As leader of this great enterprise he had become known to many people in SRC, in the UK, in Australia and in North America. In a job requiring both the ability to handle complex technical matters and maintain good relations with those with whom he came into contact, Mike was an outstanding success; his technical competence and pleasant personality will be greatly missed by all those who knew him. Mike Jeffery joined the AAT Project from the consulting engineering firm of Freeman, Fox and Partners. Whilst in their service he had played a prominent part in the construction and commissioning of the 210' radio telescope at Parkes, New South Wales, and the 150' radio telescope in Ontario; experience of these two projects served him in good stead as Manager of the AAT team. His untimely death at the age of 43 is a cause of great sorrow to all his friends and acquaintances and our condolences go out to Mrs. Jeffery and her family who had recently moved from this country to Australia.

Apollo 11's moon quest

the launch

J. F. Hosie

Official SRC duties brought me an invitation to attend this historic and unforgettable occasion. When, before the event, I was cajoled into writing a piece for Quest, I overlooked how extensive would be the TV coverage. To avoid wearisome repetition I'll pick out one or two special features.

First, at a pre-launch dinner, the USA President's Scientific Adviser emphasised the international aspects of all NASA programmes and gave two instances of foreign research which had made the Apollo Missions possible. Some may say it is now somewhat old-hat but it was gratifying, before foreign potentates, that one of the two examples was the Bacon fuel cell from the UK.

Next, for the launch at 9.30 a.m., NASA, for all its incredible precision in the space mission, found it necessary to rouse their invited guests at 4 a.m. They could not guarantee timely arrival through terrestrial traffic over 12 miles even with full police escort.

At the scene three memories stand out. First, at lift off, to spectators three and a half miles away in the shadow of the fantastic Vehicle Assembly Building (525 ft. high compared with the GPO tower of 580 ft.), the silent burst of flame started an utterly majestic rise of the 364 ft. rocket.

There followed from the assembled tens of thousands of Americans a spontaneous thunder of cheers. Their relief, pride, sense of accomplishment and much else impressed even a dour Scot.

Next the noise of the blast off reached us. It shook 45 ton door segments of the VAB as if they had been tin foil. Saturn was indeed large and violent.

Almost before one had grasped that the initial steps had been taken successfully the first stage separated, the flame dwindled from a cigarette smoke ring to extinction leaving a dense local cloud. The bald headed eagles resumed their effortless circling.

USIS photo

tracking east and west

R. N. Stanbury

Jodrell Bank, Tuesday, July 22, 6.30 p.m. I am waiting in my office for the arrival of five Russian scientists and their Interpreter. The top of my desk is inches deep in the debris of the past ten days – notes, statements, data, diagrams. The 'phone is surprisingly silent. I ring the Mark I Controller. 'No, there have been no calls in the last hour.' So it really is over!

July 13. That unforgettable Sunday afternoon (unlucky thirteenth!), lazy, sultry, with a threat of things to come. Luna 15 has been launched. Are the Russians attempting to recover samples of lunar rock, only hours before the Americans? I join the BBC Television team at Professor Lovell's house, The Quinta. Tea on the terrace and a Soviet spaceship on its way to the Moon!

After that, only a flood of impressions projected onto the screen of memory.

Sir Bernard seated on a rustic bench in the cloistral calm of The Quinta's lawn, interviewed by Tom Heaney against a back-drop of fragrant shrub-roses and cascading *philadelphus virginal.* The illusion of calm is short-lived. Back home, the 'phone starts ringing: it is 11 p.m. before it stops. Australia, America, Canada . . . 'What does Professor Lovell think the Russians are intending to do? Will this steal the limelight from Apollo 11?' Etc. etc.

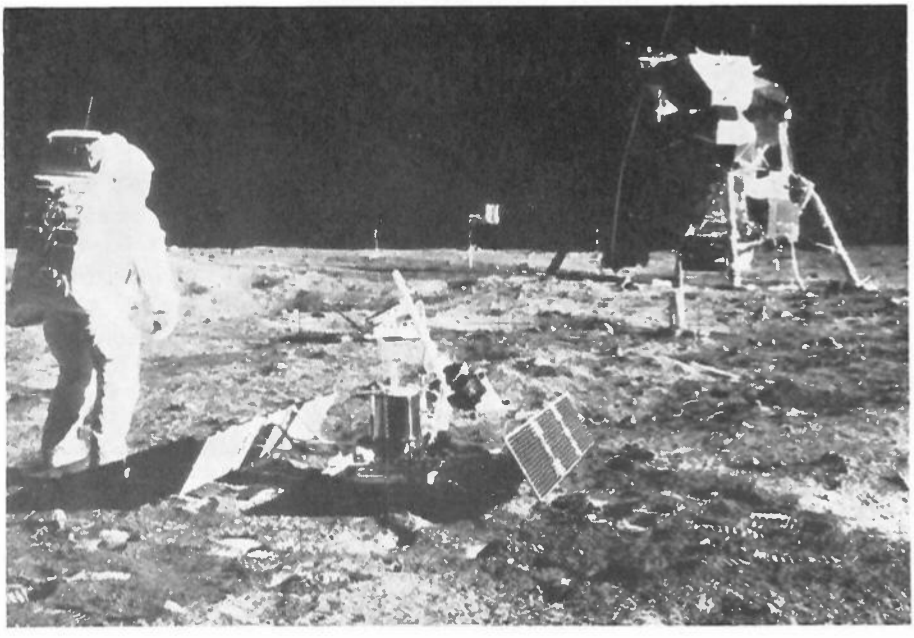
Next morning the Press arrive – a trickle at first, then a flood. You round a corner and they materialize in your path as if Hydra's teeth had been sown overnight. Luna 15 has been picked up by Jodrell Bank: its trajectory is very different from all previous Luniks. Much speculation. The Press redoubles its questions; the telephone rings incessantly; time ceases to have any meaning.

The Moon is new, a few degrees only from the Sun. The apparatus at the focus of the 50 foot Finder telescope overheats, tracking temporarily ceases. The Press are on to it – more questions.

July 16. Suddenly it is Wednesday and Apollo 11 is launched, the start of an epic voyage. A snatched moment to watch the Lift-off on the Conference Room television. A curious sense of anti-climax: you *expected* it to go smoothly. Luna 15 remains a puzzle. Jodrell Bank has calculated it will reach the vicinity of the Moon between 10.30 and 12 noon tomorrow. More speculation. The Russians, like Br'er Rabbit, say nothing.

July 17. Pick up transmissions from Luna 15 at 8.31 a.m., just after moonrise. Now one scene predominates: Lab. 5, the banks of instruments, the rhythmic click of electronic counters. Professor Lovell, eyes fastened on the dials and meters alert for any changes; Professor J. G. Davies, brows knit, making mental calculations of frightening complexity; Bob Pritchard, twiddling one knob, adjusting another, eyes darting here, there, everywhere.

Signals from Luna 15 showing the familar doppler shift as it accelerates near the Moon. 10.49 – signals suddenly stop – Lunar 15 is behind the Moon! A flurry of press and radio men as Professor Lovell announces this. 11.10 – Luna 15 re-appears, in orbit and transmitting a torrent of telemetry. Further state-



Edwin Aldrin at Tranquillity Base on the Moon. Beside him is the deployed passive seismic experiments package. Beyond is the Laser ranging retro reflector and, at the back (l to r) the TV camera, US flag and Lunar Module.

USIS photo

ment to the Press. Now the telephone swamps all other thoughts: inquiries from every corner of the world – even Apollo Control at Houston wanting details of the orbit.

July 18–19. The tension and the excitement increase as Luna 15 continues to orbit and Apollo 11 approaches the Moon. So do the telephone calls. For the first time Jodrell Bank is tracking an American *and* a Russian Moon rocket simultaneously: Mark I, Luna 15; 50 foot Alt/Az, Apollo 11. Columbia Broadcasting System arrive and set up TV cameras.

July 20 – Sunday. The pace quickens. Professor Lovell seated under the huge, floodlit dish of the Mark I giving interview after interview – CBS, BBC, ITN. Fears that he may get sandwiched between Lulu and some other non-celestial star on the David Frost Programme! A Vicar from Doncaster 'phones to inquire the time of touch-down by the Apollo 11 Lunar Module on the Moon – afraid it may conflict with Evensong. Begin to get 'telephone elbow' from lifting the receiver! 'Commander Stanbury? This is the XYZ Broadcasting Corporation, New York (Los Angeles, Sydney, Melbourne, Timbuctoo). You are on the air . . .' In twenty minutes I make seven live broadcasts over the telephone to the other side of the world – four to America, three to Australia. (Is this a record?) As Apollo 11 Lunar Module descends, our instruments faithfully register the action taken by Armstrong and Aldrin to avoid landing in a crater 'the size of a football pitch'.

July 21 – Sunday night and Monday. Fantastic, unbelievable, like something out of Jules Verne! Not just those first halting footsteps on the Moon, but the calm, matter-of-fact voice of Neil Armstrong. My eyes will scarcely stay open, but I wouldn't miss it for the world. Excitement is high all day, reaches fever pitch by 4.30 p.m., with the Lunar Module due to lift off at 6.50 and Luna 15 still orbiting – but now the orbit has been changed and it will pass right over the Sea of Tranquility only 10 minutes ahead of the CSM. Then suddenly, dramatically, after 50 orbits, the doppler shift indicates Lunar 15 is landing in the Sea of Crises. Its rate of descent is 300 mph when the signals cease. A three-hour, non-stop bombardment on the telephone: Where? When? Why? What now?

July 22. The Russians have announced that Luna 15 has completed its mission; Apollo 11 is on its way back to Earth. A triumph and an enigma. The final Press Conference is held at 3 p.m. The Control Building grows strangely silent.

Postscript As always, the visiting Russian Scientists are charming, inquiring, appreciative. Before they leave I cannot resist saying: 'We should be very interested to know whether Luna 15 was intended to bring back samples of lunar rock.' The interpreter translates; they all laugh – 'So would we!.'

no small part for SRC

W. D. B. Greening

. . . well, how do you import a piece of the Moon? and how do you obtain it in the first place?

For over three years now the Astronomy Space and Radio Division of SRC has been organising UK participation in the Apollo mission, through a Working Group of the Space Policy and Grants Committee, whose Chairman is Professor S. K. Runcorn, FRS, of the University of Newcastle upon Tyne.

This unique opportunity for UK scientists to 'reach for the moon' was taken up in earnest in May 1966 when a telegram arrived from NASA extending the deadline for the submission of proposals for analysing lunar samples to June 15 – just thirty-five days off! Although no British scientist had made any application so far, it was known that interest was high and the challenge was therefore taken up. In a remarkably short space of time the Working Group had met and had considered in detail a set of proposals which were then revised, co-ordinated, printed and bound, and finally shipped to Washington one Saturday morning by air freight with just three days to spare.

Altogether nineteen British universities and other institutions submitted proposals for a wide range of experiments which were combined into an eighty-page booklet, together with an 'operational flow-sheet' for the whole UK project. This formidable document was sent to NASA on June 10, 1966 and suspense mounted until almost a year later when NASA announced the acceptance of a total of 135 proposals of which thirteen were of UK origin. Two more have since been accepted and there are now fifteen principal investigators from the UK. Thus, this country, and SRC in particular, became part of the Apollo programme.

The principal role of the SRC has been to co-ordinate the British effort. We are the UK agency which deals with NASA over scientific matters in Space and, in collaboration with the Natural Environment Research Council, we have undertaken the planning of this work. Fortunately our existing machinery could be used without change, so you will look in vain for any specially created committees.

Most of the activity here during the intervening two years was routine and attracted relatively little public attention, but the scientists directly concerned naturally showed increasing interest with the successful completion of each stage of the Apollo programme. Continuous contact with their colleagues on the other side of the Atlantic and visits to the Lunar Receiving Laboratory at Houston convinced them of the realism behind the Apollo planning. Other people, however, saw things in a different light and in the beginning there was a certain incredulity surrounding our activities. This continued until last Christmas when Apollo 8 commanded by Colonel Frank Borman made its wonderful flight round the Moon. It then became clear to all that we were no longer dealing with Science Fiction but with real life, and that within a matter of months there would be pieces of Moon rock in London.

There have been several published accounts of the analyses which will be carried out in British laboratories and there is no need to repeat them here in detail. They include most of the standard geological studies which are applied to ordinary rocks and in addition several major investigations into the physical aspects. For instance, Harwell will irradiate a small sample in one of its nuclear reactors, and other laboratories will look at the chemical composition, magnetic properties, crystal structure and so on, of the various pieces which will be allocated to our scientists.

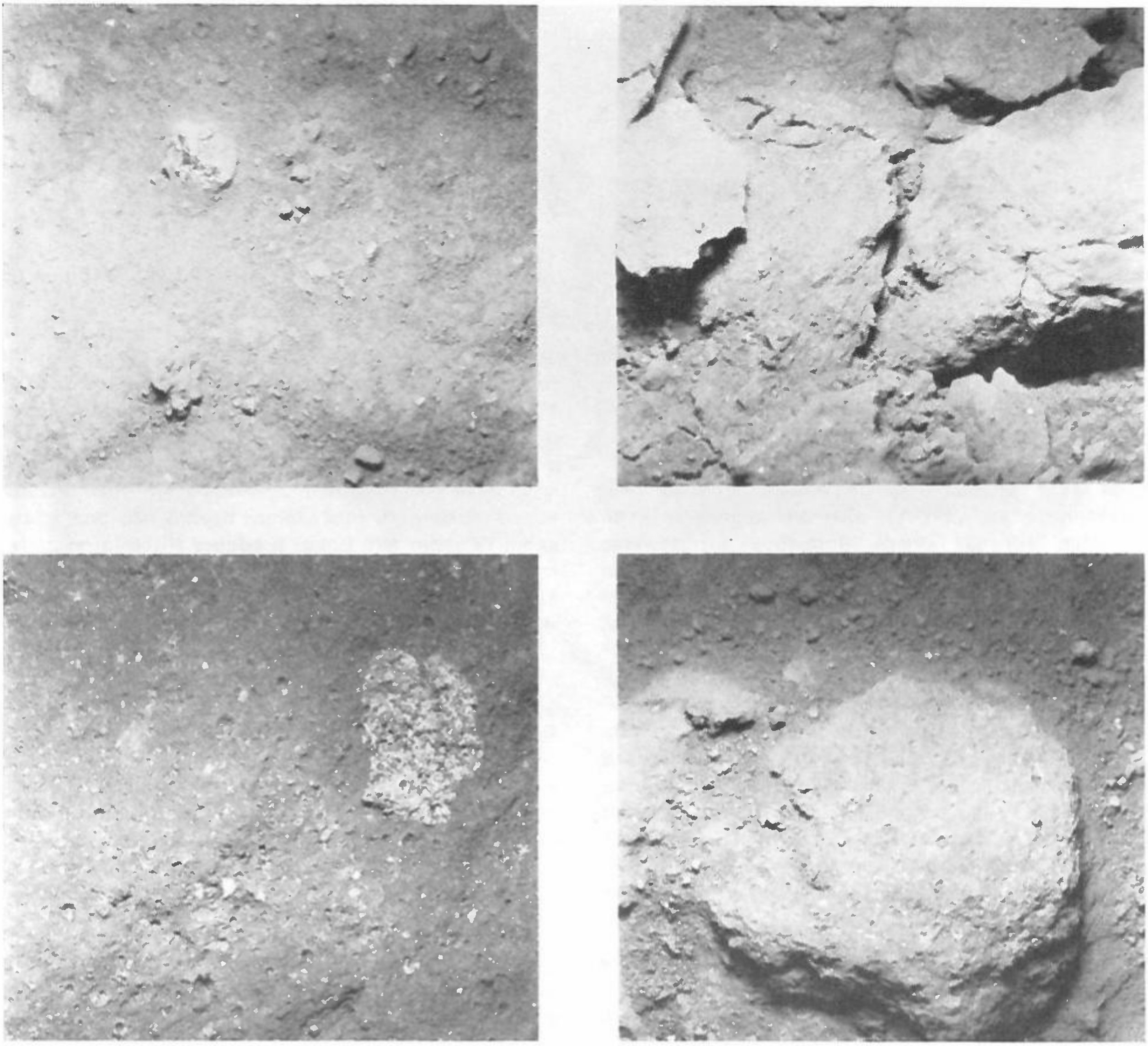
A NASA representative attended the annual NATO Advanced Study Institute at Newcastle during Easter 1967 at the invitation of Professor Runcorn, and a Working Group meeting was held shortly afterwards to which Principal Investigators were invited and at which Mr. Verl R. Wilmarth explained the Apollo programme and discussed the role of the UK investigators in more detail. The following September NASA held the first Conference of Principal Investigators at Houston with four representatives attending from the UK, and in April 1968 three attended a NASA Conference at Baltimore convened for scientists concerned with mineralogy and petrology.

At about this time, mainly due to a strong recommendation from the Working Group, plans were made for a joint 'Lunar Symposium' with the Royal Astronomical Society at Burlington House, and a highly successful meeting took place in November last year, attended by a NASA official, scientists from the Continent, as well as representatives from all the participating UK laboratories. An account of the meeting by Ian Ridpath was published in the New Scientist of 5th December, 1968, under the title 'Britain's Part in Apollo'.

Public interest in the Apollo programme increased enormously with the spectacular successes of Apollo 9 and 10 missions and the realisation that *the* achievement of landing a man on the moon was at last no longer a pipe-dream. With this realisation came a number of problems for the SRC, not least the method of importation of an entirely novel material – lunar samples – into the UK. Nobody knew for certain whether there would be any danger to man, animals or agriculture: would they carry deadly micro-organisms? Visions of epidemics provoked by alien life could not be dismissed as rubbish but had to be taken very seriously indeed, even though it was known that the probability was low. Fortunately NASA had published its plans for quarantining the astronauts and their samples, and these plans could be referred to the various UK Ministries concerned. But then there arose a new problem: who in each Ministry should one approach? There was one memorable day towards the end of last year when first enquiries were made with the Board of Trade, HM Customs & Excise, the Home Office, and the Ministries of Health and Agriculture in an attempt to find the right contacts. The results were hilarious. Try and imagine what your own feelings would be if quite unexpectedly someone telephoned you and asked if your Ministry had any objection to importing a piece of the Moon. Your first reaction would be to ask yourself whether the enquiry was serious or whether there was a crank at the other end of the line. Once the individual had recovered from his surprise, however, we received the maximum of assistance and were referred to the experts in each Ministry who examined the problem from their point of view, and passed their advice to the Board of Trade who in turn advised HM Customs. In this way official clearance was obtained.

The main concern of the SRC has been to secure the maximum scientific return from the opportunities offered by the Apollo programme. So far we have been remarkably successful, thanks to the excellence of the proposals made by our scientists and above all to the generosity of the Americans – for without the expenditure of American resources and the risking of American lives there would be no pieces of the Moon in Britain this autumn. It is our hope that the investigations, which will start shortly with the samples just brought back in triumph by Armstrong, Aldrin and Collins in Apollo 11, will continue with future lunar missions and may even be extended to new fields. The geologists would certainly like to have samples from different areas of the Moon and also cores from below the lunar surface.

All this implies a continuing effort over the next few years – and who can tell what the outcome will be! Did the Earth and the Moon have a common origin? Has the moon a magnetic field? Has there ever been life on the Moon? What, in fact, is the Moon made of? One day these and many other questions will be answered, and our scientists will have made their own unique contributions to these investigations.



USIS photo

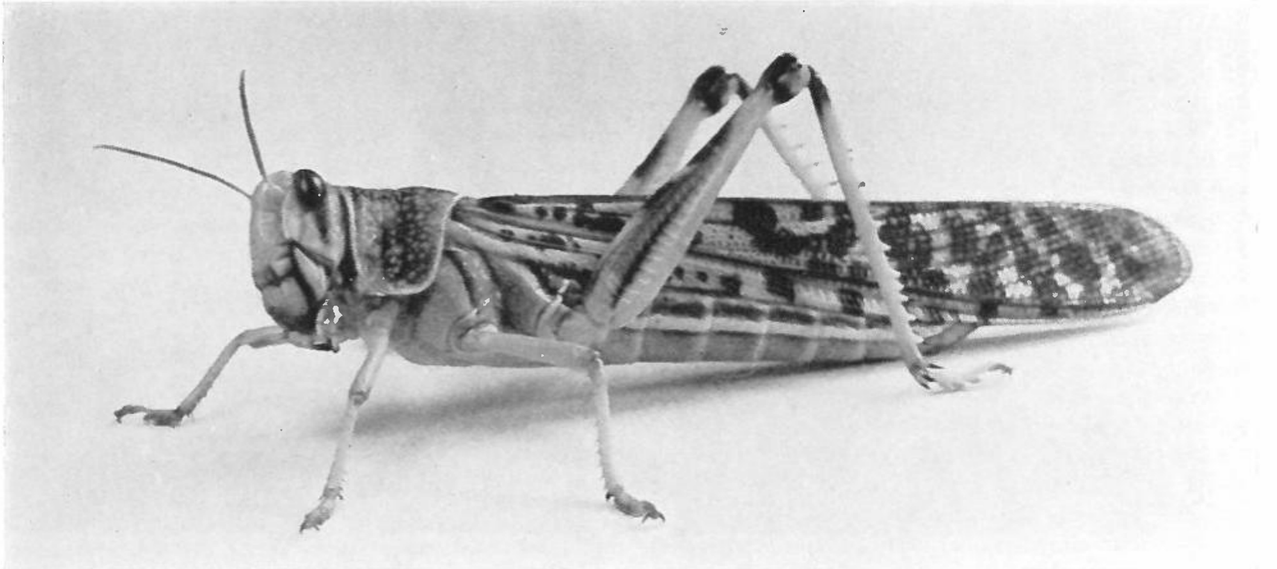
Moon Rock on the Moon as photographed by the Apollo 11 astronauts with a 35 mm stereo camera. Area covered in each picture is about 75 millimetres square.

at upper left is a small lump of lunar surface powder about 12 mm across, with a splash of a glassy material over it. Scientists surmise that a drop of molten material fell on it, splashed and froze.

at lower left is a lunar rock showing an embedded fragment, about 19 mm across, of a different colour. On the surface several small pits are seen, mostly less than 3 mm in size, and with a glazed surface.

at upper right is a clump of lunar surface powder, with small pieces of different colour. Many small, shiny spherical particles are visible.

at lower right is a rock about 64 mm long embedded in the powdery lunar surface material. The little pieces closely around it suggest to scientists that it has suffered some erosion. On the surface are several small pits mostly less than 3 mm in size with a glazed surface. They have a raised rim, characteristic of pits made by high-velocity micrometeorite impacts.



Locust

fuels, energy and insect flight

This 'Grant' article is by Dr. D. J. Candy of the University of Birmingham who holds an SRC grant worth £4,256 (over 5 years) for research into control of fuel utilisation during insect flight.

Flight is the most energetic activity which animals perform. In insects the work of flight is done by the large flight muscles of the thorax which may thus be considered as the 'engines'. These muscles are found to have the greatest capacity for energy conversion of any known animal tissue and are capable of producing about twenty times as much power as the equivalent weight of mammalian muscle.

The energy for muscular work is provided by metabolism of fuels; that is by processes which oxidize fuels derived from food and make available the energy released for muscle contraction. It has been found that the high capacity for power output of insect flight muscle is matched by a high rate of metabolism.

The oxidation of fuels with oxygen of the air is the basic process by which both insect flight muscles and the internal combustion engines of aircraft derive energy for flight, although the detailed mechanisms for achieving this are considerably different in the two types of engine.

Figure 1 summarizes the processes in flight muscle whereby energy is released by fuel oxidation and used for work. Two main processes can be distinguished. The first step (a) is the oxidation of fuel to carbon dioxide and water. This process has the same *overall* result as burning the fuel, but there is the important difference that in simply burning the fuel all the energy would be released as heat, whereas in the metabolic oxidation of the fuel some of the energy is collected as chemical energy in the form of ATP (adenosine triphosphate). In the second process (b) the chemical energy of ATP is used to perform work in the muscle by a reaction in which ATP breakdown releases energy for muscle contraction.

fuels for flight

The fuels required for flight muscle activity are ultimately derived from the food. Food is digested by the insect's gut and the products are absorbed into the body. Some of the products may be used for growth and maintenance processes in the body, but any surplus is transported in the blood to an organ known as the fat body where it is stored and is sometimes chemicaly modified. These stored food products represent the main source of fuel for flight. During flight the stored fuels in the fat body are gradually released into the blood where they are transported to their site of utilization, the flight muscles. In addition to the fuels stored in the fat body, smaller quantities may be stored in the flight muscles themselves.

A number of different chemicals may be used as fuels by insect flight muscles. These include carbohydrates, fats and, to a smaller extent, amino acids (from protein). The type of fuel used by the flight muscle varies with different species of insects, although some insects (including the locust) use all of these fuels.

The carbohydrates are supplied to the muscles in the form of the sugars glucose and trehalose. These sugars have the advantage that they are soluble in water and can diffuse rapidly into the muscle tissue when required. It has been found that many of those insects such as houseflies which carry out frequent and fairly short bursts of flight use carbohydrates as fuel, and this fact may be related to the rapid availability of these fuels to the muscles.

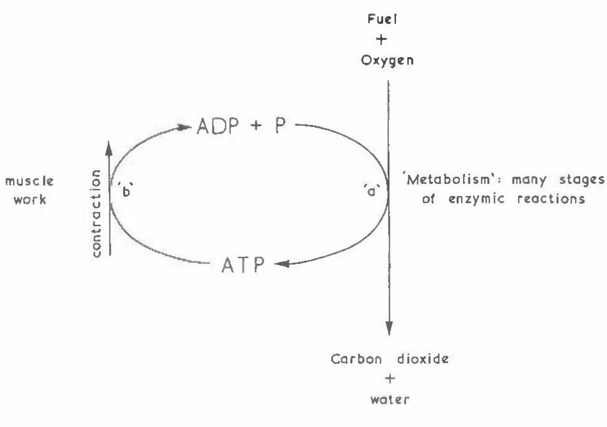
The fats, on the other hand, are not water-soluble and may thus be less rapidly available to the muscle tissue than sugars. However, fats have the advantage that they are more 'compact' than carbohydrates in the sense that much more potential energy can be stored per gram of fat than per gram of carbohydrate. This feature has particular advantages for those insects which undergo extended migratory flights of several hours. It is interesting to find that such insects (for example locusts, aphids and monarch butterflies) use fat as their main fuel for extended flights. Indeed, it can be calculated that it would be virtually impossible for such insects to store sufficient fuel in the form of carbohydrate to last for more than one or two hours flight.

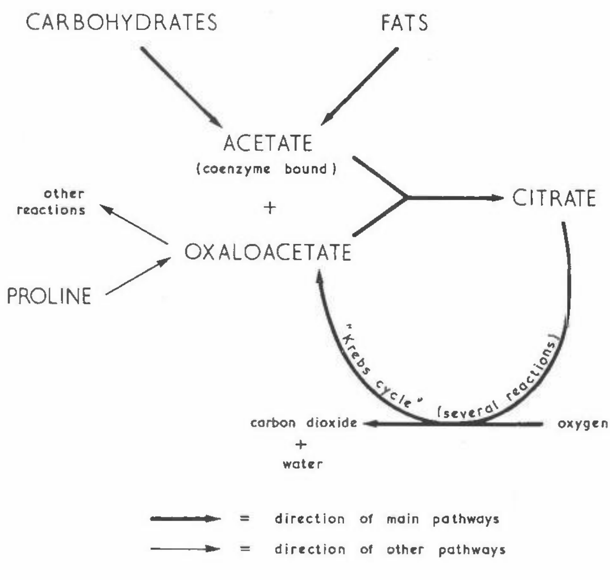
Another group of insects which use fat as the main fuel are the butterflies and moths where in some species the adult stage cannot feed. Here all of the fuel used for flight must be derived from food eaten by the insect during its earlier larval stage – with no possibility of any replacements! In these insects economy of fuel storage is essential and fat is again found to be the main fuel used for flight.

Amino acids can also be used as fuels for flight, but in most insects amino acids are quantitatively less important as fuels than carbohydrate or fat. However, it seems likely that the amino acid proline, and perhaps some other amino acids may have an important role to play in supplying a catalyst (or activating agent) for the oxidation of carbohydrates and fats. Carbohydrates and fats are converted by separate series of enzymic reactions to give coenzyme-bound acetate (Figure 2). Further oxidation of acetate to carbon dioxide and water occurs by the Krebs cycle, the first step of which is a combination of the acetate with oxaloacetate to give citrate. Subsequent reactions of the Krebs cycle in effect result in oxidation of the acetate part of the citrate to carbon dioxide in such a way that the energy released can be used to form ATP from ADP. The rest of the citrate molecule is eventually converted back to oxaloacetate so that for each molecule of acetate oxidized one molecule of oxalo-

Figure 1 (below) Biochemical relationship between fuel oxidation and work in muscle.

Figure 2 (on right) Scheme to show the role of proline in supplying oxaloacetate catalyst for the Krebs cycle.





acetate is used and one molecule of oxaloacetate is regenerated. In other words oxaloacetate acts as a catalyst for acetate oxidation. This system works perfectly well provided there is no loss of oxaloacetate, but in the cell other reactions occur which remove some oxaloacetate from the system. If this loss were not replaced acetate could not be oxidized and ATP synthesis would be reduced. The role of proline in flight muscle seems to act as a source of oxaloacetate, and thus to maintain the oxaloacetate levels at a sufficiently high concentration to ensure maximum oxidation of acetate.

Our main interest in Birmingham has centred around the locust because it uses all of the possible types of fuel (carbohydrates, fats and amino acids) for flight. One particularly interesting feature of the locust is that the proportions of the different fuels used varies during the course of flight. During the early stages when the locust first begins to fly carbohydrate is an important fuel, but as flight continues there is a gradual change in emphasis as fat forms a higher and higher proportion of the fuel used. This pattern of fuel utilization fits in well with the idea of carbohydrate as a readily available fuel suitable for the rapid initiation of flight, and fat as the main economically stored fuel for long term flight. One of the questions we are attempting to answer is how the insect controls this change in proportion of the type of fuel utilized.

Such experiments using flying locusts yield considerable information about the overall processes of flight. However, a number of important questions remain unanswered if this approach alone is used. For example, the increases and decreases in fuel concentrations of the blood during flight are a result of two conflicting processes: the removal of fuel from the blood by the flight muscle and the release of fuels into the blood by the fat body. In order to obtain more information about these processes it is necessary to study the individual flight muscle and fat body tissues in isolation.

Another aspect which it is not possible to study using living insects is the actual chemical pathways by which the fuels are oxidized in the flight muscle. To answer such questions it is usually necessary to experiment with tissues which have broken down (homogenized) to give subcellular fractions capable of catalysing the chemical reactions of fuel oxidation. Finally, it is sometimes necessary to isolate and purify the individual enzymes which induce changes at single stages of the overall metabolic process. To obtain a complete account of the biochemistry of locust flight all of these different approaches at different levels of organization are used.

Many of our experiments have been carried out using isolated fat body or isolated flight muscle and it is convenient to consider these two tissues separately.

experimental study of locust flight

A number of different experimental approaches may be used to study the biochemistry of locust flight. For example, some experiments may be carried out using the intact flying locust. Locusts can be induced to fly in the laboratory by suspending them by a wire to face a stream of warm air. Professor T. Weis-Fogh has used such insects to measure oxygen uptake, carbon dioxide output and overall changes in fuel reserves during flight. He was able to show that the proportions of carbohydrate and fat used as fuel changed during the course of flight. We have carried out experiments in which radioactive fuels were used by flying locusts and the radioactive carbon dioxide produced was measured. Such experiments have confirmed the change in emphasis from carbohydrate to fat during flight. Other experiments with flying locusts have been carried out by Dr. A. M. Th. Beenakkers who found that the concentrations of fat in the blood increased by about four times during flight. We have been able to confirm this observation and have found that at the same time as fat increases the carbohydrate concentration of the blood decreases.

the fat body

The locust fat body is a rather diffuse organ which stretches throughout most of the thorax and abdomen. The main role of the fat body in flight is to release stored fuels into the blood for transport to the flight muscles. Since the rate of fuel oxidation by flight muscle may increase by as much as one hundred times in going from rest to full activity, the rate of fuel release by the fat body must increase by a similar factor to keep pace with the fuel demands of flight.

Carbohydrate is stored in the fat body in the form of glycogen (a large polymer consisting of numerous glucose molecules joined together) but is released into the blood in the form of the sugars glucose and trehalose, of which trehalose is quantitatively the most important. (Trehalose consists of two glucose molecules joined together). Glucose and trehalose are more useful transport forms of carbohydrate than glycogen because they are much smaller and more soluble than glycogen and can thus diffuse rapidly into muscle tissue.

The initial step for carbohydrate release from fat body into the blood must be the conversion of stored glycogen into sugars. This process seems to be a target for the control of carbohydrate release since two different mechanisms have been found in insects for control of the conversion of glycogen into trehalose.

In at least one insect species high concentrations of trehalose have been found to slow down (inhibit) the trehalose-synthesizing process. This effect may operate to control trehalose release during flight; at rest the flight muscles use little trehalose so that trehalose formed by the fat body accumulates in the blood until the concentration becomes high enough to inhibit trehalose synthesis. This situation represents the stable state in the resting animal with only small quantities of trehalose being utilized or formed. When the insect starts to fly trehalose is rapidly removed from the blood by the flight muscles, so the concentration of trehalose falls and inhibition of trehalose synthesis from glycogen in the fat body no longer occurs. The overall result is that trehalose release is able to take place at a more rapid rate during flight than at rest, and this increased rate is useful in maintaining the supply of carbohydrate to the muscles.

For some insect species a hormonal mechanism has been found to control trehalose release from fat body: a hormone ('hyperglycaemic hormone') from a small gland (the corpus cardiacum) in the head causes an increase in blood trehalose levels by stimulating the enzymic process of trehalose synthesis in the fat body. No correlation between release of this hormone and flight has yet been established experimentally, but it seems possible that the hyperglycaemic hormone could be released during flight to stimulate trehalose release from the fat body.

It should be emphasized that the above mechanisms for control of carbohydrate release from fat body have only been shown to occur in insects other than the locust. However, it seems reasonable to speculate that at least one such mechanism does operate in the locust, although proof of this awaits further experiments.

Fat is the other main fuel for flight, and this too is stored mainly in the fat body. It is released into the blood as a complex with protein (i.e. as lipoprotein), which is necessary to maintain the fat in a more soluble form. The concentration of fat in locust blood during flight increases to three or four times the resting level, although at the same time the rate of removal of fat by flight muscles must increase considerably. This means that the rate of release of fat body must also increase to maintain the high level of lipid in the blood, and the question arises of how this increased rate of lipid release is initiated.

We have recently carried out some experiments which throw some light on this problem. The corpora cardiaca of the locust were found to contain a hormone ('adipokinetic hormone') which, when injected into a living locust, would produce an increase in the fat concentration of the blood. In other experiments with isolated fat body tissues the hormone was found to stimulate the release of fat from the fat body into a medium containing haemolymph. This showed that the hormone could cause an increase in blood fat by acting directly on the fat body. Evidence that this hormone is actually involved during flight was obtained when it was found that the amount of adipokinetic hormone in the blood increases considerably when a locust is flown. It therefore seems likely that the increase in fat concentration in blood which occurs during flight is initiated by release of adipokinetic hormone from the corpora cardiaca, and this hormone then acts on the fat body to stimulate fat release.

the flight muscles

The main requirements of active flight muscles are fuel and oxygen. Oxygen (in the air) reaches the muscle fibres via the tracheal system. This consists of branching tubules which lead from spiracles (holes) in the cuticle directly to the tissues. Such tubules are particularly numerous in flight muscle tissues. During flight air is pumped in and out of the tracheal system by the normal working of the flight muscles which, as they contract and relax, cause changes in the volume of the thorax which creates a tidal flow of air in and out of the tubules. In this way flight automatically improves ventilation of the tracheal system and therefore improves oxygen supply to the tissues when it is most required. Similarly, repeated contractions of muscles during flight improves the rate of blood movement between muscle fibres and therefore speeds fuel delivery.

Some biochemical experiments can only be answered by experiments using isolated flight muscle. For example, although it is well established that the trehalose concentration in locust blood falls during flight, this does not necessarily mean that trehalose is actually used by flight muscles. (An alternative explanation would be that the trehalose was being converted to glucose by some other tissue, and that this glucose was the true fuel for flight muscle). Such problems can be resolved by experiments on isolated flight muscle. In other experiments mixtures of two or more fuels can be tested to determine which fuels are preferentially utilized by flight muscle. Isolated flight muscles can also be used to study possible hormonal actions on fuel utilization.

In order to carry out such experiments it was first necessary for us to develop new experimental methods. The requirements were for an isolated flight

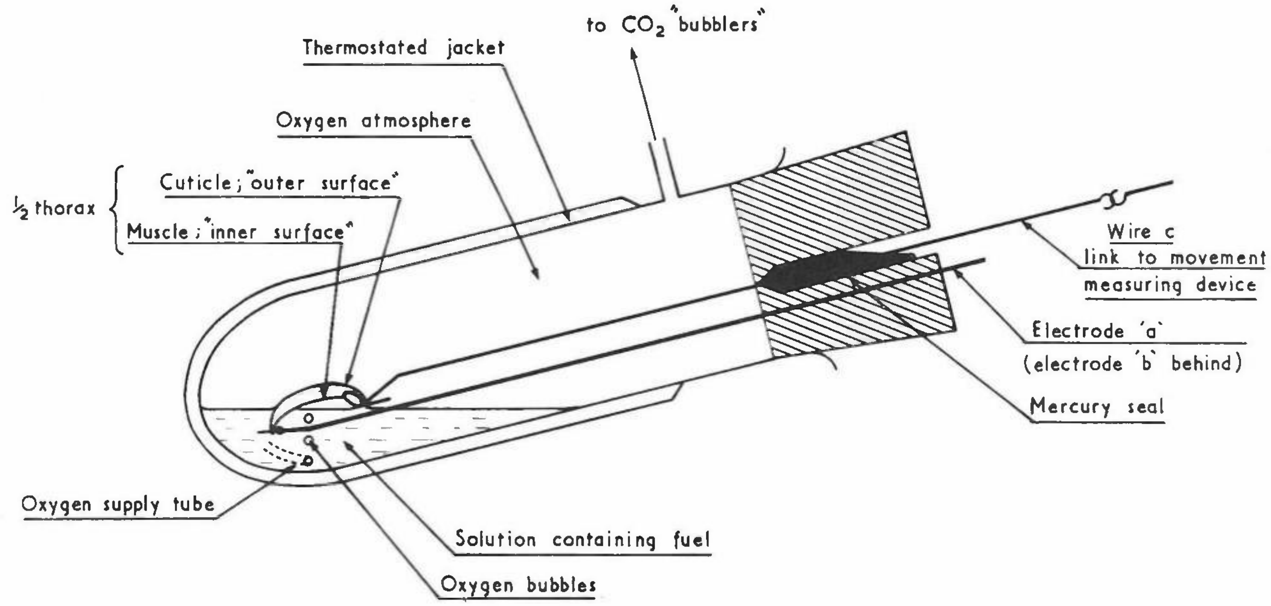


Figure 3 Diagramatic cross-section of muscle incubation bath

Insect Flight continued

muscle preparation which could be made to contract repeatedly and thus perform work (as occurs during flight). This could then be supplied with oxygen and suitable fuel. The utilization of the fuel could be best followed by labelling it with radioactive carbon so that the production of radioactive carbon dioxide and other products could be followed by radioactivity measurements.

Such requirements led to the development of a technique which employs the apparatus shown in Figure 3. The muscle preparation consists of half a thorax from a locust which has the fat body and gut removed to expose the flight muscles. The tracheal system is left intact to carry oxygen to the muscles, and the cuticle also remains as a support for the muscles and to retain the spiracles by which the tracheal system maintains continuity with the external atmosphere. In addition the main ventral nerve with its subsidiary nerves are left intact so that all of the muscles can be made to contract simultaneously by electrical stimulation of the ventral nerve via two electrodes (a) and (b). When the muscles contract they cause a movement in the flexible cuticle which then pulls down on the wire (c). This movement is measured by connecting (c) to an electronic device for recording the amount of movement. The muscle tissues are bathed in solution which contains fuel and inorganic ions at concentrations similar to those of locust blood. The 'outer surface' (cuticle side) of the preparation remains in the atmosphere since wetting of the spiracles blocks them and prevents oxygen transfer to the tracheal system. Fresh oxygen is continually bubbled into the solution underneath the preparation, and as it escapes it carries any radioactive carbon dioxide formed in the muscle to the 'bubblers'. The bubblers absorb the carbon dioxide so that its radioactivity can be measured.

Using this technique we have been able to show that a number of different fuels can be oxidized by the flight muscles. Such fuels are able to provide the energy for repeated contractions (usually at the rate of two per second) for periods of more than three hours. In the absence of any suitable fuel the mechanical response of the muscle gradually becomes weaker and weaker until after an hour or so it is only a small fraction of the original response. The results presented in figure 4 show that the fuel (glucose) oxidation rate is proportional to the frequency of contraction i.e. to the amount of work done by the muscle. The oxidation rate in unstimulated preparations is only about 10% of the rate during stimulation at two per second. This shows that in our isolated muscle preparations fuel oxidation processes and the contraction processes are 'coupled', that is they are interdependent as would be expected from a consideration of Figure 1. This gives us some confidence that our muscle preparations are functioning as they do in the flying locust.

Suitable fuels for such flight muscle preparations include glucose, trehalose, various fats and proline. When two suitable fuels are added in mixture, the contribution of each is depressed, although the total fuel used remains about the same. Increasing the concentration of one of the fuels relative to the other increases the proportional contribution of that fuel to the total fuel oxidized.

In some experiments we have looked for possible hormonal effects on flight muscle fuel utilization. In these experiments we added extracts of hormone producing organs to the solution bathing the muscles, but so far no significant effects have been detected. This could mean either that hormones do not affect fuel metabolism by the flight muscle, or that our experiments were insufficiently sensitive to detect such effects. It is always more difficult to be convinced by negative results than by positive ones!

To summarize, the main controls of fuel utilization *at the muscle* seem to be:

(a) The amount of work done. This controls the total amount of fuel oxidized.

(b) The relative concentrations of different fuels in the solution supplying fuel to the muscles. This affects the proportional contribution of each individual fuel to the total.

an overall picture of fuel utilization

Our present working hypothesis on the control of fuel utilization during locust flight is as follows: At the beginning of flight the nervous system of the insect stimulates the flight muscles to contract, and the energy for such contractions is derived by oxidation of available fuels from the blood. At the same time the corpus cardiacum is stimulated to secrete hormone(s) into the blood stream: Adipokinetic hormone which stimulates fat release from the fat body, and perhaps other hormones which may stimulate trehalose synthesis by the fat body. Simultaneously, the trehalose concentration of the blood is reduced as a result of its utilization by the flight muscles, and this may relieve inhibition of trehalose synthesis in the fat body and thus reinforce any hormonal stimulation of trehalose release. For carbohydrate the initial rate of utilization by muscle is greater than the rate of release from the fat body, so that the concentration in the blood decreases. For fat, on the other hand, the stimulation of release from the fat body is so effective that the fat concentration of the blood actually increases despite an increased rate of removal by the flight muscles. The overall result is that there is a change in the relative proportions of carbohydrate and fat in the blood during flight (a decrease in carbohydrate and an increase in fat), and according to our experiments with isolated flight muscle, this should affect the relative proportions of fuels actually oxidized. Thus changes in blood fuel concentrations can explain the change in emphasis of fuel from carbohydrate to fat which has actually been observed during the flight of locusts.

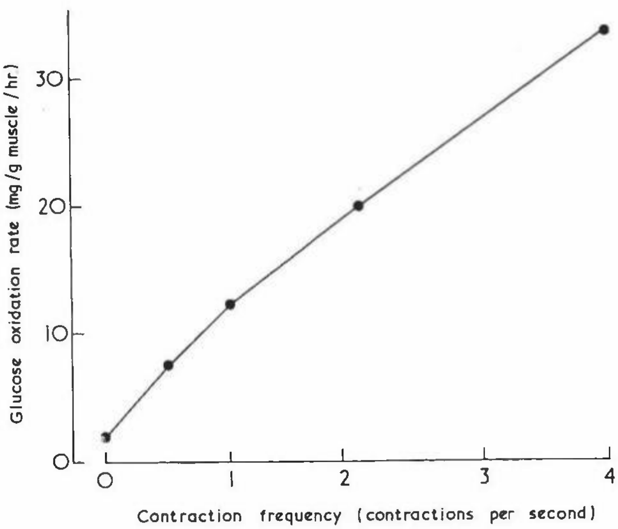
future problems

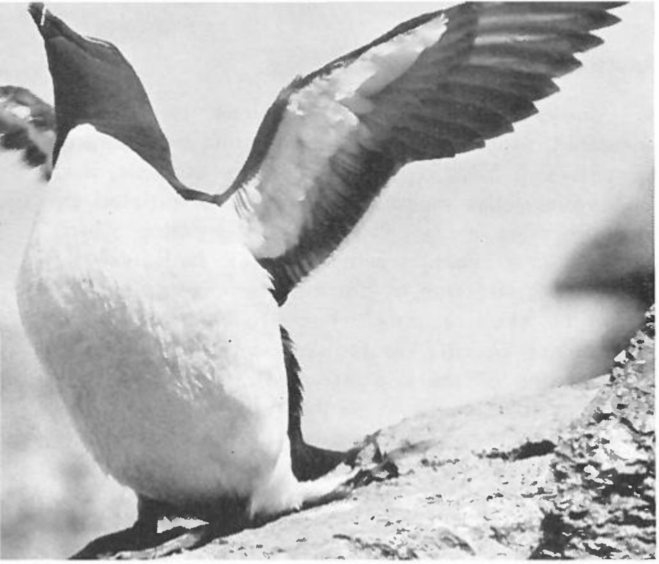
A number of interesting questions remain unanswered. Most of these are concerned with control systems at a more chemical level. For example, it is well known that muscle contraction is initiated by local changes in calcium ion concentration which activates the reaction whereby ATP hydrolysis is linked to contraction of the muscle fibres (step (a), Figure 1). More recently it has also been found that an increase in calcium ion concentration activates at least one of the key enzymes of fuel oxidation (i.e. step (b), Figure 1) in the muscle. In this way calcium ions may simultaneously activate both of the main processes in flight muscle. Further research is needed to discover the relative importance of this calcium effect, and to look for additional mechanisms for control of fuel oxidative metabolism.

The question of how trehalose enters the muscle cells is a problem which is specific to insect muscle. It has not been established whether trehalose is converted to glucose inside the cell, outside the cell, or during its passage through the cell membrane. Moreover, the rate of such processes must be controlled in some way, and linked to the rate of muscle contraction, since otherwise much of the trehalose in the blood of locusts at rest would quickly be converted to glucose.

At the present time the known effects of hormones on fuel utilization affect the fat body rather than the flight muscles. This key role of the fat body as a target site for hormonal control of flight biochemistry merits further investigation. Of particular interest is the question of exactly how the hormones act on fat body cells to stimulate the release of fuels.

Figure 4 Effect of contraction frequency on glucose oxidation rate. (Each point represents an average of several experimental results).





people and their pastimes

the birds

Mrs. U. F. Black
LO

Interesting facts about the habits and habitats of wild birds are collected by natural history societies. Originally intended for study of the mysteries in the bird world, of which there are many still to be solved, the collection became so comprehensive as to show where bird species were in danger of becoming extinct or how they might become threatened by changes in the environment, whether caused by nature or by man. In the interests of preservation, the wild life and bird protection societies were formed and they also discovered that unless the natural countryside was looked after it might become a barren desert, of no benefit to people in need of a resort from urban life.

Details of bird life come from amateur bird watchers as well as expert ornithologists and among the former are Una Black and her husband Pete, who belong to the London Natural History Society, the Royal Society for the Protection of Birds and are supporters of the World Wildlife Fund. Una has been a member of the group in Establishment Division, London Office that produces SRC Conditions of Employment Memoranda, and the related general notices, for the past three years. Welfare is another of her responsibilities: this covers any personal problem from finding hostel accommodation for young newcomers to providing a general advice and information service on quite a variety of questions.

Una and Pete have made many observations both of birds near their home in the west of London and at bird study centres on remote coasts and moorlands. It is important when studying birds not to disturb them. Rare birds in particular, often the most shy, may be upset by a careless intrusion, and frightened away from their breeding grounds.

There are only twenty species which breed regularly in the Central London area, as many more that breed there from time to time but over a hundred more fly over or through it. The green squares, parks and private gardens attract hardy woodland birds although great and blue tits, chaffinches, greenfinches and songthrushes prefer woodland undergrowth or, instead, tangled shrubberies in unkempt gardens. Here too will be wrens, hedge sparrows, tawny owls and, more rarely, black caps, swifts and hawfinches. In late autumn migrating flocks of redwings pass over in great numbers and may alight for a rest or to feed.

The development of London has made it uncongenial to certain birds but others have returned to changed surroundings. Marsh birds, like little ringed plovers, reed warblers, yellow wagtails and great crested grebes, have accepted the gravel pits created by the concrete age and reservoirs are the winter homes of 10,000 ducks and 100,000 gulls. Redshanks and other waders are content to live on sewage farms, which are often close to the site of former marshes and swamps, while the City of London is a series of cliff faces to feral pigeons and starlings, the counterparts of the starlings and rock doves on the rocky coast of northern Scotland. Pigeons have come to accept breadcrumbs, varied with scraps from street markets as their staple diet, their ability to make a rapid and almost vertical take-off keeping them safe from traffic. Starlings feed on insects in lawns, rubbish dumps and sewage farms, where they travel round on the rotary filter arms; but hunting on the ground brings them into danger from domestic cats – there are about five cats to every starling.

Many of the bird species found in London appear in the glens at the foot of the Grampians, as well as many others. Una and Pete have spent holidays there at the house of the Bird Recorder for Angus. Dippers, which can walk under water, push food into the red gapes of their young, open like so many letter boxes in the river bank;

woodcocks parade their square of territory every evening 'roding' just above the treetops, uttering a call at exact intervals; and the sound of a rusty hinge creaking in the wood may be the cry of hungry long eared owlets. The most exciting sounds are the weird crowing of grouse, drumming of snipe and the mournful cry of curlews or an oyster-catcher hunting in the estuary, its long legs and bill a brilliant red. Una has also heard an icterine warbler in Glen Esk and was once lucky enough to see a dotterell on its breeding ground; this handsome bird of the high moorlands is rare in Britain and very seldom seen.

Off the nearby coast are colonies of sea birds. Arctic terns dive at intruders like small white darts; but gentle faced kittiwakes sit wing to wing on the cliff face murmuring soothing calls in answer to the discordant cries of 'kittiwake' from their noisier partners.

Skokholm Island off the coast of Wales is a more specialised sea bird observatory, well known for its colony of manx shearwaters. The island lies in the path of a fierce tidal stream and is swept by heavy westerly and southerly gales so that, apart from the lighthouse keepers and hardier bird watchers, it is secure from human intrusion. This is fortunate, for many shearwaters and puffins nest in rabbits' burrows, honeycombed in the soft peat under a thin crust. Storm petrels use rock crevices but all have to hide during daylight and on moonlit nights from voracious great black-backed gulls, which turn their prey inside out to leave only wings and feet. Parent shearwaters take turns to hatch and feed their young chick while their partner spends a week or so feeding at sea. When they change over the noisy meetings underground on dark nights sound like ghostly wailings from the island itself. Both parents leave the chick alone ten days before it is ready to fly, to be nourished by its own body fat until it is light enough to move. During the last few nights the young bird comes out of the burrow to exercise its wings on the ground before its final take off, either by a run down to the sea if the night is calm or, more successfully, on windy nights to be lifted by the wind by facing into it. The rest of a shearwater's life is spent at sea, except during the breeding season, and young birds will be found in South America within six weeks.

Una has also watched birds in Austria, while skiing, and in the west of Ireland, where she saw large numbers of newly arrived cuckoos (a bird more usually heard than seen at such close quarters) and some mobbed by meadow pipits, whether before or after laying in the pipits' nests it was hard to tell. Meanwhile Una and Pete are saving up for an excursion further afield to the Ngorongoro crater in Africa, where they are keen to go soon before some bird and wild life species, already rare, become altogether extinct.

The photographs shown were taken by Laurie Roberts, a friend of Una's who works in State House for the Ministry of Health and Social Security. He is both a bird watcher and photographer in his spare time and has provided pictures for natural history journals on several occasions.

opposite page		*Razorbill*
below	*1*	*Bird survey*
	2	*Shearwater*
	3	*Temminks Stint*

Q column by 'observer'

The temperature was well into the eighties in Holborn on Wednesday July 16 as Apollo 11 was launched and we would be less than human if we said our thoughts were entirely on work. Quite a lot of people were thinking about the astronauts; a few were considering strawberry prices and a lot more were wanting to get back to a deck-chair, a shower, or anywhere but Central London.

The Press Office tells us that they did a brisk trade in enquiries from newspapers and journals concerning the lunar samples for British universities and research teams throughout the world which the Apollo astronauts were bringing back. Would our man collect them from Houston or would all the experimenters go over and receive their samples individually? What would the security precautions be? What about clearance with Customs and Excise? There were dozens of obvious and sensible questions asked.

The article on Page 13 by Dr. Greening gives valuable 'background' to an interesting administrative chore for what must surely be the most unique scientific exercise ever undertaken.

The last word must, however, be with the Office Wag who stopped us to say 'when the courier gets off the plane at Heathrow it's more than likely he will have a Little Green Man in tow rather than a piece of lunar rock'.

Well, we know now it's rock. Personally, I would love to have met a Little Green Man.

parts of the past

Nowadays, it seems, you have to go all the way to the moon for souvenirs of a bygone age, Archaeologists, or mere keen diggers, aren't allowed to carry off pieces of Fishbourne Palace or newly uncovered Egyptian mummies.

A hundred years ago, lumps of ancient Rome, Greece and anywhere else were a favourite ornament for the home and inspired classical themes in buildings, paintings, furniture and women's dresses. If you visit London Office, you can see how they used to look at No. 13 Lincolns Inn Fields (opposite State House). From 1811 until his death in 1837 (aged 84) this was the home of Sir John Soane, an architect of the classical revival. Parts of ancient and contemporary buildings, models and statues were brought in to show himself and his pupils how it was done. The passageways are narrow and massive blocks from stone columns hang, breathtakingly, just above head level.

The museum gained attention at Easter when a painting by Watteau was stolen. Apparently the work of a specialised 'collector' since the dozen by Hogarth were left alone. The famous 'Rake's Progress' set of eight, now priceless treasures, were bought by Mrs. Soane at Christie's in 1802 for only £570, the lot.

The house is full of deception – decoratively speaking – to suggest to the eye that it is larger and lighter than possible in a London terrace. The ideas are worth trying at home. When the house next door is opened at the end of the year there should be more to see as the interior and furniture will have been restored from engravings made during the architect's lifetime.

. . . and present

If the Sir John Soane's Museum is too intellectual a refreshment in a busy day's routine perhaps the netball teams on the other side of Lincolns Inn Fields will provide greater stimulus. Followers of this very persuasive sport tell us the standard of play is quite high (we wouldn't know of course) and the participants are sometimes quite spectacular. If these diversions are not enough there's usually a brass band on Tuesdays, speakers of a variety of persuasions at the Great Turnstile corner, and if all else fails, Henekey's Long Bar. You can always persuade yourself that this deserves a visit for its architectural merit alone. It is mentioned in 'Nairn's London'.

Quest Quarterly Quote

'Two students who have completed their year of general observations are now working on their own projects. One is working towards a PhD on reproductive behaviour at Cambridge University . . .' from Quest, April 1969.

● Here is an open secret. Most Monday mornings the London Office Directors hold a meeting with the Chairman and Secretary to discuss routine administrative business. It is known throughout the office as a 'Q' meeting. Why? There are several suggested answers ranging from 'Questions' meeting to 'Quintet' (originally five attended). We have yet to hear an authoratative answer. Please Dr. Francis put us out of our misery.

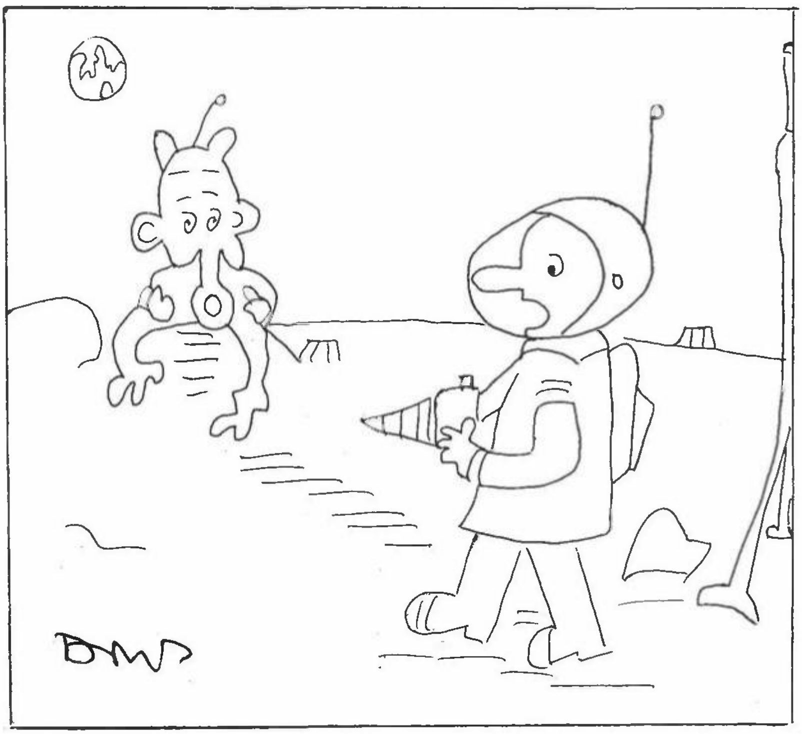
● You may notice a number of small changes in the format and content of your Favourite Journal. All are designed to make it more readable? loveable? homely? or simply to bring about togetherness (or the opposite!) The Guest Column will we hope be a popular innovation bringing an outside viewpoint to bear on our affairs (we have some very interesting contributors in mind for future issues). The Quest Quarterly Quote will depend a lot for its success on getting a good, relevant contribution each issue and this column will depend even more on either the existence of a quiet corner in the office or else a strike by the GPO engineers. Seriously though, we do need more reader participation. We can't guarantee to run a 'personal problems' column by Aunt Joan (*in* joke) but we will do all we can to print all reasonably acceptable contributions especially cartoons, light verse and articles.

a word in time . . .

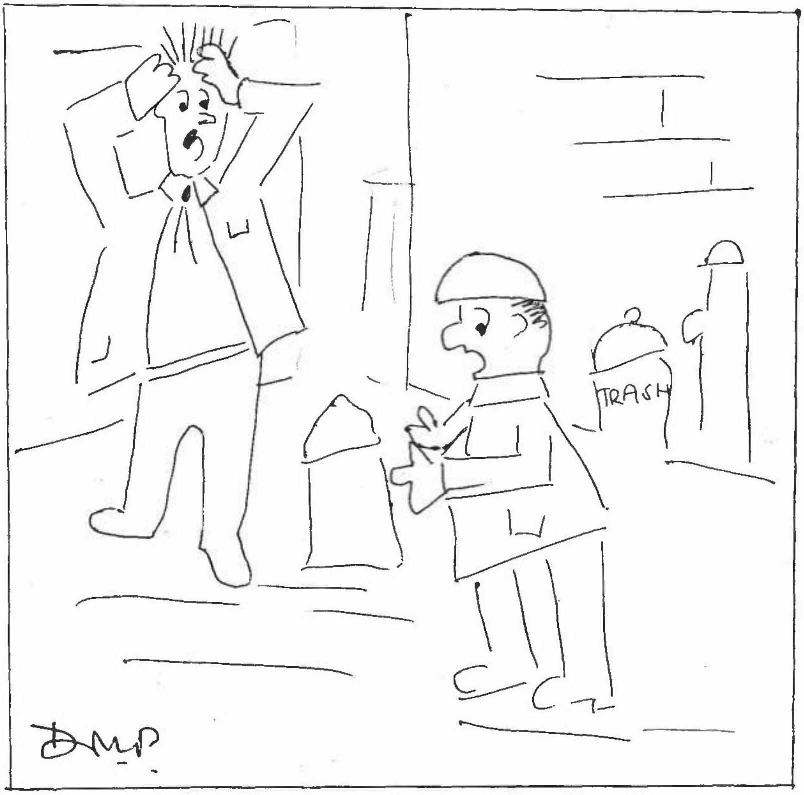
The Director of a Laboratory, not far from SRC, arriving about ten o'clock, overtook one of his draughtsmen.

'Good morning, Blankson', he called. 'Late again!'

Said the draughtsman, with a look of concern 'Are you, Sir? – so am I.'



Gee! I must have a snap to take to the folks back home.'



'A bag marked moondust, you say?'

● We have heard it rumoured around that far reaching decisions are being taken with regard to titles in the London Office. We shall have 'Director, Nuclear Physics', instead of 'Director of Nuclear Physics Division', 'Director, Astronomy, Space and Radio', etc. Each will continue to have a deputy as at present but he will no longer be called 'Head of Division'. All of this makes sense and up-dates us in more ways than one. Mr. Walker we gather will be 'Director, Administration' and under him will be deputies dealing with 'Establishment' and 'Finance'. In addition it is proposed that 'Establishment Officer' as a title should be dropped but the problem is to find an equally descriptive alternative. We are not sure why the title is going except perhaps that 'establishment' may have a slightly undemocratic ring about it in the setting of swinging Holborn, and perhaps it would establish us as leaders in the field of post-Fulton developments.

Anyway all this may be conjecture. We have to await an official announcement. Let us suppose however that 'Establishment Division' goes. Can you suggest an alternative? Decent suggestions on a postcard please to PO Box EST. Room 1517, State House, London WC1 by October 31 please. No prizes offered but the sporting chance of a mention in our next edition.

To help would-be contributors may we add that 'Personnel and Organisation' is an unlikely starter (after all, we might think of cruises every time we 'phone the P and O) and 'Staff, Organisation and Discipline' seems a little doubtful (no prizes for guessing why).

Our own suggestion is Staff, Welfare, Employment and Leave Section known throughout SRC as the SWELS (ugh).

● *'Quest' was abashed to find – and we do not abash easily – that among new staff appointments announced recently were two colleagues described individually in the official notice as 'Woman Computer'. 'Woman Computer' indeed! Has the age of chivalry shed its last garment? Surely 'Computeress' as with 'Shepherdess' would be more elegant or else Computer Lady, Lady Fortran, or any expression that avoids such language.*

Beware official draughtsmen! We are following your announcements closely.

newsfront

july 28
Minister of State's visit to Daresbury

(l to r) the Chairman with Mrs. Shirley Williams, MP, Minister of State for Education and Science, and Professor Merrison Director of DNPL.

september 1
Professor Merrison appointed Vice-Chancellor

Professor A. W. Merrison, FRS, thanking Mr. M. J. Moore (head of Engineering Services Group) and the staff of DNPL who presented him with two prints of Liverpool and an autographed album when he resigned as Director to take up his new appointment as Vice-Chancellor of the University of Bristol.

july 2
sports day

near right Summit Meeting in a six a side football match.

far right Miss Alison Astbury granddaughter of Mrs. O. J. Kirby RGO wearing 'Supporter's Hat' created by Brian Jones, Computer Engineer at RGO. The 'ribbons' bear slogans for RGO.

june 13
Site opened for 5 km Radio Telescope

Professor Sir Martin Ryle FRS starting off the work to open site of the new telescope for the University of Cambridge Mullard Radio Astronomy Observatory at Lords Bridge.

quest loses

Len Jenkins (editor) who is now Books Editor (on promotion to Senior Information Officer) in the Department of Employment and Productivity. This involves publishing the many leaflets issued at Labour Exchanges and his particular job is to redesign the literature to match the changing image of the Department.

Dr. John Baldwin local correspondent from ACL who is to spend a year at the University of Maryland under Professor Jim Stewart to assist in implementing crystallographic programming package Xray-70 on the University Computer. Then he will work on its conversion for use at ACL. Dr. Baldwin adapted the Xray-63 package now in use from the US programme. His bellringing interests were featured in Quest (in January 1969).

Dr. John Ireland from ROE whose destination is still unknown at the time of going to press.

Quest's thanks and best wishes go with them.

quest gains

Miss Anne Smith as Editor

F. Lunnon as ACL correspondent

Dr. W. M. Napier from ROE

The cartoons in this issue are by Miss Daphne Playford from LO.

contributors

J. F. Hosie

'the launch'

Director, Astronomy, Space and Radio (LO)

Commander R.N. Stanbury

'tracking east and west'

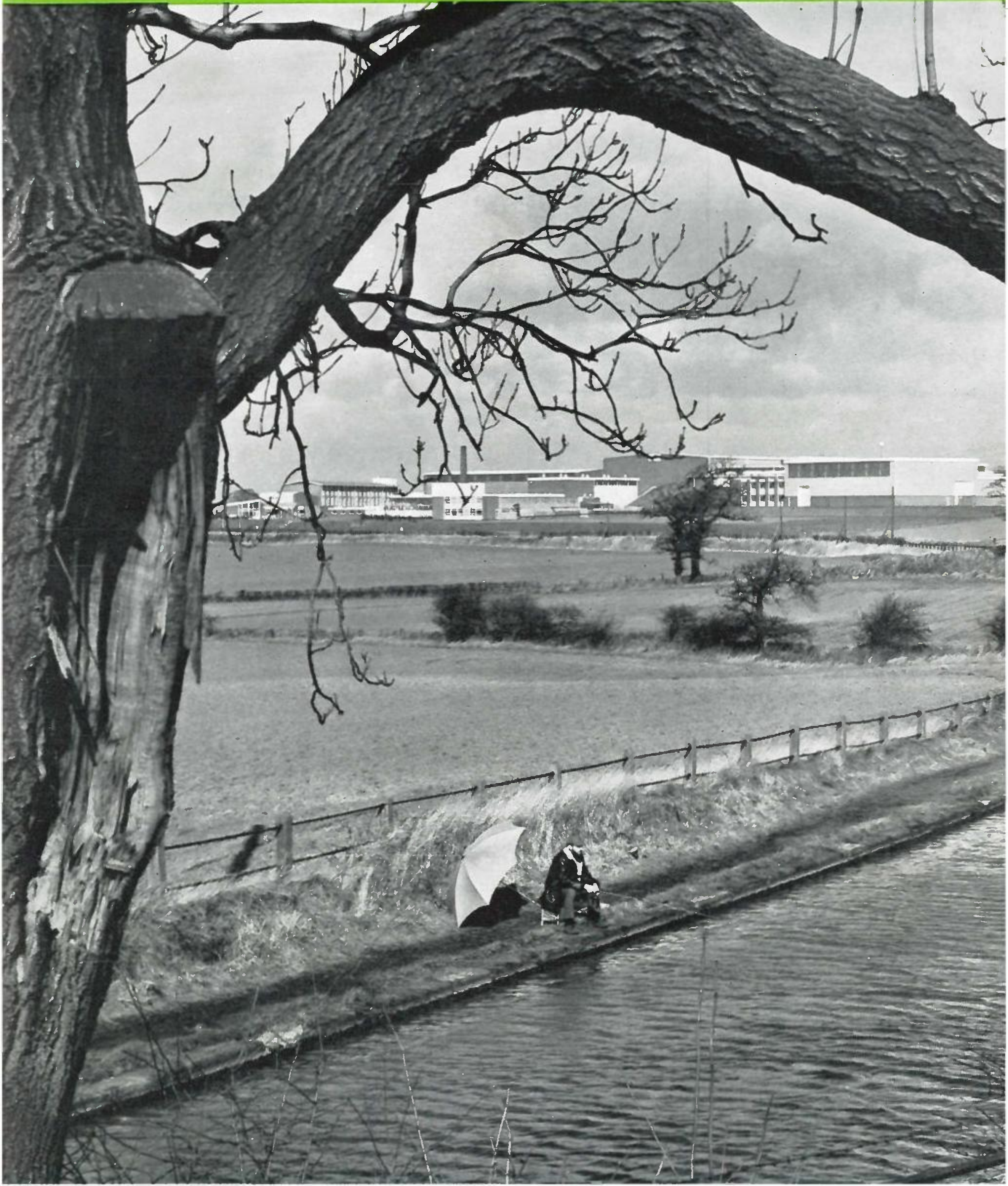
Personal Assistant to Sir Bernard Lovell at Jodrell Bank, University of Manchester.

Dr. W. D. B. Greening

'no small part for SRC'

PSO in ASR Space (International) Section (LO)

QUEST



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QUEST

House Journal of the Science Research Council

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G. W. Gardiner
W. M. Napier
H. Norris
J. Peatfield (Mrs.)
A. Powell

A. J. Smith (Miss) Editor

Vol. 3 No. 2

April 1970

contents

cover picture: research at Daresbury – Peter Tickle of the vacuum section of the Machine Group hoping for a positive result from the canal that runs close enough to the Laboratory (seen in the background) to allow lunch time fishing. A member of the Warrington Anglers' Association, Peter's local club is the Red Lion Angling Club, where he has carried off 3 club trophies in the last 2 years. He enters most local matches and travels to Wales, Scotland and Ireland on fishing expeditions. For more about spare time activities, see page 22.

The photograph was taken for 'Quest' by Arthur Pickett, DNPL photographer, whose work has also appeared in 'Cheshire Life'.

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profile

Dr. William Francis CBE

Dr. Francis was frustrated from the word go in planning his career. At the age of 13 when he had to start specialising at the Latymer Upper School, Hammersmith he decided to become a historian. But his mother said 'your father has filled this house with books on science and I will not have *you* filling it with history books – you will be a scientist like your father.' So he did as he was told and in due course won an Exhibition in Natural Sciences to King's College Cambridge, having been Foundation Scholar, Senior Prefect and Captain of Football at school. He had given up cricket, with regret, (when 14) because it 'interfered with the passing of examinations in the summer.'

At King's he enjoyed life, captained the soccer team, got his athletics colours and did less work than he should. He stayed on to take a Ph.D. in physical chemistry in 1931, studying the electrical properties of protein membranes and was invited to join the Zoology Department by Sir James Gray where he worked on the electrical properties of frog skin with the help of a DSIR Senior Research Award. In 1933 he gained a Rockefeller Fellowship in Experimental Zoology and went to the Rockefeller Institute in New York to work on the permeability of frog muscle. When asked about life in New York and California in 1933–4 he says it was well described by Eric Linklater in the novel 'Don Juan in America'!

By this time he was in danger of becoming a 'perpetual student' but, although disappointed in his ambition to become a don at Cambridge, in 1935 he was offered the choice of lecturing in a civic university in the north or teaching at Repton, which he preferred – following a family tradition.

He enjoyed 'being a beak' and also fitted in WEA lectures to industrial workers in Derby and to farm workers in the countryside around and later became an O- and A-level examiner for Cambridge exams.

During this time he married Ursula Matthew, a Cambridge geographer, and they both grew very fond of country and village life. She died in 1966.

Over the years 1931–37 he published a number of papers in scientific journals on the permeability and other properties of membranes, both living and artificial – 'not very outstanding' he says but he is still interested in what is being achieved in this field today, with modern techniques.

When the war came he was mobilised by C. P. Snow from the Royal Society list of research scientists for war work on radar. In his own words – they had recruited all the physicists before the war so by 1940 they were 'scraping the barrel' for chemists and biologists. The early days of radar were great fun. Jack Ratcliffe (afterwards Director of RSRS) was his boss – first at Anti-Aircraft Command and later at TRE in Swanage then Malvern, where it was moved in case of a south-coast invasion. Working on the introduction of centimetre radar into night fighters and bombers and submarine chasers, he now regards as one of the most amusing and exciting parts of his professional life because 'we were given all the staff and money we asked for and could translate the results of fundamental research into effective hardware within a matter of months.' Two of the 'promising younger men' at TRE in those days, Bernard Lovell and Martin Ryle, have since led the world in extending the principles of radar to radio astronomy.

Towards the end of the war Ratcliffe sent him to see Sir Edward Appleton, the Secretary of DSIR, who offred him a job as a peacetime PSO. He thinks he was very naive at first in expecting things to go as fast in peace as in war – progress was slow for a number of good reasons. Two of the causes he began to advocate in 1945 are now widespread under the aegis of Min Tech: namely, development contracts arising from research in civil science and regional technical information services for industry. Later on he had an interesting five years (1953–8) in charge of administering the Government grant to the co-operative industrial research associations, which gave him an insight into the problems of applying science to traditional industries.

In 1959 he found himself 'quite undeservedly in charge of the Grants and the Information Divisions of DSIR but fortunately Christopher Jolliffe, John Beckelt and later Harry Hookway were there to do the work, earn me a CBE in 1961 and propel me gently into my present post when SRC was started in 1965.'

When he isn't working he enjoys music, travel, gardening, his cottage in Cornwall and his children's activities. His eldest daughter Sarah, who went to St. Paul's Girls' School, is also a Cambridge Ph.D. At present she has a research fellowship from the Australian National University and is studying childhood morbidity among aboriginals near Alice Springs. This involves getting to know and understand the parents, if you can identify them, to find out what they do when their children are ill or hungry. 'They have some very odd ideas' she says.

His son Julian was so horrified by how hard his elder sister had to work at school that he gave up academic ambitions at the age of 14, at Westminster School, and opted for farming. For the last two years he has been in charge of an irrigation-agriculture-dairy farm project for Oxfam in India which has become a successful show piece and was recently visited by Mrs. Judith Hart, but much to Julian's chagrin the event was neglected by the British Press. Brigid who is younger went to the Royal Ballet School until, at the age of 16, her knee gave out. So she switched to Putney High School, scrambled some A-levels and is now in her third year at York University doing Music and English with great enjoyment.

The youngest, Emily, is at Dartington Hall where she is said to work hard. She saw the text of this article in preparation and forbade her father to reveal any secrets of her, so far, innocent life to the readers of *Quest*. Two years ago Dr. Francis married Margaret Morris, formerly of Geological Survey and Museum, who was then an SPSO in ASR Division, London Office and is now working part time in the Cabinet Office.

---

force of conflict

Time goes on indifferent without the spark
Of nuclear force and pull of gravity.
The cell defends itself from enemies
And sperm and egg do battle and then join.
The mother labours to produce her child
With father striving to achieve success.
The students quarrel with authority
And parents find their toleration thin.
Man fights for his ideals, and always will,
The creatures for their territory and mate.
The sea assaults the land and swallows it
And cold and tempest thwart the farmer's hope.
Perfection – and our world would atrophy.
Conflict exists with reason and without:
So will it be to energise and make
The cutting edge for purpose and achievement.

Nona

morning train

Faces in rows – people standing between
Hide behind newspapers, solemn restrained,
All silent: in company and yet alone.
Man of the city, upright and well fed,
Support of his country and strength of his class,
Overalled workman – his life in his hands.
Lovers, remote, with their bliss on their faces,
Women who lost it, or it never knew,
But some full of comfort and ever benign.
Heavy eyed student with long flowing hair,
Girl in her teens – all make up and sex,
Unaware schoolboy studies his book.
The morning is golden – the river is grey
But they do not notice they only endure,
Yesterday, today and tomorrow.

Nona

council commentary

£1M A YEAR FOR ATOMS MOLECULES AND PLASMAS ++ BEST DATA YET FROM SKYLARK SPACE
PROBE IN SOLAR ULTRA-VIOLET SPECTRUM ++ SYMPOSIUM ON ELECTRON AND PHOTO INTERACT
++ £59,000 HARDWARE FOR MULTI ACCESS COMPUTER SYSTEM ++ BRITISH EXPERIMENT IN OR
ING SOLAR OBSERVATORY OSO-G ++ FIRST LUNAR SAMPLES FOR BRITAIN ARRIVE AT SRC ++
FOR CONTROL ENGINEERING RESEARCH ++ ANGLO-AUSTRALIAN TELESCOPE CONSIDERABLE CONTI
BUTION TOWARDS SCIENTIFIC DISCOVERY ++ RSRS PARTICIPATES IN UK4 SATELLITE TO MEA
INTENSITIES OF ELECTROMAGNETIC RADIATION ++ DEVELOPMENT IN ANALYSIS OF BUBBLE CH
BER PHOTOGRAPHS BY SWEEPNIK AIDED BY SRC GRANT OF £40,473 ++ SUCCESSFUL LAUNCH O

At the December meeting the Council discussed the draft of a public statement of its policies on selectivity and concentration of research support. The Council also received a report on the progress of development of a possible productivity agreement with its industrial staff. The greater part of the rest of the business at this meeting was the consideration of recommendations from all four Boards of grants and projects over £50K.

The continuation of the Edinburgh/Liège infra-red astronomy experiment in ESRO's TD–1 satellite was approved at a cost of £900K; five grants for nuclear physics research in major centres in 1970 were approved at a total cost of £500K as were five engineering grants totalling £210K, most of them supplementing earlier large grants, and two Science Board grants totalling £160K. As one example, a grant of £82,000 was awarded to Dr. F. W. Randall, Queen Mary College, London, to provide a NMR spectrometer of a new type for work on the theory of C–13 and N–15 resonances and also as a general facility for other users. One other item of which the Council learned with pleasure was the decision to arrange for a study at Manchester University to assist the development of SRC and SSRC policy on problems of pollution.

January. One of the Council's major annual tasks is to decide on the policy and arrangements for postgraduate student awards. Formerly, a great deal of the work was done by the UST Board, but the Council now undertakes it directly. With the help of much detailed information submitted to the January meeting, the Council made its decisions on the quotas for various special kinds of award and for the four Boards. It also laid down that at the appeals stage priority should be given to fully qualified applicants in the Engineering Board's field, and to applicants with first-class honours.

Three items in the ASR field then followed. The Council approved the building of a 48 inch Schmidt telescope at a cost of £750K at Siding Spring beside the Anglo-Australian telescope, to be used first to complete the famous Palomar sky survey. The proposal for a Mk V large steerable radio-telescope was next considered, the scientific case being presented in very full detail. The telescope would be 400 feet in diameter compared with the 200 feet of the Mk I at Jodrell Bank, and would be suitable for use down to the shortest wavelengths practicable except on high, dry mountain sites. The Council approved the proposal within a cost of £6M. Although it will be directed and managed by the University, it will remain SRC property. Finally, the replacement of the Central Processing Unit of the computer at the RSRS was approved at a cost of £250K.

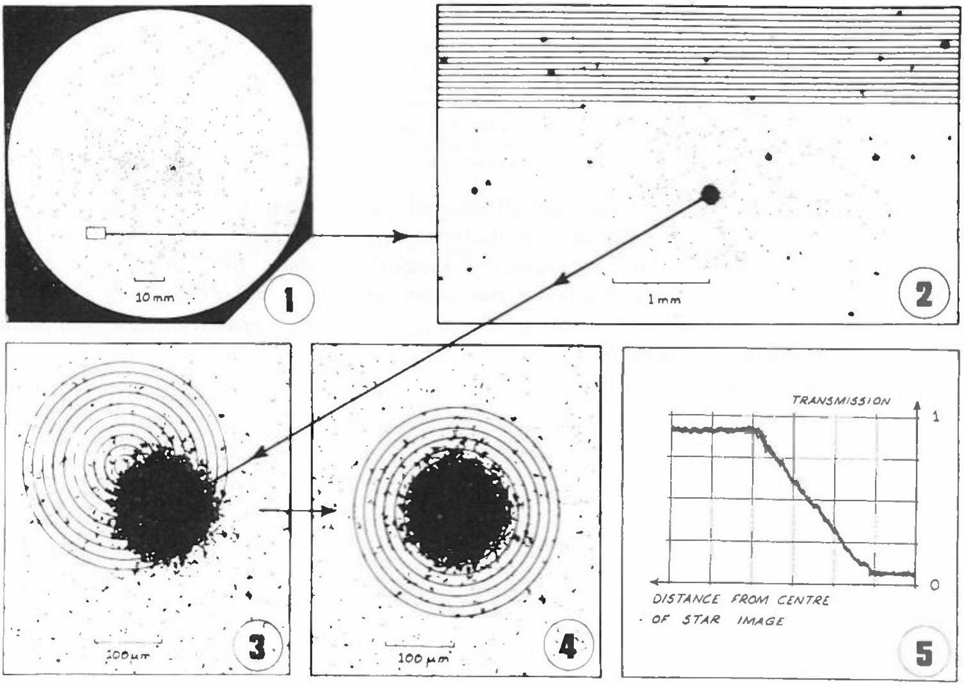
In February, there was a discussion of the basis upon which the next five-year forward look is to be prepared for full consideration in April, and of the preliminary indication of its probable lines, which has to be given to the Government beforehand. One considerable problem is the lack of definite information about the rate of the large university expansion which is certain to take place. As one important aspect of the forward look, the Engineering Board submitted a paper on its early progress with some of the questions that had led to its formation. Following the Council's expressed wish to give priority to its work, the Board has been studying the prospects for expansion, and has made plans for a 12% p.a. increase in expenditure, with about one-third being concentrated in selected centres.

Some further large grants recommended by the Engineering Board were approved by the Council: five grants totalling £375K for collaborative programmes in polymer science and technology, two totalling £320K for control engineering, one of £138K for microwave research at University College London, and one of £237K for work at Liverpool on phenomena in arc devices. The remaining items in February included a further report on the progress of development of a possible industrial productivity agreement, and the news that the new scheme of SRC fellowships, approved by the Council a year ago, had now been accepted by the Government and was being announced. The new fellowships are of higher value than the present ones, but fewer in number.

"Plus ça change, plus c'est la même chose."

We seek and explain and what do we find
Yet more to explain still leading us on
For ever and ever – or is it complete
At this moment of time. Consider and see,
Shapes are recurring, patterns repeat
Is it so simple – a life or a wheel
Showing us now what always will be?
We cannot tell – so still do we seek.
The answers elude us but maybe we know.

Nona



machine to match a telescope

N. M. Pratt

In the early 1930s, Bernard Schmidt, an Estonian optician designed the wide-field photographic telescope which bears his name. The instrument can photograph large areas of sky with nearly perfect definition of stellar images.

At the Royal Observatory Edinburgh there is a relatively small Schmidt telescope which can photograph, on a single glass plate, an area of sky four degrees or eight moon diameters across; a two minute exposure can record the relative positions and brightnesses of tens of thousands of stars. A second Schmidt camera is at the Observatory's Monte Porzio outstation (see R. J. Dodd's article on page 16).

The light from each star is focussed by the telescope to a spot with a diameter of about fifteen microns or half a thousandth of an inch and is then scattered and absorbed by the photographic emulsion. The brighter the star the further the light is spread out, so that when the plate is developed images of bright stars are larger clumps of photographic grains than those of fainter ones. Measuring the relative sizes of star images therefore gives a measure of relative brightnesses.

By comparing the brightnesses of the stars on plates taken through different colour-filters – ultraviolet, blue, yellow, red – temperatures of the stars can be deduced and at the same time effects of the obscuration caused by interstellar dust can be examined. By taking plates at different times, small changes in the positions of the stars on the sky can be detected and from these distances and motions of the stars in the galaxy can be derived. Combining measures of brightness and position, astronomers can study the history of the gas, dust and stars in space and time, in other words the evolution of the galaxy.

The invention of the Schmidt telescope presented astronomers with a particular challenge. The telescope could record the stars and nebulae in vast volumes of our galaxy in a few minutes, but how could the information be derived from the photographs? Manual measuring engines could cope with only a few thousand stars each day. A whole new concept in measuring engines was required – a machine which could measure completely automatically say, a thousand stars an hour with an accuracy of a micron in position and a quarter of a micron in size.

GALAXY

The fundamental concept of the 'General Automatic Luminosity And X Y measuring engine' – GALAXY – was due to Dr. P. B. Fellgett, now Professor of Cybernetics and Instrument Physics at Reading University. Four basic features were: a cathode ray tube to scan the photographic plate with a small spot of light; a precise mechanical carriage to hold and position the plate to better than a micron; a system developed by Ferranti Limited to measure the carriage position; and an electronic system, similar to a computer, to control the operations.

The pictures illustrate the operation of the GALAXY Measuring Machine at the Royal Observatory, Edinburgh.

1 is a photograph taken with the Schmidt Telescope, showing the stars as black images on the negative: a typical photograph contains 40,000 images. An area of the negative is selected for measurement.
2 shows the selected area enlarged. GALAXY searches for star images, using linear scanning.
3 shows a single star image greatly enlarged and the GALAXY scan of the image, using concentric circle scanning.
4 is the same star image which GALAXY has centred to measure its position to 1 micron.
5 is a drawing of the oscilloscope display on GALAXY, which measures the profile of the star image to a quarter of a micron.

Dr. Neil Pratt,

who wrote this article, is an Experimental Officer at ROE concerned with writing programmes for GALAXY.

The design and construction of the whole system was entrusted to the Scientific Instrument Control Department of Ferranti Limited, now Faul-Coradi Scotland Limited. In September 1965 a detailed design study was begun by the manufacturer working with Dr. V. C. Reddish of the Royal Observatory, Edinburgh. Based on the study, a contract was signed in August 1966 to construct the measuring machine – GALAXY – over three years. The mechanical system was constructed by Sogenique Limited and delivered in April 1967.

When GALAXY was first used to examine photographic plates, the operations of the machine were monitored on an oscilloscope display and the excitement was considerable when the first sequence of stars, from bright to faint, were seen to be detected and automatically measured. This was in March 1969.

As the weeks went by, the exact performance of the machine was assessed and improved, the output data being processed on the Elliott 4130 computer at the Royal Observatory Edinburgh.

The first major test was the accuracy of the XY carriage in measurement phase. The Edinburgh Schmidt plates are circular and so can be placed in the plateholder at any orientation. A set of about one hundred stars was measured at orientations of the plate separated by 30° through a complete revolution. The computer analysis on June 30 revealed that the accuracy in both X and Y was better than half a micron, two times better than the specifications.

The second test, in late August, was largely concerned with the search phase. A small area of one plate was searched and the search output measured as often as possible for one week. The performance was again satisfactory, and the machine was formally accepted in October. It was the first of its kind anywhere to bring complete automation to processes of optical astronomy.

Then GALAXY began to be used to measure sets of plates of parts of the galaxy in a search for newly formed and very young stars – stars less than about 30 million years old, newcomers on the galactic time scale of 10,000 million years.

discoveries in Perseus

For a Press Conference on January 20, when GALAXY was introduced, the measures and reductions of one plate through each of three colour filters had been completed. From these provisional completely automatic measures, 1103 stars younger than 28 million years were found in part of the constellation of Perseus where only about *15* were previously known. This is a striking example of the increase in astronomical knowledge made possible through the development of GALAXY, which gained front page headlines in the National Press.

GALAXY will soon be operating twenty-four hours a day, seven days a week on a growing series of varied astronomical programmes. Computer programmes to examine the GALAXY output of tens of thousands of stars on each Schmidt plate and to combine the measures of one star from several plates are being developed.

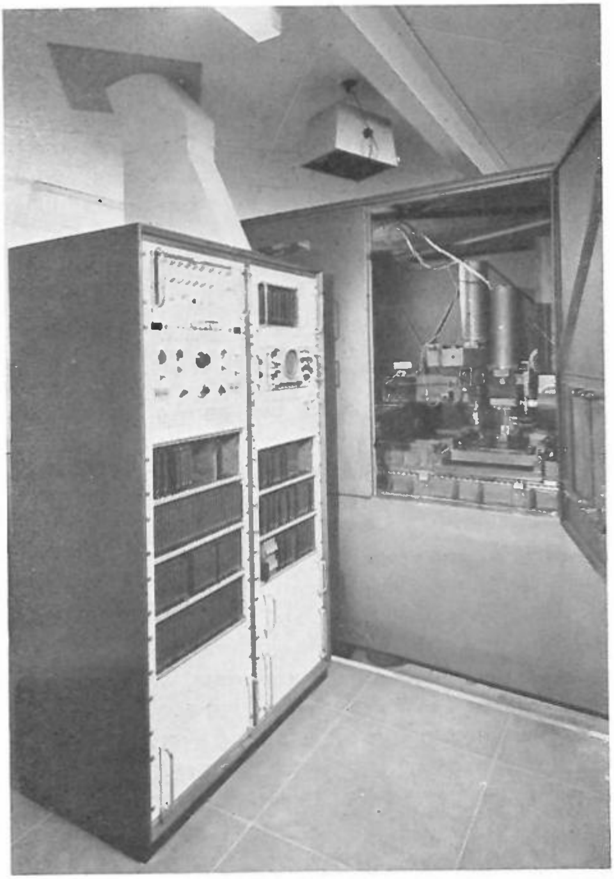
The machine, which weighs 3.6 tons, is mounted in a light-proof cabinet 8 ft. x 6 ft. x 7 ft. high. The heavy base casting supports a very accurate two-dimensional table on to which is clamped the plate-holder containing the Schmidt plate. A bridge casting over the carriage supports two parallel optical systems each with a micro-spot cathode ray tube as light source. The electronic circuitry and operating controls are contained in two racks, each 6ft. high.

One of the two optical systems, the Search Phase, projects a small spot of light, say 16 microns in diameter, along a linear scan in a raster pattern over specified areas of the plate. A photo-electric cell monitors the light transmitted through the plate and detects the reduction in brightness when the light spot falls on a star image. With the above resolution, 30 square millimetres are searched every minute, and up to ten thousand stars are found per hour and their approximate coordinates recorded on paper tape.

This paper tape is used as the control input for the second optical system, the Measurement Phase. The machine drives to the approximate coordinates of each star and scans the plate with a spot only one micron in diameter in a spiral pattern. If the star is not centred, a photo-electric cell monitoring the transmitted light detects more light coming through one side of the spiral than the other and generates signals to servos which move the carriage to centre the star in the spiral scan. The position is determined in units of a micron. At the same time the size of the image is being determined with the spiral scan, and the position and size of the star image are put on to paper tape. The next set of approximate coordinates are then read from the search tape and the carriage moves so that the next star image can be examined. This process is carried out on 900 stars an hour.

In addition to the programmes from Edinburgh, astronomers from the Royal Greenwich Observatory have used GALAXY, and there is an increasing number of enquiries from astronomers in both hemispheres. Investigators in other sciences have also shown great interest in the general system.

Soon, we hope, GALAXY will be providing answers to many astronomical problems which could never be tackled previously – and, no doubt, it will pose many more.



Photograph of GALAXY Measuring Machine at ROE constructed by Faul-Coradi Scotland Ltd.

physicist talks

The Chairman delivered a lecture to the Institution of Electrical Engineers on February 5, 1970. Here is a summary of the things Sir Brian had to say about 'Engineering and the SRC'.

Engineering must engage the most serious attention as an element of any advanced society. Its practice is technical and inventive, but it is not just these; it is an art embodying the deepest consideration of human, aesthetic, environmental, economic and social factors . . . Together with the UGC and the other Research Councils, the SRC is responsible for encouraging, and in a broad sense guiding, the research and postgraduate activities in science and technology in the universities, which in one way and another absorb most of our annual budget of over £40 million.

In 1962, concerned by the decline in Britain's share of international trade in engineering goods, and recognising that design 'is the very heart and origin of all engineering activity',[1] DSIR appointed the Feilden Committee to consider the present standing of mechanical engineering design and to recommend any changes which were likely to result in improved design of British products, including changes in education and training.

The Committee found evidence that the engineering industry largely failed to accommodate itself to the post-war development of the educational system, the shop floor remaining the main point of entry. On top of this, it attracted a lower proportion of the ablest school leavers than science because it had a lower social and economic status in Britain than in other highly industrialised countries. Research was the prestige activity, attracting the best scientific and technological brains.

Since 1960 there has been a steady rise of activity in engineering and the applied sciences under DSIR and, later, the SRC. In terms of research grants to Universities and technical colleges the current value of engineering grants first exceeded that of science grants (excluding 'big science') in 1966; it reached £11 million last year and continues to rise. By the creation of the Engineering Board in 1969 with its own indicative budget, considerable delegated powers, and wide terms of reference, we have for the first time in SRC set engineering on manifestly equal terms with science.

In the engineering field, subject reviews in depth have been made of electrical machinery, control engineering, electrochemistry and polymer science and others are in progress dealing with desalination, high temperature processing, transport and building science. Our reviews will normally be published so that there is an opportunity for public discussion before their recommendations are put into effect.

education for industry

Applied science in the abstract is all too often dull and unattractive; it is from the application that it derives its inspiration and excitement, and the applications are usually to be found in industry. The Board believes that increased collaboration on research projects between industry and the universities is necessary not only for the execution of the projects but also for the effect such collaboration has upon training of scientists and engineers.

Several new schemes for the awarding of post-graduate research and advanced course studentships have been introduced, designed to meet the needs of industry. Co-operative Awards in Pure Science (CAPS for short), operated by the Science Board, enable graduates working in pure science departments to undertake, in direct collaboration with industry, research of joint interest. Another scheme is the Award Scheme for Science in Industry and Schoolteaching (ASSIST for short), under which new graduates are given promises of SRC studentships to be taken up after one to five years spent in industry or schoolteaching.

some investments

Public attention was focussed on the social problem of noise in 1963 with publication of the 'Wilson Report'.[2] At that time the DSIR was giving increasing help to technology and awarded a major grant to Southampton University for work in the field of acoustics which helped to establish the newly-formed Institute of Sound and Vibration Research upon a firm footing. The Institute has grown rapidly and now commands considerable support from industry and the SRC for research into human problems of noise in vehicles and buildings, and the effects of noise and vibration on machinery and structures.

The SRC has invested over £½ million in the Cambridge control group which has enabled them to develop experiments based on real operating data from real industrial plants. The group has contributed to the control of a paper-mill during grade changes; it has completed a model of a hot steel strip rolling mill which is now being extended to include all operations from the output of the reheat furnace to the input of the coilers of an actual mill in order to get much improved temperature control urgently required to keep the metallurgical properties of the product within specification. It is also being consulted by industry on the control of once-through boilers required in the nuclear power field, and on the control of distillation columns in cascade.

High energy nuclear physics has had a direct impact on engineering through the problems of designing, operating and developing the great accelerators and associated experimental equipment. Engineers and physicists at the Rutherford and Daresbury Nuclear Physics Laboratories, and industrial firms which have provided the equipment, have played their part in this.

Anglo-French link

Following failures of large pulsed motor-alternator sets at the Rutherford Laboratory and at other high energy laboratories overseas (and these failures provided new information on fretting and fatigue in such structures) Rutherford Laboratory engineers studied a static power supply system which would dispense with rotating machinery altogether. As part of this programme, 160 MW pulse tests were conducted between CEGB and Electricité de France using the submarine DC link between the two national systems and the results were analysed at the Atlas Computer Laboratory. Not only did these tests demonstrate the feasibility of the static power supply when coupled to a suitably massive public network, but they provided valuable information about the dynamic behaviour of the two national electricity systems.

Perhaps the most interesting interaction with industry in radio astronomy is in respect of the large steerable dishes. Initially dishes were developed for radar and then used for radio astronomy. The development of the Mark I radio telescope at Jodrell Bank and the design of further large steerable paraboloids, led to one of the designs being adopted for satellite communication at the Goonhilly station. The story continues by the adoption for Sir Martin Ryle's new 5 Km telescope at Cambridge of eight of the dishes developed for satellite communication work.

We are anxious that more collaborative projects should be proposed and we are willing, even more than in the past, to support those aspects undertaken by the universities even if the work itself takes place in industrial laboratories . . . However, I am not sure that industry is yet sufficiently aware of the possibilities open to them for such collaboration. I therefore draw your attention to it today.

[1] Wallace, P. J. *The Engineer*, 19 April 1963.

[2] Cmnd 2056

enzymes

J. A. Feather

Man has been putting enzymes to work on his behalf since he first brewed beer, fermented grape juice to make wine, or converted milk according to local taste into cheese or yoghurt. These processes have, of course, been known for a very long time but it is only in the last hundred years that the part which enzymes play in them has been understood. The fermenting agents used were simple organisms such as yeasts and bacteria in which they occurred naturally. The word 'enzyme' comes from Greek roots meaning simply 'in yeast'.

Enzymes of one kind or another are in fact found in all forms of living matter. They are essentially proteins and their function is to control the complex sequences of chemical reactions on which life depends. They act as catalysts causing the biochemical processes to occur rapidly and efficiently but remaining unchanged themselves at the end of the reaction.

The ease with which enzymes can bring about chemical reactions is one of the main reasons for the current interest in them. Not only do enzyme-catalysed reactions take place rapidly and under very mild conditions (in contrast to the high temperatures, pressures and extremes of acidity or alkalinity often used for industrial chemical processes) but they are highly specific. That is to say, a particular enzyme often acts as a catalyst for a single reaction of just one chemical compound. The result can be a complete absence of the by-products produced, almost inevitably, when a reaction is made to occur by ordinary chemical means.

One of the long-term aims of enzyme research is to gain understanding of how these molecules behave as catalysts to a level sufficient to enable synthetic substances, with similar properties, to be tailor-made to catalyse specific reactions of industrial importance. A major short term aim is to find ways of using naturally occurring enzymes industrially. Since pure enzymes are expensive it is uneconomic to use them once and throw them away. This is likely to be the result if they are used to bring about a reaction by simply dissolving them in the solution containing the materials due to react, because the very small amounts of enzyme required cannot be extracted from the solution at the end and will be lost. The answer is to attach the enzyme to some insoluble material such as a natural or synthetic polymer. An additional advantage is that the 'insolubilised' enzyme is often found to be more stable than the free substance in solution. It is therefore less likely to have its catalytic activity destroyed by heating, for example, and is usable for longer periods and at higher temperatures.

These are only a few aspects of enzyme chemistry. It is a subject of great potential importance and in 1969 it was selected by the Council as an area of science worthy of special encouragement. The Enzyme Chemistry and Technology Committee (now a committee of the Science Board), which was subsequently established to further research in this field, has already made a number of substantial awards.

One of the first awards was a grant of £200,000 over five years to Dr. M. D. Lilly and Dr. P. Dunnill of the Chemical Engineering Department at University College, London, for a programme of research on enzyme technology. They describe this project in the following article.

[Dr. John Feather (SSO) is Secretary of the enzyme chemistry and technology committee at London office.]

enzyme technology

Enzyme technology has two immediate aims. The first is to improve methods of preparation so that relatively large amounts of a wide range of enzymic proteins can be made available for detailed studies. These will lead to a better understanding of enzymes and their role as catalysts in living systems, which will have important implications for biochemistry and, in the long term, for medicine.

They will also open up the possibility of preparing more enzymes synthetically, and should lead to a sufficient understanding of the mechanism of enzyme action to permit the construction of artificial enzymes.

The second aim is directed to the more immediate application of enzymes as catalysts. If natural enzymes can be prepared economically on a large scale and can be converted into a form suitable for incorporation in a chemical reactor, they can play a much greater rôle than they do at present as industrial catalysts. Previous processes employing enzymes used whole organisms, cell extracts or enzymes secreted by cells in free solution. The new technology seeks to use purified intra-cellular enzymes catalysing a wide range of reactions and aims to justify the higher isolation costs by retaining active enzymes in the reactor system for much longer periods.

When the enzyme technology programme at University College London began, six years ago, it had two goals. The first was to enlarge the scale and scope of insolubilised enzyme reactors then under examination and the second to make available several trace enzymes for x-ray crystallographic study. Since then requests for help in isolating enzymes from various sources, industrial interest, and a realisation of the lack of basic data in this area of biochemical engineering have all helped to stimulate the growth of an inter-disciplinary team of chemical engineers, biochemists, microbiologists and chemists, with a broad range of interests. The part of the current research programme supported by the Council centres on three main themes – continuous enzyme isolation, simultaneous enzyme isolation, and insolubilised-enzyme reactors.

large-scale isolation

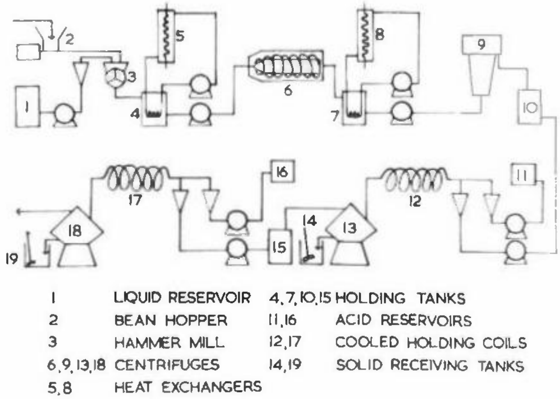
Experience in the first few years of the enzyme project indicated that the scaling up of a batchwise isolation procedure often involved losses in enzyme yield and activity. Many enzymes are particularly susceptible to damage and degradation in the early stages of fractionation and the losses were found to be due to the longer process times required on the larger scale. Moreover it became clear that the extension of batchwise procedures towards an industrial scale of operation would involve the use of increasingly massive and clumsy apparatus. A solution to similar problems in the chemical industry is to convert individual stages or, better still, the whole process to continuous operation. To find out if this approach would work with enzymes we chose two enzyme isolations, one from plant tissue, and one from microbial cells, for preliminary study.

The layout of equipment used for these two continuous isolation processes is illustrated in *figures one and two*. The isolation from plant tissue required the extraction of the enzyme from the tissue, the removal of cell debris, and two stages of acid precipitation; each of these was carried through continuously in the system illustrated. The yield and specific activity of enzyme produced were increased 50-fold and 16-fold respectively, compared with batch operation at the same scale. The isolation from microbial cells required continuous disruption of cells, streptomycin precipitation of nucleic acids and two stages of polyethylene glycol precipitation.

Of importance in relation to the continuous isolation of microbial enzymes is the fact that considerably elevated levels of some enzymes can be obtained by continuous culture. The test system was one which showed this phenomenon. In such instances the coupling of large scale continuous fermentation and continuous isolation is especially profitable. Each of the products of these processes required more purification and while the microbial amidase was purified further at the time by continuous electrophoresis, a continuous chromatographic operation was desirable. No commercial machine suitable for the purpose existed and a new machine is now being constructed with the support of the NRDC.

These preliminary experiments showed that the approach was promising but equally that the knowledge of individual operations was inadequate in chemical engineering terms. We therefore began detailed studies of operations such as continuous cell disruption and continuous precipitation with a view to providing fundamental data. The study on cell disruption is well advanced and suggests that it will be possible to define the operation in precise mathematical terms.

Another reason for making a detailed study of such operations is that a number of them are widely applicable in the biological industries. A study of the disruption of micro-organisms to release enzymes is also relevant to the release of protein from cells and hence to the economic feasibility of obtaining food proteins from single cell material grown on



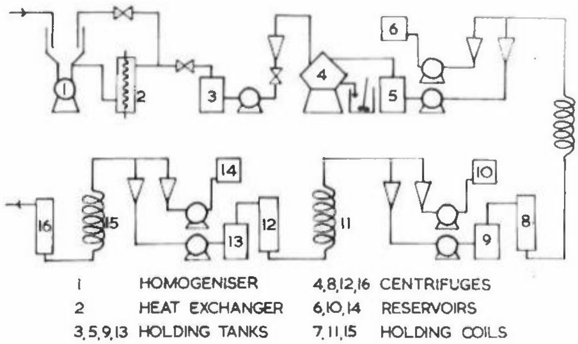
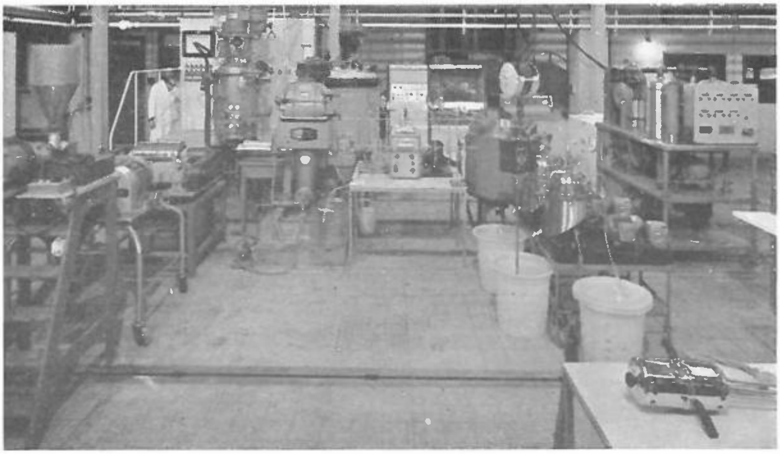


figure 1 (top) **Isolation of Prolyl tRNA Synthesase enzyme from Phaseolus Aureus (Mung Bean)**
The beans are fed continuously to a grinder (3) with extraction liquor. Cell debris is removed continuously in a centrifuge (6) and after final traces of solid have been removed in a second centrifuge (9) the liquor is pumped to meet a stream of acid from reservoir (11). The first acid precipitate is removed continuously in a centrifuge (13) and the acid precipitation is repeated.

figure 2 **Isolation of an Aliphatic Amidase from Pseudomonas Aeruginosa**
Continuously harvested cells from a fermenter (not shown) are pumped to a homogeniser (1) where they are disrupted. Cell debris is continuously removed in a centrifuge (4). In three identical continuous stages the liquor is then subjected to the action of streptomycin (6) and polyethylene glycol (10) & (14). The precipitates are removed in centrifuges (8), (12), (16).



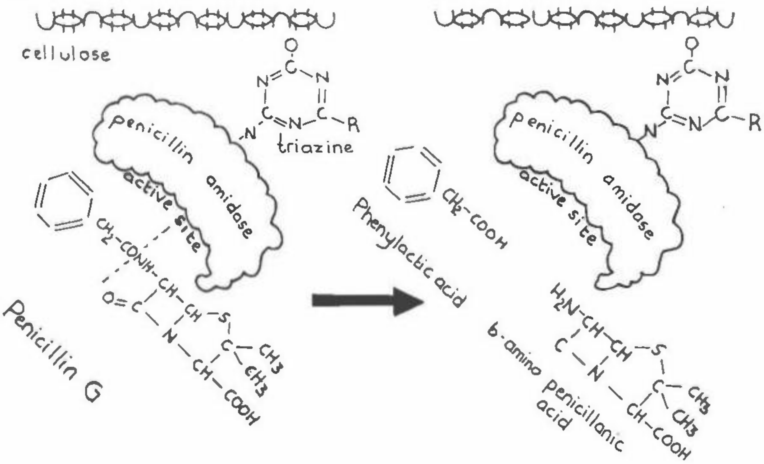


figure 3 **Enzyme Isolation Pilot Plant at University College London**

figure 4 **Action of Penicillin Amidase enzyme on Penicillin G**
Diagramatic representation of the enzyme deletion of the original side-chain of penicillin G in an immobilised enzyme reactor.

hydrocarbon (petroleum or natural gas) or carbohydrate. The special problems of continuous large scale solid/liquid separation of protein precipitates have very close analogies in the food industries and the mechanism of precipitation of proteins especially in relation to continuous operation is being followed with interest since few detailed studies have been made in these industries. It is important to us that there should be close interactions of this kind with other aspects of biochemical engineering because our research goes hand in hand with a teaching programme on all aspects of Biochemical Engineering and it would be unfortunate if it became too biased towards one area. Also, there is a danger that in an effort to give enzyme technology the emphasis the SRC believes it needs, other areas of biochemical technology and engineering could be down-graded.

The second principal theme in our fundamental studies concerns the simultaneous isolation of a number of different enzymes from a single mass of tissue. In the laboratory it is usual to isolate at one time only one, or at the very most a very few, of the thousand or so intracellular enzymes (that is, enzymes found inside cells) and to discard the remainder as purification proceeds. The same thing happens when enzymes are manufactured on an industrial scale. The protein-dissolving enzymes used in detergents are separated from the cells which produce them and the cells are discarded. (The separation is relatively simple in this case because the enzymes are secreted by the cells which do not, therefore, have to be broken up to release them.) When intracellular enzymes are made industrially – invertase, for example, which is used to convert cane-sugar (sucrose) into invert sugar (a mixture of equal amounts of glucose and fructose) – the process is controlled so as to optimise the yield of a single product.

In some instances this policy will remain the best, such as when a particular enzyme can be stimulated to a high level within the cell. However, this is not often possible, and even when it is there may be economic advantages in using the waste tissue as a source of other enzymes. Their recovery may be more attractive commercially if a number can be isolated simultaneously. The costs will certainly not decline in direct proportion to the number of enzymes simultaneously isolated, but the approach may be valuable in some circumstances, just as continuous isolation coupled to continuous culture may be in others.

As with continuous isolation we have chosen several systems on which to test the concept of simultaneous isolation. With Bakers' Yeast we are beginning to examine the isolation of a number of enzymes of possible economic importance. Another system, *Escherichia coli*, is perhaps the micro-organism which has been studied in most detail, biochemically and genetically. The enzymes from this bacterium are therefore in great demand for detailed physico-chemical study.

For our work, we have chosen a group of enzymes, the aminoacyl-tRNA synthetases, which are of particular interest to molecular biologists, in view of their central involvement in protein biosynthesis. The project will have the useful second aim of providing material for study by the team at the Cambridge MRC laboratory with whom we are collaborating. This group of enzymes is also a logical choice for purely operational reasons in that the assays for the 20 enzymes of the group are closely related and therefore particularly amenable to automation. Automatic assaying will be essential for any process which must keep track of a large number of different products.

handling problems

The last material we plan to employ as a test material for simultaneous isolation is human tissue. A joint project with the Department of Human Genetics at University College, on the isolation of enzymes from red blood cells, made us aware of the difficulty of obtaining human enzymes for detailed study and it seemed probable that, in view of the scarcity of human tissue, simultaneous isolation would be of interest here. Feasibility studies are now in progress with placentae, but a major obstacle in the large scale processing of any human tissue is the occasional presence of viruses.

This is an acute example of one feature of large-scale isolation of enzymes – the need to take bio-safety very seriously. We are fortunate in having the collaboration of the staff of the London School of Hygiene and Tropical Medicine in establishing a programme of environmental hygiene and personnel screening for our laboratory.

The third, and in many ways the culminative theme, of the study concerns insolubilised enzyme reactors. As already indicated, to be really useful and industrially economic, enzymes should be retained in some manner and if possible stabilised. Laboratory studies of the immobilisation of enzymes have been proceeding for over fifty years but only in the last decade have reasonably well defined systems been prepared. Three from among those prepared at University College will serve as examples of the state of knowledge and the potential interest of insolubilised enzymes. **Penicillin amidase** is crucial in the synthesis of the newer semi-synthetic penicillins. It removes the benzyl side-chain of the old penicillin to permit the addition of a new synthetic side-chain *(see figure four)*. At present a whole organism containing the enzyme is used but more effective control and continuous operation would be possible with an insolubilised enzyme reactor. The insolubilised enzyme retains full activity at 37°C for 11 weeks compared with a loss of activity by the free enzyme of 65% in 3 days. **Amyloglucosidase**, is employed industrially in the soluble form to convert starch to a syrup containing a high proportion of glucose. The insolubilised enzyme acts effectively on viscous solutions and retains full activity for 100 hours at 55°C. Again closer control and continuous operation would be possible using a fixed enzyme reactor. Finally, insolubilised **β-galactosidase** has been used to bring about the continuous conversion of lactose to glucose and galactose. The process may become industrially important as a means of producing, from the large amounts of lactose obtained as a by-product in butter and cheese manufacture the more useful sugar glucose.

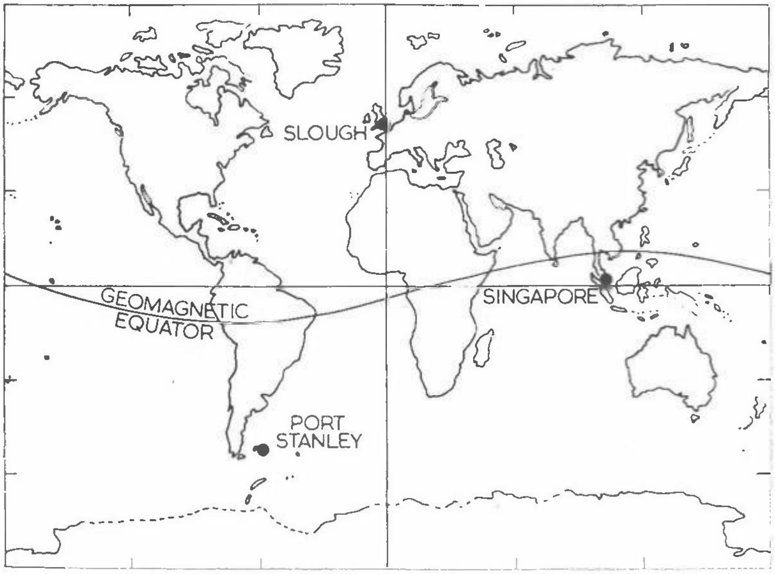
In each of these studies laboratory or small pilot-scale projects have been completed. The next phase with single enzyme reactors is concerned with establishing their effectiveness in industrial pilot-scale operation and where necessary modifying the support material and associated systems to take account of practical problems such as blockage by suspended solids, microbial spoilage and poisoning by metals. As in the case of large-scale enzyme isolation, there is a dearth of basic biochemical engineering data on these aspects which must be patiently remedied. This part of the programme is also supported by industry and by the NRDC.

The next phase of fundamental research will concern reactors employing more than one insolubilised enzyme. There is no reason why some of Nature's bio-synthetic pathways should not be emulated but perhaps more interesting is the possibility of combining enzymes in new ways. A start has been made on multi-enzyme systems with a reactor containing two enzymes (pyruvate kinase and lactate dehydrogenase) each enzyme being attached for convenience to a separate sheet of cellulose.

Some processes involving insolubilised enzymes have already gone beyond the laboratory stage. A Japanese company is using a insolubilised enzyme reactor to produce twenty tons a month of L-amino acids, which are added to cereals to improve the quality of their protein. In the US drug industry antibiotic and steroid conversions are being undertaken with similar reactors.

So the age of enzyme reactor technology has begun. Against this background, the development of British enzyme technology is a matter of some urgency.

quest abroad



Since the work of the Science Research Council is by no means confined to the United Kingdom, news and pictures from overseas have been collected for the following pages.

To begin – the pictures on this page show RSRS stations around the World which also, of course, have connections beyond the World – into outer space.

far east

the Ionospheric Observatory at the Singapore outstation of RSRS, which also includes a satellite data acquisition station.

far west

the satellite telemetry receiving station operated by RSRS on behalf of the European Space Research Organisation which is one of the RSRS installations at Stanley, Falkland Islands.

guest column

Mr. S. F. Bailey who is Secretary to the University Grants Committee of Hong Kong was formerly a member of SRC finance division. In this report from Hong Kong it appears that he is not the only SRC contribution to a research grants programme that is, as yet, barely under way.

beyond chinese

There are two universities in Hong Kong: the older one is the University of Hong Kong, which was established in 1911 on the foundation of the Hong Kong College of Medicine, which goes back to 1887: and the other is the Chinese University of Hong Kong which was established in 1963 on the basis of three existing colleges – Chung Chi College, New Asia College and United College. Both universities are still very small: in 1969/70 the University of Hong Kong had 2,816 students and the Chinese University of Hong Kong 2,215. By 1973/74 these figures are expected to rise to 3,130 for the University of Hong Kong and to 2,870 at the Chinese University of Hong Kong.

The total population of Hong Kong is now about four million of whom approximately 56% are under 25 years old: and the university population is therefore indeed a small one – admissions are about 12% of secondary school leavers and only about 0.5% of the age group 18 to 21.

In theory the two universities serve slightly different purposes which, again in theory, arise from a doubled secondary school system. On the one hand there is the Chinese Middle School system, adopted from the mainland system in which, naturally, Chinese is the language of instruction (and in which, incidentally, there is only one year of Form VI). A large majority of all students is Cantonese-speaking: and not all understand Mandarin well enough, in which, at least at the Chinese University, much of the instruction actually given in Chinese is likely to be. Moreover the supply of University standard teachers who speak Mandarin or Cantonese is limited: and in practice a great deal – probably more than half – of the CUHK teaching is in English. At the same time in theory all, and in practice a majority, of the students at CUHK have gone to the end of their secondary school with Chinese as the language of instruction: and this imposes a considerable burden of English teaching right across the University for the first two years (the basic course at The Chinese University of Hong Kong is four years). The fact that a similar across-the-board teaching of Chinese for the first year is also necessary is perhaps significant.

On the other hand there is the Anglo-Chinese secondary system in which the medium of instruction is English, and this is actually the larger of the two school systems. The University of Hong Kong also uses English as its medium of instruction and the whole of its intake comes from this system. Even so the general standard of English is often inadequate and this University also has to do a great deal of English teaching across its first year (the basic course here is three years).

In strict theory the reverse was supposed to apply too i.e. school leavers from the Anglo-Chinese system went only to the University of Hong Kong. This no longer applies and many Anglo-Chinese school leavers now go to The Chinese University of Hong Kong – in this year roughly 30% of their intake did so.

a few faculties

With such a secondary system and what seems to be less than satisfactory English teaching: with no serious possibility of clearing the tertiary level wholly in Chinese (either Cantonese or Mandarin) and with one University wholly, and the other heavily, committed to teaching in English: then clearly University problems here have a slightly different aspect before so much as looking at standards, courses, academic policies, research or anything else.

The Chinese University has only three Faculties – Arts, Science and Commerce and Social Science. Its campus is still being built. For the moment it has no proper central teaching accommodation and uses college accommodation, all of which is in varying degrees inadequate. Worst of all it has no central science laboratories. The University of Hong Kong has five Faculties – Arts, Social Science (which includes a new Law Department), Science, Engineering and Architecture, and Medicine. The three Engineering Departments (Electrical, Mechanical and Civil) are not as well equipped as they might be, but are improving their position as rapidly as funds allow. The Science Departments are fairly well equipped and set very respectable undergraduate standards. The Medical School is a good one and relatively large, with an intake of 120 undergraduate students per year, which will rise to 150 per year in October 1970.

Both Universities are almost wholly undergraduate institutions. In 1968/69 they had between them only 62 post-graduate Science students and 17 in Engineering. This is not for lack of good teachers or of able students. The trouble is there is no separate organisation other than the University Grants Committee with a commitment to post-graduate work: and the University Grants Committee, although far from indifferent to post-graduate problems, has naturally had to concentrate on the main tasks of assisting both Universities to develop and actually getting the new Chinese University built. We have no Social Science Research Council, no Agricultural Research Council, no Medical Research Council, no Natural Environment Research Council and no Science Research Council, not even the equivalent of a Department of Scientific and Industrial Research. Moreover the University Grants Committee system in Hong Kong is not a weighted one and for all purposes – including equipment – a post-graduate student counts as *one* alongside an undergraduate student. Even if Hong Kong were not a comparatively old-fashioned laissez-faire society (which it is) the advocates of research would therefore have an uphill job no matter how orientated the research might be.

help from Atlas

Perhaps the most remarkable thing is that any gets done at all: but nevertheless some *is* done. None of it constitutes anything like a major programme, and perhaps such a programme would in any case be premature in Hong Kong. Quite the most interesting scheme has nothing to do directly with research although it will certainly radically affect further prospects. This is the development of a Joint Universities Central Computer project (just approved) under which the two Universities will jointly own and operate a central computer, with remote controls and displays at each University. A good deal of helpful advice on this has come from the U.K. University Computer Board and from Dr. Howlett of the Atlas Laboratory. The machine will be a middle-range type, roughly equivalent to a CDC 3300.

A third set of remote controls has been reserved for a Polytechnic now under planning and scheduled to have an intake of 4000 day-time students in 1973/74 (I should perhaps explain that in addition to being Secretary to the University Grants Committee I am also a Member and Secretary of the Polytechnic Planning Committee.) Both Universities already have small machines – the University of Hong Kong an IBM 1620 and The Chinese University of Hong Kong an IBM 1130 – and the joint central facility should enable them to tackle a range of work which at the moment is out of the question.

The total number of post-graduate students at the two Universities, including 39 in the two Schools of Education, is 224 or approximately 4.4% of the student body: and only 1.6% of the student body are in Science and Technology. It seems a small allowance for a country which has no physical resources and is wholly dependent on its people. But – and it is a large 'but' – there is no organisation with a primary commitment to post-graduate and research work. The University Grants Committee of Hong Kong has its primary commitment to the development of the Universities as a whole and it is heavily, although by no means exclusively, concerned with undergraduate development.

a brighter prospect

Hong Kong is a colony and, legally, entirely dependent on the UK. In, for example, such matters as air-transport, it counts as part of the UK: and it would be nice if in addition it counted as part of the UK for SRC grants. This is perhaps a bit unrealistic: Britain has other and more pressing demands on her resources, and Hong Kong is in monetary terms comparatively well off. The interesting question is not whether SRC can provide research grants, but whether Hong Kong by its own efforts can adapt the general education system better to twentieth century purposes. This is not just a matter of the Director of Education leaping into action but of a large number of people coming to recognise, however vaguely, that something needs changing: and that not all the old ways are going to work for ever.

It may be that the principle lever for change will (as some expect) be the development of the proposed Polytechnic. If the present time-table is maintained it will in three years increase the numbers in higher education (consisting at the moment of students at the two Universities plus a small Technical College) from the present target for 1973/74 of 7,500 to 10,000. This may not sound very much: but it can hardly fail to highlight problem areas at the secondary level.

How well, or how far, this will work out remains to be seen. It should be possible to appoint a Director of the Polytechnic within the next five or six months: and some of the pattern should begin to appear in about twelve months' time. If so it might justify another, and perhaps more exciting, report from Hong Kong.

quest abroad–south

W. M. Burton

above is the Royal Observatory at the Cape of Good Hope which will be celebrating its 150th anniversary later this year.

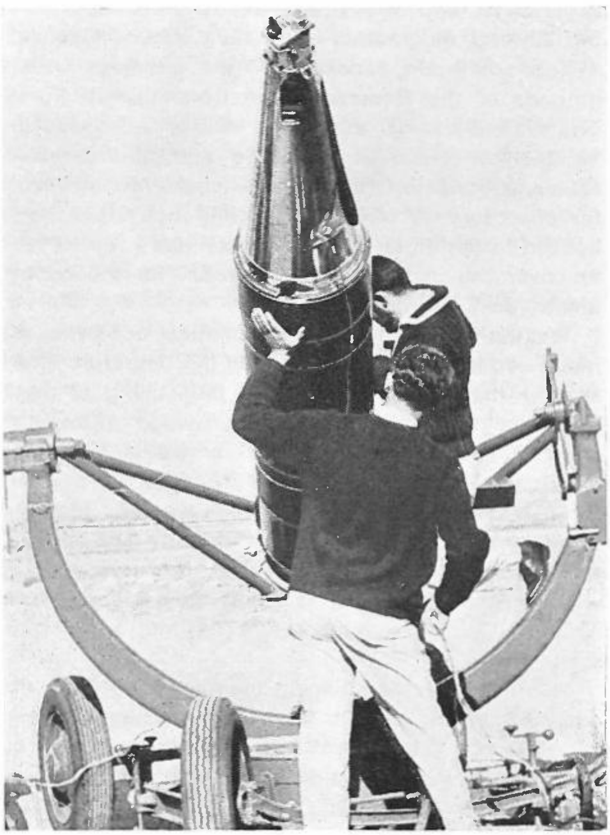
below is a Skylark rocket payload under pre-flight tests at the Woomera range (photo 1964).

In South Australia staff from several SRC laboratories are working on the Woomera range preparing experiment payloads for 'Skylark' rockets.

The present launch campaign extends from March to April 1970 and seven rockets are scheduled to go up. They will carry payloads prepared by SRC groups working at the Astrophysics Research Unit, Culham Laboratory and at the Royal Observatory, Edinburgh as well as experiments from the Meteorological Office and the Space Research Groups of Leicester University and University College, London.

Each year there are three separate launch campaigns, when a series of Skylark rockets are fired during a two month period. SRC controls and plans the research programme, while the British Aircraft Corporation is responsible for firing the rockets from the Woomera Range.

Several of the rockets will carry very complex payloads which separate from the rocket motor when all of the solid fuel propellent has been burnt and then become stabilized in space, pointing very accurately towards the sun or the moon as the particular experiment requires. A typical Skylark payload reaches an altitude of 120 miles and this allows the experimenter just about three minutes of precious observing time in which to study the universe undisturbed by the effects of the earth's atmosphere – a very short time in comparison with the years required before to prepare the experiment and afterwards to analyse all of the data obtained.



quest abroad

they haven't kept us out of Europe

Besides contributing to CERN nuclear research at Geneva and ESRO space research at Kiruna, Sweden, SRC has selected some pleasant spots for astronomy. They are reported on in the two articles which follow.

resort to Italy

R. J. Dodd

Richard Dodd is the Scientific Officer in charge of the Schmidt telescope at the Monte Porzio outstation of ROE shown above.

The Monte Porzio outstation of the Royal Observatory Edinburgh lies some fifteen miles south east of Rome at an altitude of 1,200 ft. in the Alban Hills. To the south of the observatory one looks towards the vine, olive and pine covered hillside of Tusculum, an ancient Etruscan settlement. The plain of Rome lies northwards, and to east and west are the foothills of the Abruzzi mountains, and the Mediterranean sea.

The outstation consists of two buildings in the grounds of the Osservatorio Astronomico di Roma. The main building, a circular structure, houses the 16/24 inch Schmidt telescope and offices, store-rooms, a workshop, rest room, kitchen and bathrooms for observers. A Michelson stellar interferometer is housed in the other building, which has a run-off roof to cover the instrument and a room for the control electronics.

Weather conditions for astronomical observing are much better in Monte Porzio than in Edinburgh. There are far more clear nights and the seeing is much better at the Italian outstation, which allows for shorter exposures. Also the more southerly latitude of Monte Porzio means that observing is possible throughout the year. The climate is typically Mediterranean with hot dry summers and warm wet winters, though snow in the Alban Hills is not uncommon in winter. Most observing is done during spring and summer when the temperature permits working in shirt sleeves.

There are three permanent members of staff at the outstation. From time to time they are supplemented by observers sent from ROE and occasionally by research students from the Astronomy Department of Edinburgh University.

The Schmidt telescope is used both for direct photography and for studies of stellar spectra; a great variety of observing programmes are currently being carried out with it. The quasar 3C 345 has been monitored with a view to finding periodicities in its light emission, the observations being processed with the Elliott 4130 computer at the Royal Observatory in Edinburgh. Some evidence of quasi-periodic outbursts has been obtained. Clusters of very young, hot stars have been photographed with different combinations of filters and photographic emulsions. It has been found that such clusters are often surrounded by dense shells of dust or smoke, which may be primordial material expelled from the cluster by pressure of radiation from the stars.

Work in the near infra-red is also carried out. A topic of particular interest has been a near-infra-red survey of red giant and carbon stars in part of the constellation Cygnus. This was a joint effort with the Rome Observatory and made use both of our own Schmidt camera and of a second Schmidt telescope at Camp Imperatore in the Abruzzi. The results will be published soon.

The Michelson interferometer is an instrument with a base line of two metres for observations of the pole star. It will be used to test methods of measuring, electronically, the 'seeing' spectrum that is the quality of a star's image after it has passed through the atmosphere. Binary star observations are to be made after the initial seeing experiments are completed and when the instrument has been mounted on an altazimuth. These will yield new data on the orbits and masses of such stars.

spain under the stars

When I first started astronomy I never thought that one day I would find myself walking across a mountain snowfield to work a telescope belonging to the Society of Jesus, but since June 1968 the RGO has had regular use of such a telescope in the Sierra Nevada in Spain.

The 12" telescope is in a small building at a height of 8,700 feet some twenty miles from, and over a mile above, Granada. Observations are made with a photometer attached to the end of the telescope, so, with the aid of a set of colour filters, the magnitudes and colours of various celestial objects can be determined. This type of work needs very clear skies, for accuracies of the order of less than 1% are required and even very thin cloud can prevent this. Conditions in Britain are not at all good for photometry and it is hoped that a British observatory will be established, probably near the Mediterranean, where it will be a feasible proposition. In the meantime the Sierra Nevada site is being given a thorough test in the course of a programme of photometric observations.

The Sierra Nevada Observatory came into being a few years ago when the Observatory, a Jesuit institution, at the University of Cartuja, Granada, decided to take advantage of the road up from Granada to the Pic de Valeta in the Sierra, which was being extended. This road reaches 10,400 feet at the top.

The building, consisting of five rooms for living and working and the dome itself, was built near the road and within reach of a very isolated hotel. The telescope was a gift from Georgetown University in Washington, D.C., and was shipped by the US Navy as part of its goodwill programme. By an agreement between the Astronomer Royal and the Jesuits, the RGO has helped in the provision of electric power and other facilities, in return for time at the telescope.

As most photometry can only be done with a dark sky, there are only about seventeen days around new moon which can be used each month. This has shaped the present observing system whereby two observers go out to Spain for these days. Flying to Malaga, one drives the hundred miles to the Sierra, to stay at the hotel near the telescope. Then each clear evening, or as soon as the sky becomes clear, one goes to the Dome. In summer, the trip from the hotel is a car drive along the road and a walk of 100 feet upwards to the building itself. At 9,000 feet this is tiring.

In winter the whole area is thick with snow. This means donning army arctic clothing, including long woolly coms and hooded windjacket trimmed with wolverine fur, plus ski boots and crampons, then checking torch, compass and whistle and the snow goggles for the morning. The route is a dark, cold and tiring climb, which takes over half an hour and rises 500 feet. Night time temperatures can drop as low as –20°C, and a major problem is the freezing of the rotatable dome. When this happens the snow and ice is cleared from the skirt of the dome by climbing out on to a catwalk and hacking away with an ice axe.

At the dome observations are made until dawn or until clouds arrive. The preliminary reductions from the pen recorder output from the photometer are sometimes made during the day. But clear skies mean working all night and, especially in the summer, night after night. Sleeping and resting then become the main priorities.

Both the preliminary and the final computer reductions to provide magnitudes and colours are made at Herstmonceux. Work has been done already on variable stars, Kapteyn Selected Areas, the establishment of standards, a systematic survey of some nearby stars, and other subjects.

There are horror stories of belongings sliding over the precipices, people being marooned by bad weather, 'gyppy tummy' and trying to obtain equipment in Granada at temperatures of over 100°. But these are offset by the pleasure in actually doing photometry, such a rare occurrence in England, a nice climate, an interesting country and a holiday afterwards in Spain or North Africa.

Picture above shows the Sierra Nevada Observatory in winter.
The picture on right is A. J. Penny, a Scientific Officer at RGO, who wrote the article from on the spot.

people and their pastimes

Les Mitchell RSRS

In the last issue of Quest the story of Dave Boffin told how a radio amateur could progress from a bed-spring to a sixty foot tower. Now we tell how Les Mitchell uses the same activity to extend another; and include some suggestions on how to get 'tuned in' to this world wide network.

Les Mitchell with G3 EKL and two local scouts at Blandford Camp in Dorset.

'CQ Jamboree! CQ Jamboree! . . .'

The first time that call came over the radio made a day to remember for Les Mitchell. This special call sign of Jamboree-on-the-air, known as JOTA, was first heard eleven years ago.

Les Mitchell works on the office services side of the Radio and Space Research Station. He has not been 'on the air' there but he spends two hours every Saturday morning as a radio amateur, transmitting and receiving calls from his home on equipment he has built for himself over some years. The first hour is spent on messages for the boy scout movement in the British Isles and the second for Scouts in Europe.

war and friendship

During the war, Les Mitchell was a radio mechanic in the Fleet Air Arm of the Royal Navy, stationed at Lee-on-Solent. His interest in radio began there and the recommencement of post war amateur transmitting was a strong attraction, which led him to become a qualified operator. At the same time Les had continued to run a boy scout troop throughout the war and when posted to USA, in 1942–43, he became an assistant scoutmaster in Brunswick, Maine, and in 1945–46 he ran a troop in Sydney, Australia. He had always regarded the world scout movement as a valuable contribution to international friendship. It seemed especially important in war time.

In the next ten years Les was an active radio amateur while equally active in his support of scouting – becoming District Commissioner of Scouts in the late 1950's. He introduced radio as an activity for his own scouts and ran several 'radio' camps at Reading. Then in 1957, at the World Jamboree held at Sutton Coldfield, he helped to set up a field radio station to contact some of the millions of scouts who could not travel to the jamboree.

This experiment raised such great enthusiasm that Les decided to try a jamboree 'on the air' and in May 1958, as Honorary Organiser, he ran the first one. So many scouts joined in that it was decided to make it into an annual scouting activity to supplement the meetings of the World Jamboree which are only held every four years. Organisation on an international level was passed to the Boy Scouts World Bureau (in Geneva) and Les continued to be National Organiser for Great Britain.

In this country there are about 8,000 licensed radio amateurs. Many are pleased to show their equipment to visitors or cooperate with organisations to provide transmitting facilities. Only licensed radio amateurs may make transmissions or speak through the microphone – to get a licence one has to pass a City and Guilds Technical Examination and the GPO morse code test. At this point you are given a call sign – CQ G3 BHK identifies Les. No technical qualifications are needed to become a *listener* and anyone may tune in to radio amateurs over a short wave radio receiver. Broadcasts are made within bands of frequencies that spread from just outside the medium wave up into the centimetre wavelengths.

In some countries, such as Australia, Norway

John Waters of 1st Edgware (Herons) scout group operating from Baden-Powell House, London, assisted by Richard Farm, Venture Scout of 3rd Harrow Weald.

Liu Tak On of 5th Kowloon group, Hong Kong.

and the United States, *anyone* can talk on the air, as long as they keep within the strict rules of broadcasting and use equipment operated by a licence holder. The Governments of a few other countries waive transmission restrictions especially for boy scouts and girl guides during the forty-eight hour period of the JOTA so that groups of people can make 'live' voice to voice contact and the organisation hopes to persuade more Governments to recognise the event in the same way.

yells into the ether

In 1967 the World Jamboree was held at Idaho, USA, and as this was the year of the Diamond Jubilee of Scouting and the tenth international jamboree-on-the-air, JOTA made special preparations. Les discovered that Idaho was not merely the other side of the Atlantic, it was another 2,000 miles beyond New York, so he asked a scout radio amateur who worked for the BBC to help. As a result JOTA transmitted through a special 700 foot long multi band aerial that year and, instead of the usual search round the wave band, immediate contacts were made with Idaho, and with Australia, New Zealand and stations all round the world. Like all good radio operators, scouts try to make worthwhile contacts; the number is not important. Last year for instance Les and the Dorset Scouts (who were his local troop before he moved nearer London) talked for thirty minutes to ZL3BT in New Zealand and were taught a camp fire yell in a mixture of Finnish and Swedish by SMOXAE until they were word perfect.

The time spent on radio for scouts does not end for Les with the annual JOTA. During the rest of the year he has numerous letters to answer or 'pass on'. Sometimes he meets visitors from abroad but regular operators can get to know their contacts quite as well over the air. He has made contact with Fr. Moran in Katmandu; Bill Pole-Evans in the Falkland Islands; also operators in St. Helena, Tasmania, Seychelles and other 'out of the way' places.

HV 3ST is unusual in that it comes from Vatican City. An ex-scout commissioner from England, Robin Paulson, at College in Rome has been assisting the local operator Ed Amram to contact scouts. In the USSR there are few amateurs and transmissions are usually made from club stations. Les heard recently that one operator there, contacted during JOTA, said that he was a member of a youth organisation based on the ideas of Baden-Powell. This is not known 'officially'.

To anyone who wants to find out how to become a radio amateur, Les recommends a radio club. There is one in practically every large town in Great Britain. They welcome new members and are always willing to help beginners. Once you hold a licence, you may operate by morse or voice or, on certain frequencies, transmit TV pictures. Permission can be granted to operate mobile from a car, sometimes from ships, and certain countries allow amateurs to transmit from aircraft.

On the subject of scouting Les is himself a good ambassador. One of the chief aims of scouting is he believes also true of radio operating: that is to provide a medium whereby people from anywhere in the world may converse with freedom and on an equal footing.

Q column by 'observer'

Have you noticed a tendency towards Internationalism in this issue of Quest? Just before the holiday season seemed a good time to mention some of the best of the resorts where one may go for a change entirely at Council expense. Booking by rail, sea or air is done by your friendly personnel office and first class travel is awarded on merit. A special bonus is the full itinerary and plans on how to spend your stay which you will receive—in good time to save you the trouble of making any plans of your own—from your cheery Head of Section.

● Even the least scientific must have heard of Pythagoras but may not know that his greatest success lay with music (and we don't mean the song about the 'right tri-angle').

Pythagoras observed that the strings of musical instruments delivered sounds of higher pitch as they were made shorter and that the pitch could be simply correlated with length. He discovered that if one string was twice the length of another, it emitted a sound one octave lower. If the ratio of the strings were three to two the musical interval called a fifth was produced and if it was four to three the interval was a fourth. Thanks to these observations, the study of sound is one branch of physics in which Greek views have lasted into modern times.

We found this in Asimov's biographical encyclopaedia of Science and Technology which contains brief histories of over 1,000 scientists from Thales (eclipses in 600 BC) to Galileo to Hoyle. (There is a copy in the LO Library).

● *A prize is offered for a short treatise of not more than 100 words in prose or verse on an invention to make a new kind of sound. If that is not in your line, we are also interested in ideas on how to suppress some of the most annoying of modern noises. The prize for the winner will be a £1 record token to spend on any favourite noise. We hope that even the most modest will expose their talent since you can always pretend that you only did it for the money.*

● A suggestion for study in a more traditional field that seemed both timely, for the present season, and promising appeared in a recent RSRS bulletin. We are duly grateful for permission to reprint as follows:

Dear Sir, As our research programme becomes more closely associated with problems of a practical nature I feel sure your readers will note with interest the following extract from a recent issue of Proc. IEE—'A noticeable reduction in noise pick-up took place when gooseberry bushes were removed from the front of the test site.'

Now, Sir, there's a fruitful topic for study! We know of course that such vegetation is correlated with one source of interference, having a noise spectrum dominantly in the audible range and exhibiting a diurnal variation with a maximum generally soon after midnight. But the possibility that these sources might possess a wider spectral output had not occurred to us, and their characteristics would seem to deserve further study. So far as we can determine, these sources are quite inexpensive to produce and I'm sure there would be no shortage of staff willing to assist in their construction, with a view to observations starting in the autumn. I propose to raise this at the next progress review. Yours hopefully—Volunteer.

. . . where all is revealed

Contrary to accepted practice and the IPCS handbook, a senior member of RSRS staff was found to be sharing his office. If you are hoping for revelations, nameless abominations, etc. dont bother to read on. The Senior member was not even aware of his partner. It was a Cox and Box arrangement and, curious paradox, the unofficial inhabitant was discovered only when he had no further needs. In short, a rat had run its last race and left the earthly remains in the ducting to lie in cold obstruction and to rot.

This fact of death soon manifested itself and a removal operation was mounted. Next, to crush the general cause of this particular complaint, the Health authorities were appealed to and a man arrived. In the best Holmesian tradition the expert spent little time dealing with the obvious and almost at once occupied himself with the seemingly irrelevant. He went for a stroll round the outside of the building. Returning shortly afterwards he pronounced – 'A simple case: block up a hole over by the boiler house and all will be well'. He then left, presumably to tackle more subtle problems worthy of his steel.

It was all very impressive, so much so that when this expert asks the corporation for a rise it would be as well for the Mayor to grant it. He seemed to like serious music while working, no one saw him with a radio but the sound of a flute or recorder was heard. A funny old tune it was – it seemed it might be sort of German, fourteenth century.

Quest Quarterly Quote

Among the favourable Press comments on GALAXY appeared the following:

'Senior Astrologer, Dr. Vincent Reddish, said "At dawn yesterday we made history".' The newly created grade, in place of SPSO, caused more stir than the quotation but, regretfully, we learn from official sources that both are fictitious. There were no predictions available for this issue of 'Quest'.

● We think though that whoever blue-pencilled 'SPSO' may have been right in intention. Like the anonymous 'public servant', it might have lacked impact beside news of a breakthrough in automation in an age of technology. Therefore we suggest you ACT NOW. Let's have our own campaign, properly placarded – with sit-ins, sit-downs and the rest of the trimmings – for the right of everyone to have a title that befits their role in the Council. If Fulton's practical pattern of pay is adopted heedlessly, we might even get labels like CSD scale II – and where's the titillation in that?

Footnote: *pseudonyms are acceptable on any contribution for 'Quest' providing that the identity of the author is admitted to the Editor.*

swinging space

*If you transfer to London Office you may find that there is actually no room for you: not a room – any room. With an eye to the minimum standards laid down by the Brambell Report, our man in the very middle * has thrown out a few suggestions as illustrated – thought out in no more than the space allotted to one waste paper basket.*

Some valuable space is occupied by those employed to consider the problem, yet they might do better to move outside to get a broader view. Around the London Office portion of State House there is nothing for miles except some pigeons and an occasional helicopter. Finance division, and we do understand this, haven't authorised even a very small helicopter but there are other resources. Window cleaners' cradles are nearly always vacant and every window on the twelfth to fifteenth floors is fitted with a ring to swing from like the fairy in a pantomime – though perhaps these are reserved for future O and M inspections. Obviously all of them are mere short term solutions. Our ultimate answer – which may be inexpensive in comparison with accommodation in London, from what we hear, and certainly more interesting – is to take the lead in being the first to move into a Jumbo satellite.

** cartoons by Tony Treglown, LO*

Oh rose
Do you suppose
That you were sent
To make me feel
That life is better
After all.

Nona

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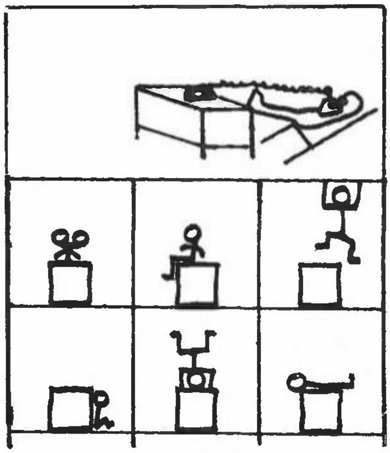
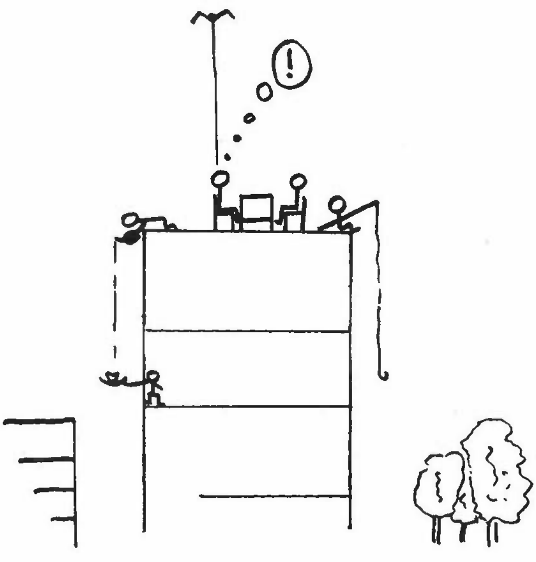
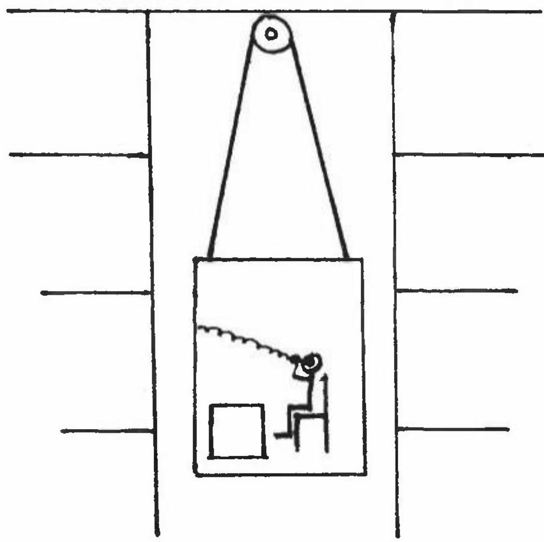
the human (?) zoo



'. . . as long as they can stand up and turn around it's humane.



But what if it rains?



'This is the lift speaking'

Enigmatic on the lawn she lies
Sunwarmed and black.
Unknowing bird pursues his search for food
Too near her paws.
She sleeps and pays no heed – apparently
– But then a flash
Of muscled movement swift and accurate.
The bird is dead.

Nona

sports report

Even the most sporting may not realise that the SRC Sports and Social Association is nearly four years old.

It exists as a link between our own sports and social clubs and the Civil Service Sports Council to make sure that members' subscriptions to the CSSC are rebated to the various clubs in the correct proportion. Its prime object, though, is to encourage amateur sport and recreation in the SRC. Success depends on your enthusiasm.

The annual sports day comes high on the list of fixtures. This is the chance for your local talent to prove topdogmanship – so make a note that it will fall on Wednesday, 1 July this year, at the CSSC Sports Ground, Chiswick – and start practising!

Last year's visitors can tell you that there are plenty of playing fields, hard and soft courts, changing rooms and showers at Chiswick for most sports (and sexes) as well as a good bar and restaurant. Even if you don't shine on the turf, you can show off your capacity for beer and darts (friendly) and the strength of your shout (for your own team or anyone else's).

Work should *not* be brought and may be removed at the door for this occasion demands concentration and initiative as devoted to Lords and the World Cup (not perhaps often associated with the office). If local press gangs collect enough volunteers, the contest will be decided by matches of tennis, cricket, football, bowls, netball and athletics. Private enquiries have revealed that most of these go on in most local clubs.

At Daresbury they manage to fit in almost everything, including fishing and karate, and they take on outsiders at football, table tennis and netball in local leagues. In less than four years this association has made great progress. It also runs a club night, a film society, occasional dances and a traditional Hot Pot supper.

The Clubhouse at Herstmonceux was built at the Club's own expense and caters for most indoor sports, dancing and parties, and has its own bar. They play cricket, hockey, tennis and Stoolball – a traditional Sussex game. It might be described as something between cricket and rounders, for lack of space, but we think it merits a *Quest* article of its own (*over to you,* **Ed.**).

To the usual choice of indoor and outdoor sports, RSRS add motoring, bridge, photography, chess, billiards and snooker, amateur radio and wine making. The club bar is open at lunch time and on other occasions when the need arises.
(With gallons of home brew, the hangovers must be terrific, **Ed***).*

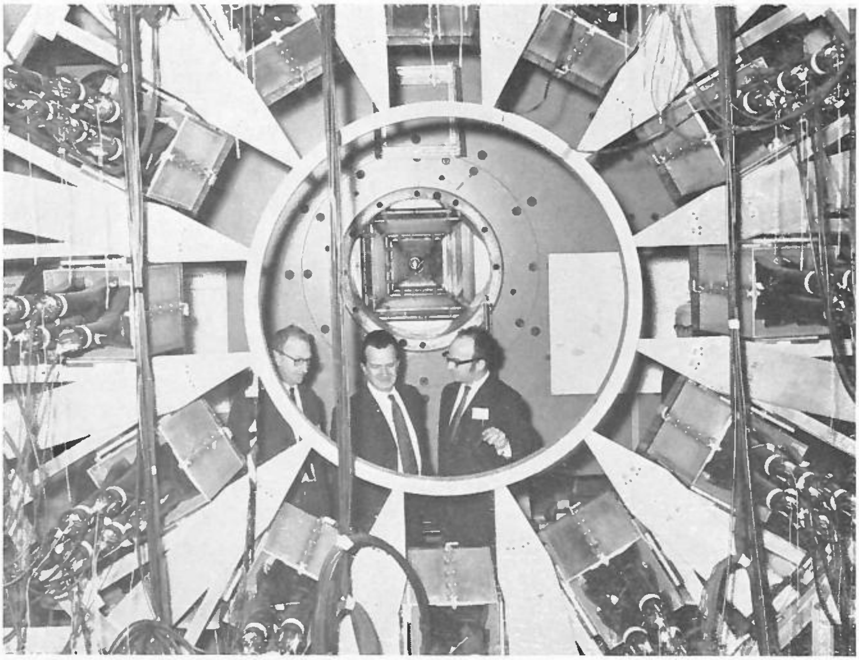
Unexploded bombs found in a piece of land marked off for a sports field have held up developments planned by the Rutherford and Atlas laboratories Recreational Society. Until the field is clear – all clear – activities are limited for lack of a nearby ground, but they do have football, cricket and putting. The lunch hour chess club and darts league are well supported *(see opposite page).*

For lack of space, the LO sports and social club lost its club room but cricket, tennis, swimming and skating, using hired facilities, are catered for. Some go to the CSSC centre or belong to the Riding Club. Support out of office hours is light because of the wide selection of other activities but many join in to make the Christmas Party a great success. The lunch hour music society, which meets weekly to play recordings chosen by each member in turn, has totted up a score of 184 pieces by 78 composers to date.

Another combined effort, Sports Day being one, is the Curtis Bennett cricket competition, a tournament held for the whole of the Civil Service plus 'bodies' like us. All local clubs are invited to lend of their best for a SRC team of picked men – or eleven.

Evidently there are many ideas here on how to fritter leisure. Another time we will collect some from the outstations abroad who may even now be wishing they had a chance to meet the home teams. The SRC Sports and Social Association intends to encourage many combined activities between the SRC clubs. It means to play the game of bringing parts of SRC together – not as one but as a group of friendly rivals.

newsfront



Rutherford Laboratory visited by Minister of State

Dr. Stafford (Director of Rutherford Laboratory), Mr. Gerry Fowler M.P. (Minister of State for Education and Science) and Dr. H. Lipman framed by a ring of neutron counters used in the π 8 experiment on C-violation in the three pion meson decay. In the background is the large electro-magnet in the gap of which can be seen the liquid hydrogen target and an array of spark chambers.
Emphatic discussion. *(below l to r) Dr. G. H. Stafford, Dr. T. G. Pickavance, Mr. Gerry Fowler and Dr. L. C. W. Hobbis.*

checkmate

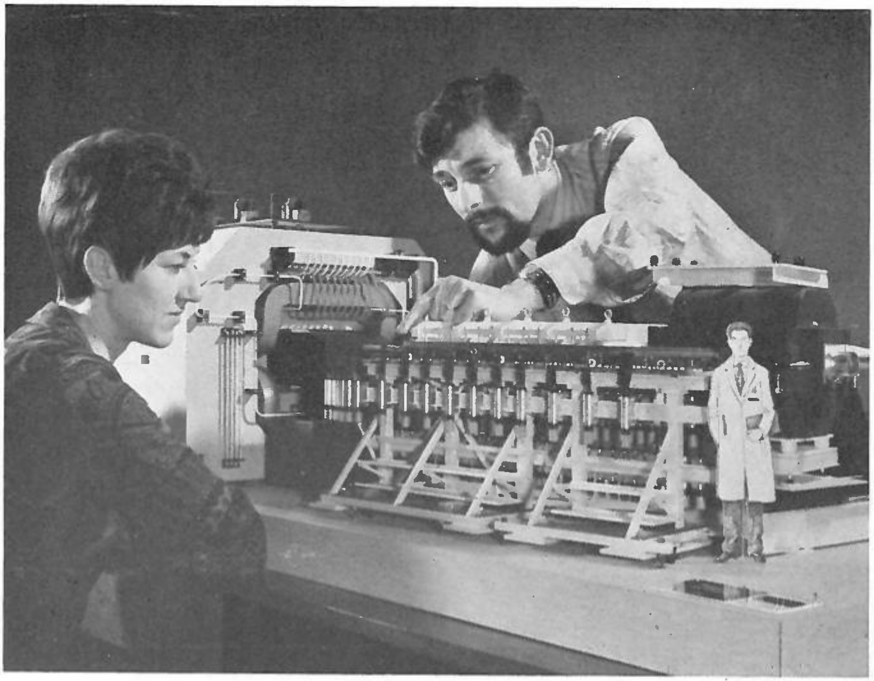
For the third year running, Bill Turner of the Applied Physics Bubble Chamber Group, has won the Rutherford/Atlas Chess Championship. He finished with a score of 8½ points out of a possible 9, remaining unbeaten once again.

Bill started playing at the age of 12 and by the ripe old age of 14, was a member of the Sussex junior and senior County teams. The same year, he became the youngest competitor in the British Boys' Championship, held at Hastings, collecting on the way the Sussex Junior Championship three years in succession.

After his National Service, during which time he played for Somerset, he went up to Oxford in 1958. By his final year he had worked his way up to Board 3 for the University and Board 4 for Oxfordshire. (Non chess players note – there are 50 boards in a County team – Board 1 being top).

After graduating in Physics in 1961, Bill spent a year in Chester, and of course, played for Cheshire, returning to Oxford in 1962 and has regularly played for Oxfordshire since then.

Bill confesses that these days he finds more pleasure in badmington and has therefore slipped to around Board 12 in the county team through lack of competitive chess. However he enjoys lunch time chess, finding this a good way of not losing touch. The twenty-seven other competitors in this year's tournament may have other ideas about his touch!



Daresbury exhibit in London

The intricacies of some apparatus used in high energy physics experiments at the Daresbury Nuclear Physics Laboratory being examined, in the picture above, by Mrs. A. J. Peatfield, an EO in administration and local 'Quest' correspondent, and Mr. A. J. Wardle, an Exp O in the Experimental Physics Group.
The $\frac{1}{8}$th scale model of the 'photon tagging system' has been on view at the Physics Exhibition, London. The equipment is used in conjunction with an extracted electron beam from the NINA accelerator to provide physicists with high energy photons of known energy.
There were seven SRC exhibits at the exhibition from both Daresbury and Rutherford Laboratories.

Professor Ford

towards dynamism

'Take overs can be a mistake unless there is adequate technology to back up management' Professor Ford told London office staff. The Chairman of the new Engineering Board was speaking of 'the way ahead' for engineering.

The dynamic situation that led to success depended on good management and good technology which would come better from within than from forming a merger. The Engineering Board therefore saw the importance of providing first rate training for engineers who would enter top management.

Professor Ford went on to describe how the Board hoped to influence the pattern of training for postgraduate engineers so that they would learn more of the importance of time, money, management, design and manufacture. This was how a real and living interface and industry would develop.

In many cases the M.Sc. courses were too rigid and academic for meeting the future needs of industry. Creativity should be encouraged and, from this point of view, the staff too needed to have a wide knowledge of industrial needs.

*The engineering board had been given responsibility for the 'non–R and D needs of Industry'. Professor Ford felt however that this was an unfortunate title, although it was difficult to think of a better one, and he offered a bottle of champagne to anyone who could give it a more promising name.**

In reply to questions, he said that university staff were free to have their inventions developed by industry. If this practise increased, as it should, some rules on share out would be necessary. The Board would also have to consider the situation that might arise if public funds appeared to be helping one commercial firm in competition with another.

Asked if the Board placed any emphasis on social needs, particularly for underdeveloped countries, Professor Ford said 'no' although the interplay of social responsibility, time, cost and technology were all a part of real engineering. Many of these were covered in environmental engineering – pylons, polution, smoke and noise were a few examples – and the Board intended to look closely at this field. However there might well be end products of processes and research that would be of particular help to developing countries.

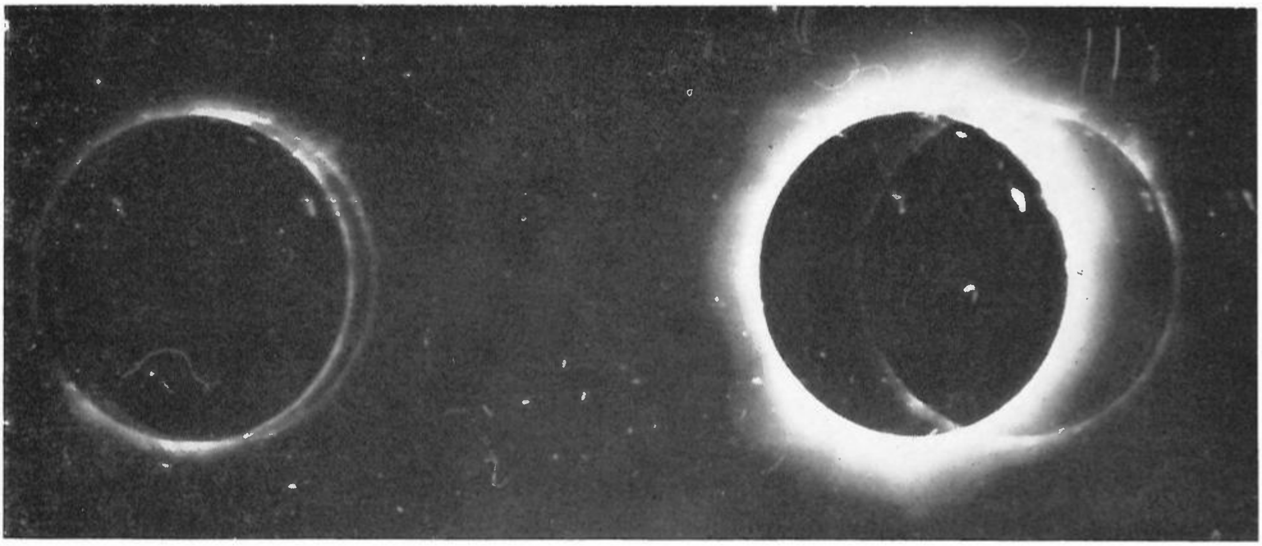
** [We understand that this offer is still open to any fairy godmothers who read 'Quest']*

mexico 1970

A team from the Astrophysics Research Unit and the Physics department of Imperial College London scored an outstanding success with the payload they designed and built for a rocket which was launched into the path of the total solar eclipse that crossed Mexico on March 7.

Congratulations *to Mr. D. H. Sadler of the Royal Greenwich Observatory who has received an honorary degree from the University of Heidelberg. A DCSO (special merit), he has been granted special leave of absence from his post of Superintendent of the Nautical Almanac Office to continue his own research and to organise the 14th General Assembly of the International Astronomical Union at Brighton this year. Formerly Mr. Sadler was General Secretary of the IAU, from 1958–1964.*

D. H. Sadler



The experiment, which fully exploited the event in order to study the hot upper layer of the sun, was formulated by an international team of scientists drawn from Harvard College Observatory USA and York University, Toronto, as well as the team from Great Britain.

The Aerobee 150 rocket was launched from the NASA range at Wallops Island on the Virginian coast (about 150 miles from Washington) as the eclipse passed over there. The payload included scientific instruments to photograph the eclipse over a wide range of ultraviolet wavelengths from 850 angstrom to 3000 angstrom, also internal control and waterproofing systems to facilitate its recovery from the sea afterwards. Sequential observations of the ultraviolet emissions of the chromosphere and Corona were made as the moon passed over successive layers of the sun.

Shown above is part of the first photograph to reach this Country out of the many taken in the rocket. It shows multiple overlapping images of the sun's atmosphere revealed during the eclipse. Each image is in a different wavelength of ultraviolet light and shows hydrogen, oxygen and ion at successively higher temperatures. ...

Another member of the staff of the Astrophysics Research Unit concerned with rocket launched experiments is Bill Burton, shown on right. He is a Senior Scientific Office engaged in spectrographic studies of the extreme ultraviolet spectrum of the sun and other stars, carried out by flying special optical instrumentation in stabilised Skylark rockets which are launched from the Woomera range in Australia. His account of the latest launchings is on page 15.

QUEST

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cover picture: discussion in the Quadrangle at Herstmonceux Castle, home of the Royal Greenwich Observatory. l to r: Dr. A. L. T. Powell, Dr. R. J. Dickens, Dr. R. A. Bell, Dr. B. D. Yallop. Dr. Powell has written the article on this year s Herstmonceux conference on page 3.

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When the Commonwealth Observer – the first and last of that line – arrived in England in 1956 to become the eleventh Astronomer Royal, press reports could only guess what his contribution to British astronomy would be. Hopes were based, however, on his considerable reputation for getting things done.

In sixteen years at the Mount Stromlo Observatory, near Canberra in Australia, Dr. Richard Woolley, FRS, had built up the Stellar Observatory as an important centre for southern hemisphere observing, he had persuaded the Ministry of the Interior (the parent organisation) to finance a large, 74 inch telescope – together with the Radcliffe 74 inch, this is still the largest in the hemisphere – and as a final act he had been instrumental in having the Observatory handed over to the Australian National University. Since the Government post – of Commonwealth Astronomer – lapsed at the same time, he incidentally assured himself of no successor!

How he became the first holder of the post is due, he says, to his tutor at Cambridge, Professor Stratton, who fulfilled the true university function of finding out the student's potential and giving guidance towards a career. Born in Dorset, later a pupil at All Hallows School, Honiton, Devon, the future astronomer then joined his family in Cape Town (his mother was South African, his father a Paymaster Rear Admiral in the Royal Navy) and took an MSc in mathematics at the University. He gained his next step by winning a scholarship to Cambridge and the consequent approval of his uncle who agreed to pay for his keep. At Caius College, after hesitating between research and a tripos, he took the mathematical tripos and was classed a wrangler. He became Eddington's pupil for his PhD. Then, he says, encouraged by Professor Stratton's advice, he turned to practical astronomy and spent an absorbing two years at the Mount Wilson Observatory as a Commonwealth Fund Fellow, followed by his first post at the Royal Greenwich Observatory – which was then *at* Greenwich.

As a chief assistant at Greenwich (1933–7) and for two more years as a John Couch Adams astronomer and Eddington's assistant at Cambridge, his early work was concerned with the spectrum of the sun's outer layers. Some of this work appears in the book 'Eclipses of the Sun and Moon' in which he collaborated with Sir Frank Dyson (pub. 1937). During the second spell at Cambridge, it was again Professor Stratton who encouraged him to take the Australian appointment – 'Commonwealth Astronomer' – a new, and therefore untried, position. As the stature of the appointment developed, he hopes that Professor Stratton had some personal feelings of satisfaction and was in some way repaid when he lived to see his former pupil become Astronomer Royal.

profile

Sir Richard Woolley, FRS
Astronomer Royal

When he took up this next appointment, the Royal Greenwich Observatory was in the final stages of its removal to Herstmonceux, to be further away from the neon lights, the smoke and the polluted atmosphere of London. Proposed in 1939, and abandoned when the year turned out to be so inauspicious, the move was actually started in 1948. Early in 1956 the all important telescopes were still at Greenwich but were re-erected in their new domes at Herstmonceux later that year. Within his first three years he had the telescopes working on scheduled programmes. Another step which became identified with him but had in fact been agreed to by the Lords of the Admiralty (the parent department) was the decision to build the large telescope. He was however entirely responsible for getting it out of committee (where it had been for about ten years), and, together with Professors P. M. S. Blackett, R. O. Redman and H. H. Plaskett, deciding on the shape and scope of the 100 inch 'Isaac Newton' telescope in a commendably short space of time. Inaugurated by the Queen in 1967 it remains the largest telescope in Western Europe.

In the last decade the Observatory at Herstmonceux has been developed in many directions: chiefly as a research establishment, as a training centre for young astronomers and, together with the linked observatories in both hemispheres, as an important scientific centre. These are undoubtedly his most important, and most appreciated, achievements as its director.

In the 1950's the Observatory's work was mainly of a recording kind: measuring positions of stars for almanacs (for both surface and air navigation), running the time service, and making geomagnetical and meteorological observations. Without in any way

profile continued

cutting down or detracting from this work (apart from meteorology which has been taken elsewhere), the greater part of the work in 1970 is research. As a research establishment it has a new look unsuspected by people who decried the transfer to Herstmonceux as a move to 'recreate a nineteenth century observatory'. (In fact, the castle dates back to the fifteenth century and the science of astronomy has at least three thousand years on record).

Links with the southern hemisphere were natural, not so much due to his own background, but because observing 'down under' gives the other side of the picture – particularly for taking the positions of southern stars, for the nautical almanac, and for the study of the Magellanic Clouds – the galaxies nearest to our own which are only visible from the south. Overseas co-operation has been taken much further too, with staff being sent to observatories all round the world – to Mount Palomar (California) and Egypt in particular, although the Egyptian 74 inch has been inaccessible for a few years, buried under sandbags, as it is right in the Arab-Israeli line of fire. At Herstmonceux there are always astronomers from abroad on working visits, at present from Australia, the United States, Turkey and Spain. For the Anglo-Australian 150 inch telescope, now under construction on a mountain site in New South Wales, he mounted a virtually solo campaign. The idea was supported by Professor Bok and Dr. Eggen (who took over from him at Mount Stromlo when it became part of the university), but he initiated it and conducted the demonstrations before learned bodies, gaining the support of the Royal Society and, finally, funds from the SRC who are sharing the cost with the Australian Government.

Having no ambitions to be a teacher or to learn by just listening, he believes in 'training on the job' and enjoys working beside young people. The association with the University of Sussex began from the time the University – and its astronomy department – opened (in the 1960's) and ever since there has been a constant interchange of undergraduates, who come to work at the Observatory, with post graduate staff who go to the University. An eight week summer course brings in students from all over the British Isles (the applicants outnumber the places). Many of the scientists at the Observatory have been 'talent spotted' during such training – about 20 are Sussex graduates. The success of the scheme is indicated by the friendly atmosphere between people who are obviously very involved with their work and identify themselves with the aims of the Observatory.

Although his abilities as a driving force have meant a career in administration, Sir Richard (he received a Knighthood in 1963) remains at heart and in practice, a working astronomer – as witness his office equipped with instruments for measuring spectra, and many hours of night observing. It has meant a constant struggle to make time for it – where other people might have had to give up.

In Australia he admits to having been more of a '9 till 5' astronomer (or the night observing equivalent – it was a stellar observatory) due to the lure of the open spaces. It was quite usual to ride ten miles for 4–5 sets of tennis and ride back on an Australian horse which was, by British standards, unruly and unbroken – he kept his own horses plus a few house cows. Even in the English climate he finds time for tennis and cricket (playing with colleagues) and to look tanned and very fit.

Nevertheless his work in Australia led to one of his most important books 'The Outer Layers of a Star', published in 1953 in collaboration with Professor D. W. N. Stibbs (now at St. Andrews University) and he has worked in most branches of astronomy. At Herstmonceux he began with astrophysics and has turned, more recently, to star clusters – the motions of stars (galactic orbits) and variable stars (R R Lyrae). His instigation of new research for others has played an important part, also encouragement of publication through the Observatory bulletins and other media, so that there is an up to date record of their current research into the movements of stars and the chemical composition of stellar atmospheres.

This interest in the design of things is reflected in an interest in the structure of music – and that means music by Bach. Having rescored many pieces for two pianos for himself and his wife to play (while they were in Australia) he plays for the sheer pleasure of Bach's composition. A regular partner on the two grand pianos in the castle's ballroom is Mr. H. F. Finch, a retired member of the staff, and occasionally visiting astronomers.

From the amenities of the castle to the working facilities of the domes and the auxiliary machines (which include an ICT 1909 computer), the Herstmonceux Observatory mirrors his constructive achievement. Although it left Admiralty hands in 1965 to join SRC – a move he helped along, foreseeing that it would be easier to justify expense on research to fellow scientists than it had been to the buyers of naval frigates – the Observatory today has the atmosphere of a vessel with a sense of direction and urgency both at the helm and in the engine room, but with all shipshape and Bristol fashion. It is a very pleasant place for a visit – working or social.

As an illustration of the position held here today by the eleventh Astronomer Royal, that saying which applied to the architect of the original Greenwich Observatory is rather apt: 'Si monumentum requiris, circumspice'.

latest design

Following the new proposal for the 300 GeV Accelerator – the 'missing magnet' design that could be set up alongside the present accelerator at Meyrin in Switzerland – we reprint below the editorial comment from the CERN Courier. Their other comment was 'let us hope that it won't be very long before we move from the present extreme position where all the magnets are missing'.

The initial proposal was for an accelerator of 300 GeV with conventional combined-function magnets in a ring of diameter 2.4km. Using separated-function magnets an accelerator of 300 GeV could be built in a ring of 1.8km diameter which could later accommodate a superconducting accelerator of about 800 GeV.

The new proposal is that the project be started with a tunnel of 1.8km diameter capable of accommodating a 300 GeV accelerator using existing techniques but that initially only half the magnets be installed. Such a magnet ring would permit a maximum energy of 150 GeV. Should superconducting technology develop as hoped, the spaces could be filled with superconducting magnets which would permit a maximum energy of about 400 GeV. During the installation, the disturbance to experimental physics at 150 GeV would be minimal.

If the superconducting accelerator proved successful then the original conventional magnets could be removed, the whole ring filled with superconducting magnets and the maximum energy taken to 800 GeV or perhaps more.

On the other hand, should superconducting techniques not be mastered, the ring could be filled up with further conventional magnets at an additional cost of about 60 million Swiss francs and the accelerator taken to 300 GeV.

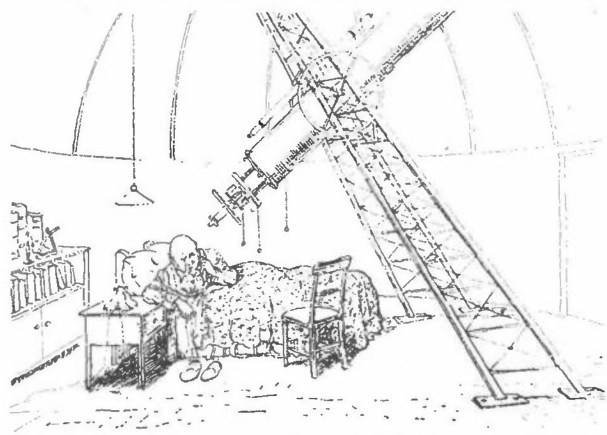
In this way, physics at high energy could start as early as is now possible with the future possibilities of completing the project as a conventional accelerator of 300 GeV or of conversion to an accelerator with energy higher than any currently under construction in the world and based on the most modern technology.

The present impasse in the 300 GeV project is due to the difficulty of selecting a site. At the same time it is disturbing to the traditional unity of CERN that only half the Member States (Austria, Belgium, Federal Republic of Germany, France, Italy, Switzerland) have so far adopted a positive attitude towards the project. The new proposal could possibly resolve these difficulties. With a diameter of 1.8km, the accelerator could be built not only on one of the five sites previously under discussion, but also on a site adjacent to CERN-Meyrin. There is sufficient uninhabited ground on the opposite side of the Geneva–St. Genis road to take such a ring and a long ejected beam line. The ground is not ideal but experience in tunnnelling the ISR beam transport lines indicates that it is practicable.

Such a possibility has been discussed before. The construction of a machine in the range of 300 GeV across the road from the existing Laboratory was first proposed by C. A. Ramm on 13 April 1961. An extension to higher energies using superconducting techniques was referred to in a paper of G. Plass on 27 April 1961. The new potential of the missing magnet design and the growing likelihood that pulsed superconducting magnets will be mastered, open up again the discussion of a site at CERN-Meyrin.

Significant economies would then be possible in the project by sharing development effort, overhead costs and services with the existing Laboratory. The conventional accelerator plus experimental facilities would cost approximately 1100 MSF instead of 1431 MSF and there could be similar savings in the cost of running the existing Laboratory. The personnel complement, for example, could stabilize at 5,000 people instead of 7,400 in two separate Laboratories. In subsequent exploitation of the research facilities, the plateau budget could be 450 MSF instead of 600 MSF for two separate Laboratories.

from CERN Courier, April 1970



'PRO 3754. Is that the exchange? Would you please give me a ring five minutes before the occultation of Sirius by Pluto.'

(This cartoon first appeared on Dec 28, 1938 and is reproduced by kind permission of 'Punch').

astronomers meet

Alan Powell

The 14th Herstmonceux Conference is this year a precursor to the 14th meeting of the General Assembly of the International Astronomical Union, the latter being the tri-annual event that will be held at Brighton in August. The present Astronomer Royal instituted this Conference in 1956 shortly after being appointed to this position. Over the years the popularity of the Conference has grown and a pleasant tradition of events has emerged which are now well established. My memories of the Conference go back to 1965. British weather being what it is these must be tainted for they always seem to have taken place in brilliant spring sunshine: plants in the delightful Castle grounds bursting with renewed vigour after the winter. (However, the records show that one year the Conference was held earlier than usual and the Castle became snow-bound).

In spite of the idyllic setting of the Castle and its grounds, serious discussions on astronomy do take place. A particular topic is chosen each year to engender interest in most of the British astronomical establishments; thus this in an ideal opportunity for British astronomers to meet and to compare notes. Usually one or two eminent astronomers who are experts in the chosen subject for the Conference are invited from Europe. This year the topic was 'The Distances and Sizes of Cosmic Objects'. There were over forty participants at the Conference most of whom stayed in the Castle. Some came from places as distant as Dublin and Aberdeen; in fact one hardy traveller came from Edinburgh in a three-wheeler.

The Conference seemed to be a great success, although maybe not so memorable as some in past years. One senior delegate was heard to remark that 'the establishment visitors have been replaced by the long-haired ones'. I do not know that I would go along with this sentiment as I feel there was a good cross-section of both talent and age.

The first day was high-lighted by the invited discourse on stellar rings by the eminent European astronomer, Professor Th. Schimdt-Kaler (Ruhr University). His thesis maintains that the rings are ellipsoidal shells of equal size seen in projection on the celestial sphere. The most convincing evidence for their existence comes from their use as galactic distance indicators; they delineate the spiral structure of our galaxy right into the centre. This structure is shown in more detail than by any of the previous methods. Professor Schmidt-Kaler finished with the remark that his work had not yet been approved by the establishment. With this the Astronomer Royal on behalf of the establishment formally accepted Professor Schmidt-Kaler's thesis. Naturally a very lively discussion followed which unfortunately had to be curtailed so that adherence to the programme could be maintained. The interest shown is perhaps best illustrated by the fact that he was still having discussions two hours after the end of the Conference, when they had to be curtailed so that he could meet other commitments.

In the afternoon Dr. J. S. Hey (formerly of Royal Radar Establishment, Malvern) gave a fascinating account of the history of radio astronomy. Dr. Hey had been in at the beginning of radio astronomy just after the war and was able to give a lucid account interspersed with amusing anecdotes. The audience was amazed at the sophisticated engineering of one of the earliest radio telescopes that was built single-handed by Reber in 1939. With hindsight the delay in discovering the existence of radio sources seems incredible, but 'tout le monde est sage après coup' is perhaps a very apt comment here.

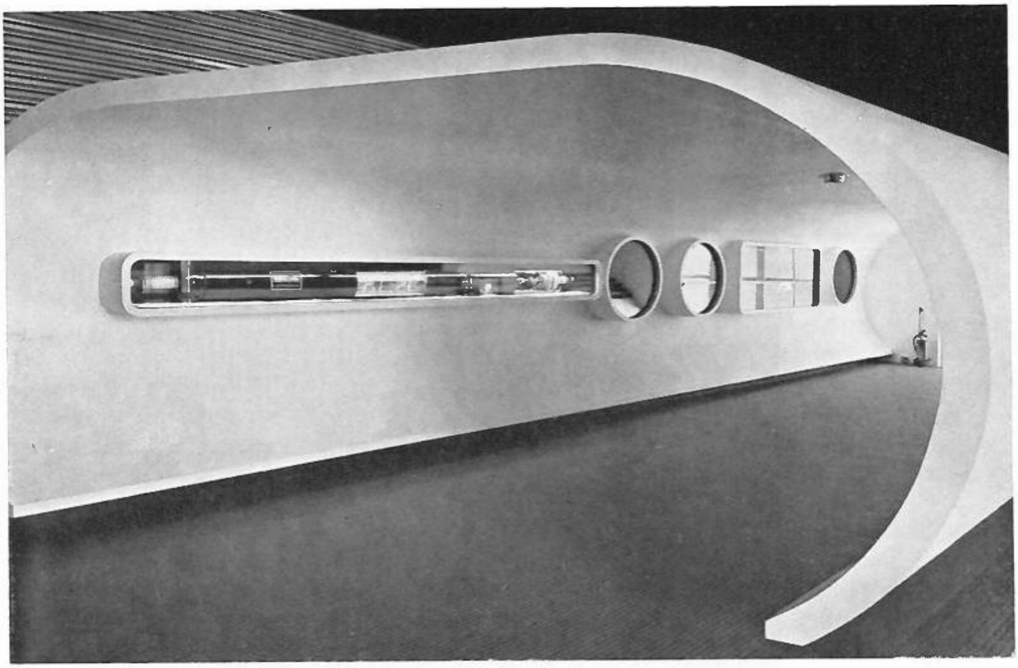
The evening was a kaleidoscope of social activity. At the kind invitation of the Astronomer Royal and Lady Woolley, the delegates and their wives enjoyed cocktails before dinner and afterwards partook of fruit and wine in the ornate Long Gallery. The evening was rounded off with an informal piano recital on two pianos given by Sir Richard Woolley and Dr. Malcolm Longair of the Institute of Theoretical Astronomy. Unfortunately throughout the Conference Lady Woolley was indisposed: so too was one of the speakers who was undergoing an appendix operation. Gallantly Malcolm Longair and Andrew Webster offered to fill the gap in the programme (in the final twenty minutes of the Conference) and gave a devastating and somewhat esoteric account of the current state of the theory of X-ray background radiation. Also they presented a theory which predicted both the observed X-Ray and Radio background radiation, a subject which, so far, has received little attention.

Although I have only mentioned three of the lectures, this is by no means a reflection on the remainder. In fact a lively and stimulating discussion continued throughout the two days of the Conference, and as the proceedings of the Conference will appear later in the year in 'The Observatory' I have not attempted to cover the Conference fully here. I will just add an amusing remark made by a delegate in one of the lighter moments, who said that the magnetic field played the same role in astronomy as sex does in life!

Having organised the Conference this year I realise how much the success of this annual event relies on the hard work of the members of the scientific and non-scientific staff, many of whom performed functions outside their usual line of duty.

One hopes that this annual event will continue in the future.

Dr. Alan Powell is a Senior Scientific Officer at the Royal Greenwich Observatory engaged on research into the chemical composition of stars.



The following article on Expo 70 is illustrated by photographs taken by the Central Office of Information. Above is the communications display in the 'Building for the Future' section, designed by Casson Conda and Partners.

guest column

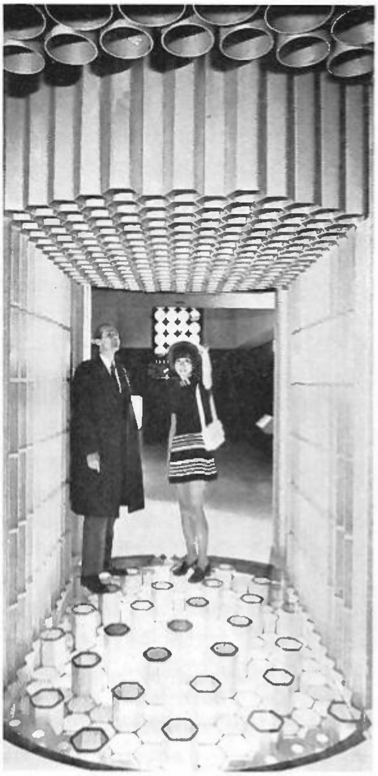
The guest writer is Dr. Paul Roberson, Deputy Chief Information Officer at the Department of Education and Science. He has recently returned from a visit to Japan made to see how Science and Technology are presented in Expos by Britain and other nations.

expo 70-science

The first problem that must face the designer of a national exhibit in an Expo is to decide the purpose of the Expo itself. The first international Expo of all, the Great Exhibition of the Industry of all nations held in 1851, was brought into being in an attempt to show the world contemporary invention, design and manufacture. More than 30 nations took part. The aspect of good design appeared from time to time in later International Expos, for example in Paris and in Chicago, but more recently the character of Expo has changed from a forum of good design into an exposition of national prestige, a presentation of the better aspects of a nation's way of life. As such, Expos are now places where one nation can get an idea of the progress, life, work and recreation of many others.

Inside this framework, the designer of a national exhibit is faced with a number of constraints, the most important being the sum of money made available to create the national exhibit and the amount of space that this sum will purchase. Here it has to be borne in mind that the space has to be furnished at a standard compatible with national prestige and arranged to accommodate the number of visitors expected to pass through the exhibit, a function of previous success.

For Expo '70 sufficient funds were made available to acquire a site of 90,000 square feet and to furnish it with a hanging pavilion covering some 27,000 square feet, the pavilion being designed in the form of a Japanese house suspended from four vertical steel structures. The total number of visitors to Expo was estimated at 50,000,000 over the six months of opening. This indicated to the designers that between 5,000 and 6,000 people would pass through Britain's pavilion every hour. Hence at peak periods each visitor might have about 20 minutes to see the whole pavilion – five minutes in each of the four main sections – a time function causing the



Two photographs of the 'Progress for Mankind' section designed by Leslie Gooday and Associates.
On left a hostess and a visitor enter a representation of the core of the Dounreay fast breeder reactor.

COI photos

Picture above shows North Sea gas display (l) and the Harwell freezing method of desalination (r).

designers, along with many others, to adopt an 'Information on the move' philosophy. The 'stand and stare' philosophy can only be adopted by those nations able to afford huge pavilions or by those expecting to attract few visitors. These design restraints obviously control selection, deployment and presentation of exhibits from the long list put forward to cover education and aspects of the work of the Research Councils, of particular interest to the Japanese. It was decided by the designers to present all exhibits so that the rapidly moving hordes could gain impressions as they passed by.

The opening section, 'Britain's Heritage' contained references to major scientific achievements such as Harvey's discovery of the circulation of the blood, the initial discoveries of antisepsis, penicillin and Vitamin B 12 accompanied by exhibits showing the range of British inventions and discoveries *ie* from Faraday's work on induction to television, from Stevenson's 'Rocket' to the Jet engine and the Hovercraft and from pioneer work on navigational instruments, particularly the chronometer, to the first non-stop crossing of the Atlantic.

Radio astronomy was depicted by dioramas of the Chilbolton steerable aerial of the SRC Radio and Space Research Station and the new Jkm aerial array at the Mullard Laboratory, Cambridge.

Medical research was shown in a metal sculpture of the cell animated to show its basic functions, followed by a convoluted structure some 30ft. long by 17ft. high representing a myoglobin molecule. Into this structure were inserted very simple presentations representing research into genetic diseases, antibiotics, lysozyme viruses and interferon and immunology.

Agricultural research was represented by a number of dioramas showing engineering developments to mechanise harvesting and automatic control of tractors, biological control of pests by the introduction of predators, work on animal breeding and genetics, blood stock improvement and artificial insemination. Other exhibits showed bacterial conversion of hydro-carbons into proteins, production of better plants by breeding or chemical control, soil physics and the optimised use of fertilisers.

The work of the Natural Environment Research Council was restricted to displays showing the operation of GLORIA, the ultra high powered sonar device used for obtaining pictures of the deep ocean floor, the development and exploitation of natural resources under the sea and the development of oceanographic instruments such as the Clover Leaf Buoy.

In view of the density and habit of the audience, it was necessary to display these exhibits in a simple form with very little caption material so that a quick impression of Britain's scientific effort could be obtained as the audience passed rapidly by.

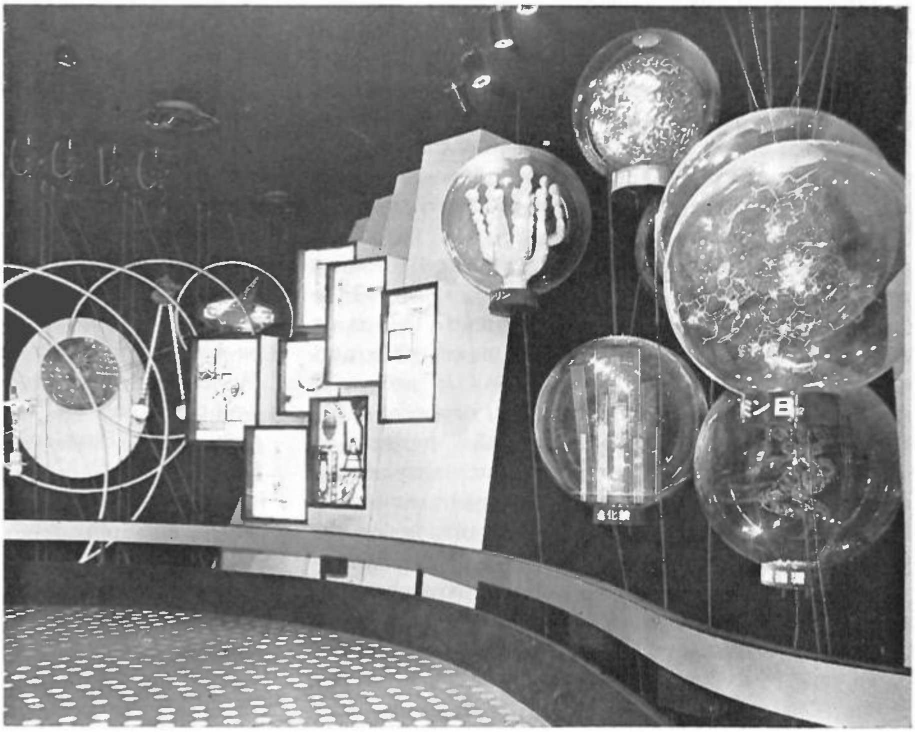
The Russians with a total of half a million square feet of display space dealt with the centenary of Lenin's birth, their education, services and the development of their culture and their territories. They obviously had a large section on Space, but their only reference to pure science was a display of scientific instruments and simple displays showing the fields of scientific endeavour where they had initiated certain pieces of work – for example Mendeleef and the periodic table.

In another giant pavilion, the US air supported plastic dome, the main exhibit on the technical side, was related to the moon landings and in this area the only scientific exhibit related to actual samples of moon rock. They did devote some space however to an artistic exhibit based on the use of lasers.

The French pavilion contained a substantial area devoted to the work of the National Centre for Scientific Research with a series of exhibits at quite a high level on for example, oceanography, molecular biology and immunology. The exhibition contained a number of very good films, including ones on mathematics, electron micrography and molecular biology.

The Australian pavilion had concentrated its exhibits on either side of an underground exhibition tube through which the audiences were carried on a travelator. On either side of this tube exhibits of highlights of Australian scientific work were displayed together with other aspects of Australian life. The work shown included anthropology, brain research and vision, viruses and immune reactions, soil science, meteorology and radio and optical astronomy – Parkes and the 150 inch Anglo-Australian telescope, the British end of which is administered by the SRC.

Within the first few days of its life, the British pavilion fulfilled the expectations of the organisers – the Central Office of Information – in that it was a popular exhibit. From opening to closing time there was a constant stream of visitors, mainly Japanese, passing through the pavilion sometimes four or five abreast. Very little of what was shown really stopped the majority, but they were obviously intrigued by exhibits from Britain showing the great contrast between the organisation of industrial life in this country and Japan and by our efforts to conserve our environment. Commonplace scenes of green fields, countryside, seashores, ancient buildings, wild life and flowers caused considerable astonishment to a people to whom these things seem completely unfamiliar.



Picture shows (from l to r) Time, Industrial Archaeology and Science displays in the British Heritage section designed by Charles Munro and Associates. COI photo.

council commentary

£1M A YEAR FOR ATOMS MOLECULES AND PLASMAS ++ BEST DATA YET FROM SKYLARK SPACE PROBE IN SOLAR ULTRA-VIOLET SPECTRUM ++ SYMPOSIUM ON ELECTRON AND PHOTO INTERACT ++ £59,000 HARDWARE FOR MULTI ACCESS COMPUTER SYSTEM ++ BRITISH EXPERIMENT IN ORB ING SOLAR OBSERVATORY OSO-G ++ FIRST LUNAR SAMPLES FOR BRITAIN ARRIVE AT SRC ++ FOR CONTROL ENGINEERING RESEARCH ++ ANGLO-AUSTRALIAN TELESCOPE CONSIDERABLE CONTRI BUTION TOWARDS SCIENTIFIC DISCOVERY ++ RSRS PARTICIPATES IN UK4 SATELLITE TO MEAS INTENSITIES OF ELECTROMAGNETIC RADIATION ++ DEVELOPMENT IN ANALYSIS OF BUBBLE CHAM BER PHOTOGRAPHS BY SWEEPNIK AIDED BY SRC GRANT OF £40,473 ++ SUCCESSFUL LAUNCH OF

March. All the Research Councils have recently arranged that each is free to send a senior assessor to meetings of the others at any time. The Chairman specially invited the other Councils to be represented at the March meeting when the agenda included a discussion of scientific manpower, and in particular postgraduate training appropriate to the needs of industry, and the numbers of postgraduate students in relation to the numbers needed as future university teachers and the numbers needed at the first degree stage for industry. Sir Gordon Cox, Secretary of the ARC, Dr. J. A. B. Gray, Secretary of the MRC, Mr. R. J. H. Beverton, Secretary of the NERC and Mr. D. Allen of the SSRC attended and all contributed to a valuable discussion, which will be taken further later in the year when the Government's plans for university expansion are known and later statistics are available on the employment of scientists and engineers.

The assessors from the other Research Councils also joined in a discussion of the broader aspects of future policy raised in the Chairman's Nottingham lecture on 'Science in Universities'. The latest form of the proposal for a European laboratory for molecular biology was next discussed. In the light of reactions from the UK and other countries this had been considerably scaled down by its proposers, and the first objectives had been somewhat modified to give special emphasis to the development of methods and instrumentation. The Council viewed this revised proposal more favourably than the original one.

April. The first main item before the April meeting was the five-year forward look programme for 1971–1976, which was discussed and agreed. This is an expanding programme, taking account of the expected increase of about 7% *pa* overall in university numbers in the next quinquennium. It proposes a 5% *pa* increase in studentships and a 3% increase in staff at SRC laboratories, including provision of staff for the proposed high flux beam reactor. It remains to be seen of course how much of the expansion the Government will authorise.

After the Forward Look, eight large research grants recommended by the Science Board were then fully considered and approved, the largest being a grant of up to £370,000 over 5 years to the Oxford enzyme group (Chairman Professor R. E. Richards) for research on the structure and function of enzymes of the glycolytic pathway. The major part of this grant is for an ultra high field NMR spectrometer, the first of its kind in Europe. Another Science Board item was the approval for a powerful national facility for synchrotron radiation at Daresbury, using ultra violet radiation from NINA, but without interference with the nuclear physics experiments. This is a revised and extended version of the proposal which was approved in principle in July 1969. The capital cost will now be £270,000.

The Council then turned to a review of the three large proposed items on the Nuclear Physics Board's domestic programme – a large computer at the Rutherford Laboratory, the high field bubble chamber and the nuclear structure facility. The first two of these were submitted for approval, and although the nuclear structure facility was not yet ready to be submitted for approval, Professor Wilkinson emphasised that the Board gave it equal priority. The computer, costing about £3½ million will be used for other work besides that arising directly at the Rutherford Laboratory. The high field bubble chamber, costing about £3¼ million will be used at CERN. The Council approved these projects subject to the NP Board accommodating also the nuclear structure facility, and possible UK accession to a new CERN 300 GeV accelerator, within the present financial pattern.

May. The May meeting was held at the Royal Greenwich Observatory, Herstmonceux, with a tour of the Observatory on the previous day. At the beginning of the meeting, Dr. Pickavance outlined the new CERN proposal for a substitute for the 300 GeV accelerator; more economical but capable of more development, and small enough to site alongside the present CERN laboratory. The Council greatly welcomed this development, which appears to re-open the possibility of UK participation.

The next item was the proposed high-flux beam reactor, put forward as a purely SRC project now that the Ministry of Technology has withdrawn, and at an estimated £19 million capital and £4½ million *pa* operating cost the most expensive project which the Council has ever considered. The scientific case was presented by Professor E. W. J. Mitchell, Chairman of the Physics Committee and of the Neutron Beam Research Committee and the technical status of the project was reported by Dr. Pickavance, Chairman of the working party on this aspect. After a full discussion the Council authorised the appointment of a project leader and staff, to develop the proposals and the reactor design to the stage where costed proposals could be submitted for consideration.

The Council next approved five research grants recommended by the Engineering Board, the largest being a grant of up to £131,000 over 3 years to Professor R. W. H. Sargeant, ICST, for the development of on-line estimation and control of industrial processes. The new appointments to Boards to be made next October were approved, as was the formation of a Transport Committee of the Engineering Board.

Finally, the Council discussed in detail the issues which will arise at the forthcoming Ministerial meeting of the European Space Conference, concerning the future organisation and conduct of European space research.

the new biology

What are we all but music,
Chords of time and oscillations
Mostly harmonised but sometimes
In disorder – is each one
An extended variation?

Nona

international conference at Brighton

The International Astronomical Union is to hold its 14th General Assembly at Brighton this year from August 18 to 27. This is the second to be held in the United Kingdom, the first was the second assembly held at Cambridge in 1925. The eighth (in 1955) was held in Dublin.

The hosts will be the Brighton Corporation, the University of Sussex and the Royal Society (which is the body through which the UK belongs to the IAU). The officers of the National Organising Committee are:

President: HRH Prince Philip, Duke of Edinburgh.
Chairman: Professor Sir Bernard Lovell FRS, Director of the Nuffield Radio Astronomy Laboratories (Jodrell Bank) and a council member of the SRC.
Chairman of Finance and Policy Committee: Professor R. J. Taylor, University of Sussex.
Chairman of Local Organising Committee: Mr. D. H. Sadler, Superintendent of the Nautical Almanac Office at the Royal Greenwich Observatory. (He was a previous General Secretary of the IAU from 1958 to 1964).

The SRC has given Mr. Sadler leave of absence from his normal duties and has seconded Mr. R. C. Pepperell – Rutherford Laboratory Conference Organiser – to act as an administrator. Although it is not one of the host institutions, the SRC is very much involved both in the organisation and in participating – there will be about 300 astronomers attending the assembly from the Observatories, other SRC establishments and from universities. Also the RGO will be providing many services and has undertaken to invite all the participants (2,500–3,000 are expected) to make afternoon tours of the Royal Greenwich Observatory, including tea.

The IAU General Assemblies are usually held every three years. Their purpose is to provide meetings of IAU Commissions and to give astronomers from different countries a chance to meet each other for informal discussions. This year the two important 'invited discourses' will be on pulsars – with A. Hewish (UK) and V. L. Ginzburg (USSR) as speakers – and on galactic spiral structure – with B. J. Bok and C. C. Lin speaking (both from USA). There will also be a special scientific meeting on a topical subject – the scientific results obtained from the exploration of the Moon! In addition the various Commissions will hold up to 150 separate meetings and there will be several joint discussions on astronomical subjects – all to be fitted in in the space of ten days.

The IAU itself is one of the scientific unions federated in the International Council of Scientific Unions (ICSU). It was founded in 1919 with the primary aims of encouraging international cooperation in the field of astronomy, furthering the study of astronomy and safeguarding its interests. It is one of the very few international organisations that has individual membership but without payment of individual dues. The membership is about 2,000 (from 50 countries) and it tends to increase by about a third at each general assembly. Professor Otto Heckman of Germany is the current President and Dr. Lubos Perek of Czechoslovakia is General Secretary. The IAU is directed by the elected executive committee but most of its scientific work is concentrated in the Commissions – there are about 40 of these.

The members are also given a chance to meet on a cultural and social level. At this year's Assembly events will include tours and excursions on Saturday and Sunday, a concert of British music by the Royal Philharmonic Orchestra and a recital of Sir William Herschel's organ concertos by Lady (Susi) Jeans, the organist, who is also the widow of the distinguished astronomer Sir James Jeans.

eclipse 1970

Paul Dickinson

An account of the launching in Nova Scotia, during the solar eclipse, of the rocket-borne experiments prepared by the Radio and Space Research Station, represented on the spot by Tony Hall and Paul Dickinson who writes:

It was rather a special eclipse. Not every eclipse has the moon so near the earth that an observer can see totality for over two minutes. Very few indeed conveniently go on display all up the eastern seaboard of the USA which is rather well supplied with laboratories, observatories, people, and even one or two rocket ranges. Many of these were perfectly placed within the eighty mile wide path of totality. Even less probably in Nova Scotia, where the centre of the totality path was precisely along the south coast and where a second total eclipse will pass over the same place only two years later. The paths coincide where the latitude happens to equal that of the ionospheric observatory at Ottawa.

The sun is 'switched off' every night, but so slowly that many of the more rapid ionospheric processes cannot be observed. In an eclipse the sun is switched off much more rapidly. One can measure how the ionosphere follows the sudden drop in the sun's brightness, and measure the 'sluggishness' of the ionosphere.

The Canadians, through their National Research Council decided to contribute to the world programme of observations of this eclipse by flying four rockets to measure the ionisation in the D and E regions of the ionosphere, and to try to relate this to the sun's brightness. They invited us to contribute experiments to measure solar intensity at wavelengths relevant in the D region, namely the far ultra-violet (Hydrogen Lyman alpha at 1216Å) and the X-Ray spectrum (1.5 to 10Å).

We had about six months in which to prepare the experiments for eclipse day 7th March 1970. Some development work was needed mainly to get the extra sensitivity to measure a very obscured sun. Integration checks took three weeks in January in Winnipeg. There Tony Hall discovered the significance of what Canadian meteorologists call the Chill Factor. This is a sort of negative cold bonus. The temperature outside may be –40°, but if there is a wind your bones may inform you that it is –60°C. The chill factor is 20°!

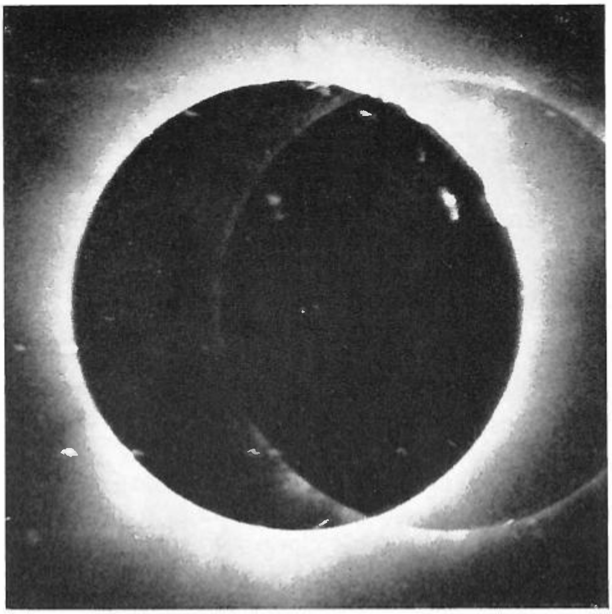
I had no idea what to expect in Nova Scotia. The map shows the south coast to be basically a straight line running WSW to ENE, but drawn by someone with advanced delirium tremens. Having seen the coastline I can now vouch for the sobriety of the cartographer, although the mapping could well have driven him to drink. The coast is a mass of bays, islands, estuaries, rocks, lakes and harbours. Each feature is itself tortuously indented and each indentation has rocky protruberances and so ad infinitum (knobbly barnacles on the rocks?).

Pine forest extends to the water's edge, more exactly to the edge of the sea ice. This extended about a mile offshore in places, when we arrived, but receded rapidly during the fortnight that we were there. Being salt ice it didn't thaw like civilised ice, which is either there, and hard, or not there, and wet. Instead it went to a white pulp which was a realistic imitation of ice until you tried to walk on it . . . . Not quite Richmond ice rink.

We arrived on February 23rd at Halifax airport and were driven in a gentle blizzard, a large station waggon and a series of graceful skids, seventy miles eastwards along the tortuous marine highway to Sheet Harbour. We stayed in an historic hotel (anything over 100 years old is historic in Canada), founded in c. 1860 by one Theobald Conrod, and now owned by Frazer Beaver. (Beaver may be named after the rodent, but Conrod . . .?) At the hotel Tony was able to demonstrate his virtuosity in audio frequency modulation, on the electric organ belonging to Mr. Beaver.

The rockets were to be launched from a temporary launch site established at East Quoddy, about twelve miles East of Sheet Harbour, on a spit of land called Smith's Point. Everything happened on Smith's Point. The four launchers were at the seaward end, while the entrance gate at the north end was barely 600 yards away. In between were the rocket store, the meteorologists accoutrements for balloon sonde launching, tracking and wind analysis for impact prediction, then there were trailers for the triplicated telemetry receivers, the experimenters, and the range safety officer, and for the ground transmitters for Dr. Belrose's experiment, complete with four 100 foot masts carrying his square array of dipole transmitting aerials. Lastly there was a trailer referred to as the

The writer, Dr. Paul Dickinson (seen left) is a Senior Scientific Officer in an RSRS research group at present engaged in rocket-borne experiments to measure ionising influences in the upper atmosphere.



The photograph shows the solar corona as recorded from above the earth's atmosphere during the eclipse of March 1970. The corona is seen in 1216Å wavelength radiation scattered from coronal atomic hydrogen. (The localised bright regions on the photograph are formed by overlapping images in spectral lines near to 1216Å.)

This observation was made from an Aerobee 150 rocket launched from Wallops Island which carried instruments prepared by the Astrophysics Research Unit in collaboration with other groups in the UK, USA and Canada (as reported in Quest, April 1970).

'Guard Van' from which trespassers could be repelled from the site and in which we, the press or others could be briefed, harangued, or fed as the case might be.

The objectives were to fire one rocket 75 minutes before totality, in full sun, and then to fire the other three in quite rapid succession, at totality, at totality plus 2 minutes and at totality plus 8 minutes. Since each rocket would be in the air for about 6 minutes we would have two rockets in the air at once, for several minutes. This meant that the last three rockets needed separate telemetry frequencies. Hence the triplicated receivers.

Immediately on arrival at the range Tony and I had to check out all twelve experiments (Lyman Alpha, X-Ray and Solar aspect experiments, four times each). A few long days and all our experiments were checked, fitted to the payloads, and working.

The rockets were Canadian Black Brant III vehicles, single stage, 10" diameter, solid fuel, each launched off a separate rail type launcher. They were spin stabilised by virtue of canted fins, but were despun from 8 to less than 1 rev. per second shortly before the clamshell nosecone was ejected. Release of the nosecone exposed our sensors to the sun, and allowed deployment of the Langmuir Probes which Dr. McNamara, the chief experimenter, was flying to measure electron and ion densities. The nosecone also had to come off to make Dr. Belrose's experiment work, as only then could his receiver detect the RF pulses from the ground station, and measure differential absorption. If those clamshells refused to open, the mission would be a write off, so we were interested to see what held them on. It was a short stainless steel hawser, the same multistrand high tensile wire that is used in a yacht's rigging. This held the two halves together and was to be cut by an explosive chopper. I visualised the mess that wire would make of an ordinary chopper but tried to share the Canadians' confidence that the very opaque stainless steel shells closed over our precious experiments would deploy when the clockwork timer, started by the thump of launch, had counted off 45 seconds to the appointed time.

The payloads were not to be recovered after flight, so all our data was to be obtained from the radio telemetry link, using IRIG on frequencies around 250 MHz.

Six days before the eclipse there was the first of the planned dummy count-downs. In this operation everything was done except the pressing of the firing buttons. In fact a few artificial catastrophes were put in. The mains electricity supply failed, and we switched to the two diesel generators for auxiliary power (there was also a spare diesel generator!). We had a surprise as we were told that our experiments were drawing double the expected current on two rockets. Perspiration. Feverish checking of our signals. We found no fault in them. Then we realised that both the rockets affected were sharing one ground power supply. It was the meter not the current that was wrong. The Canadians changed their meter, and we breathed again.

The dummy run was so successful that no more were required. This was just as well, because the Sheet Harbour disease struck almost the entire crew. We English were spared, and the reader will be spared details.

We next suffered ordeal by visitors, with the NRC's own photographers making a comprehensive cine record, followed by the Press, and then by the CBC radio coverage, with tape recorders, interviews and short dummy count-downs ad nauseam.

The day of the eclipse was a long day. The launch team were on site at 0200 hrs. We were on site at 0500 hrs. The count-down went on, about an hour ahead of schedule. Two things could stop the firings, either high winds, or ships in the target area. There was no wind but eight ships, with about three hours in which to get rid of them. The lobster fishermen were obliging and stopped to fish just outside the danger zone. The Russian trawler obediently steamed radially away from the predicted point of impact. The American ship's radio operator appeared to be having his coffee break, and they steamed radially towards the impact point, where they would arrive just as we were due to fire our first at 1343 hrs. Fortunately they heard us at 1200 hrs and got out fast.

We had cameras ready to photograph the spectacular solar corona at totality, and to take progressive shots of the occulting disc. We had worked out that one needs a x 10,000 filter to photograph the sun itself, and we had one at the ready. Relentlessly during the morning the sky clouded over and was opaque just in time to obscure the occulting sun completely. This meant we could concentrate on photographing the rockets (and on monitoring our experiments!). Our efforts were rewarded.

The rockets all went off with split second accuracy. The clamshells worked . . . everything worked. Even the eclipse was on time. Although obscured by cloud the rapidity of darkening during the final minute is most impressive, and one can well understand the fear produced among primitive peoples.

After the eclipse was over there was a marked 'rosy glow' particularly over East Quoddy. It is not normal for a rocket flight to be perfect. Four essentially perfect flights are worth celebrating. This we did, at lunch next day in the Guard Van, with Crackling Rosé wine and 80 (Eighty) lobsters between 30 of us. They were cooked for us by the nearest local inhabitant (who lived 20 yards away!) by name Byron Publicover, and with a name like that, no wonder he could cook lobsters.

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experiment

Intricate tracery of shape and glass,
Or metal finely tuned and
chatting lights,
Endowed with beauty born of
function.
Which secrets to you hold
and which will yield
To benefit mankind or cause him ill?
And will he use them wisely –
is he now
Adult in knowledge,
childish still in wisdom?

Nona

one o'clock shock

'You remind me of the incident of the clock and time-gun in Egypt. The man in charge of the time-gun fired it by the clock; and the man in charge of the clock set it right by the time-gun'.
A. S. EDDINGTON: 'Space, Time and Gravitation', p.3

Bill Napier

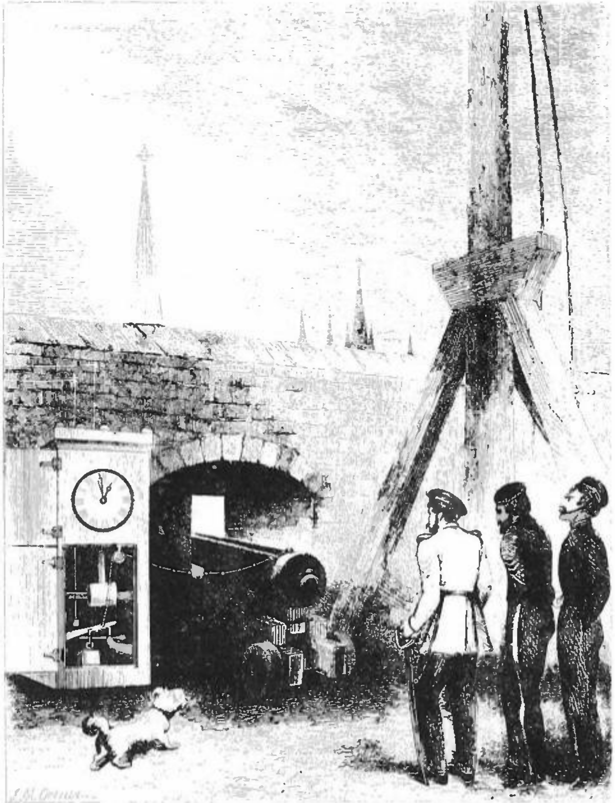
Edinburgh's Royal Observatory prides itself on being a most up-to-date establishment responsible for all sorts of innovations such as the GALAXY machine. The truth is, there is a skeleton in the cupboard, in the form of an antiquated Edinburgh tradition: the daily firing of the one o'clock gun. Nervous citizens have protested down the years, but this time-gun still shakes the city every day at 1 p.m. It is fired from the battlements of Edinburgh Castle, situated on a high escarpment dominating the city and therefore well placed to maximise the blast.

Although now a mere relic from the past, regulation of the time-gun was once a prime function of the Observatory. The link dates back to the mid-nineteenth century, when commerce in the city found itself increasingly hampered by the lack of accurate time-keeping. For navigational purposes, shipping interests also required a daily time check. In 1855 Edinburgh Chamber of Commerce attempted to meet this need by erecting a time-ball next to the Observatory which at that time was situated on Calton Hill at the East end of Princes Street.

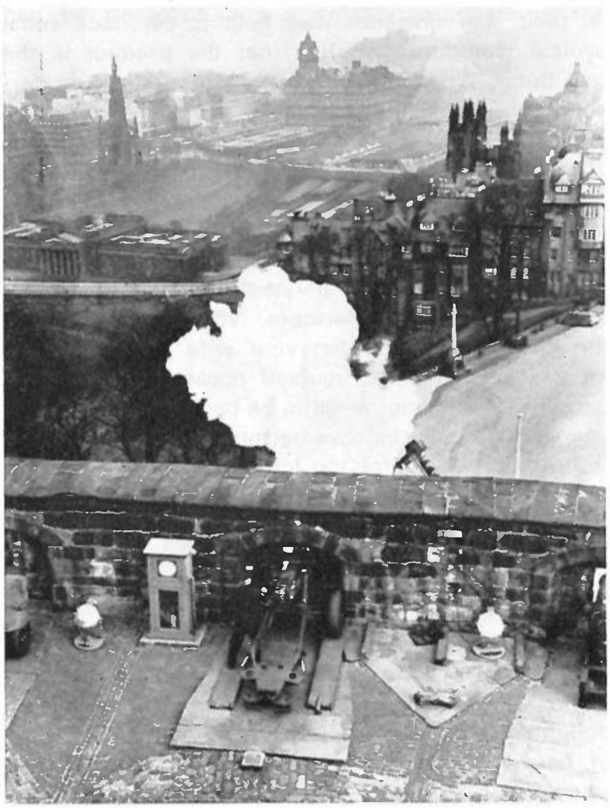
The experiment was not a success. In bad weather the ball was invisible from the Firth of Forth, and in high winds the Observatory staff lacked the courage to raise the heavy ball on its column. And so there arose the idea of a time-gun, as recorded in the Proceedings of the Royal Observatory, 1861: 'The electrical time-ball, daily worked by the Observatory has given rise amongst the citizens of Edinburgh to a desire to have its visible manifestations supplemented by an audible signal, in the shape of a cannon in the Edinburgh Castle, to be fired by electrical signal from the Observatory. This desire has not only manifested itself at the meetings of public commercial companies, but also in the collection of so large a subscription to pay for the expenses of the connecting wire, and the gunpowder, that Her Majesty's Government have been pleased to entertain the proposal to some extent, and experiments were lately made by the military in the Castle, as to the best size of gun, charge of powder, and general position.'

Eventually a 24-pounder cannon was chosen. Con-

Dr. Bill Napier is a Senior Scientific Officer engaged in stellar atmospheres and close binaries.



The Firing of the Time Gun 1861 and . . .
1961 (photo below by courtesy of Scotsman Publications)



nection between Observatory and cannon was by means of a steel wire which carried in one gigantic span from Nelson's Monument (on Calton Hill) to the Castle. For its time this was a remarkable engineering feat. The wire was 0.2 inches in diameter and weighed 3 cwt.; it stretched 4,020 ft. in a catenary with a central dip of 155 ft.

A trigger mechanism fired the cannon automatically. In spite of its Heath-Robinson appearance *(see illustration)* it could boast an accuracy of 0.1 seconds. Nowadays the gun is regulated by a crystal clock giving electronic pulses accurate to five milliseconds, but since hand firing has replaced the automatic trigger, the precision has deteriorated to $\pm$ 5 seconds.

Daily firings of the gun, synchronised with the falling of the time-ball, began officially on June 7th 1861, and created quite a stir amongst the local population. The Proceedings of 1862 record :

'From the Royal Observatory, Edinburgh, we hear of the usual round of official duties performed. The first and most prominent of these consists of the double system of time-signals, the visible and audible, which are kept up daily from the two chief hills of the city, under the electronic control of the Observatory and the interested surveillance of the citizens, but with a decided bias in favour of the "gun" over the "ball".'

The 'double system of time-signals' was beset by many troubles over the years. The fuses did not always ignite the gunpowder: snow or high winds broke electric cables; and only eight months after the official inception of the time-gun, a flash of lightning magnetised clocks in Castle and Observatory and set fire to Nelson's Monument.

The *useful* lifetime of the one o'clock gun was rather brief: electric clocks, connected at first to the Royal Observatory, were to supersede the time-gun within a generation. Eventually the introduction of radio was to remove all necessity for direct connection between the Observatory and town clocks. However the daily firing has become an institution and it earns dollars. Edinburgh's gun is likely to thunder its contempt for the nervous for many years to come.

home brewing

Alan Dobbins

'Genius of Health, thy grateful taste
Rivals the Cup of Love
And warms each English generous Breast
With Liberty and Love'

from Hogarth's engraving Beer Street.

If you are in favour of an increase in your prosperous presence – read on. But if you want to keep your coat buttoned and your prosperity in the bank – don't! Alan Dobbins' major pastime – and, incidentally, he helps to look after the finances of SRC as the Head of Finance II at London Office – has taken him through the money saving *(sic)* stage, followed by the purchase of big time equipment to the haven where he has a cellarful of his own home brew – some tens of gallons of wines, beers and liqueurs. He has other spare time interests but we thought this one would appeal most to some *Quest* readers, particularly the members of the wine circle at RSRS.

One good reason for starting home wine making is that for an imbiber, it is perhaps the only acceptable alternative to buying drinks which always seem to fall in the top tax bracket. Then in wine making, the brewing of beer can play an important part – for to achieve a mature wine of two years' vintage, one may well need another thirst quencher to get through the waiting period! Whatever the motive, the number of home brewers is certainly on the increase and so is the circulation of the amateurs' wine making journal, and the number of books published – though not all of these are very reliable or helpful. The ingredient for wines and beers are now to be found in many more shops, together with a splendid array of both simple and more complicated aids and equipment.

The only equipment needed to brew the first gallon is a one gallon jar or plastic bucket, three feet of polythene or rubber tubing, a piece of polythene sheet to cover the containers, a rubber band to hold down the sheet and the courage to start the whole chain reaction. For after the first success you are almost sure to be hooked, and you will then be able to consider using thermometers, hydrometers, wine-ometers and what-have-you-ometers, and a wide range of additives – rated as essential by some and as pure science fiction by others – as tools to help man in his struggle with nature and natural processes.

Perhaps it is easiest to start by assembling the basic items, buying a tin or jar of concentrated grape juice (for the kind of wine you fancy) or a can of hopped malt and then just following the instructions on the label – these amount to little more than adding water. If the results are pleasing, then is the time to think about trying more intricate recipes and buying specialised equipment.

At a more advanced stage, even if you use the gadgets only as an occasional check to prove that the specific gravity of the brew is what you think it is, their very presence may help to persuade some cynical would-be samplers that the product is the real thing. When they ask for yours again in preference to, say, whisky or gin – you know that they think it's good or that perhaps they have some ulterior motive.

To help in making his beverages Alan has built a corner unit in the kitchen with a lid instead of a door, which hides – in a 19in. by 14in. space – nine one-gallon high-density polythene jars of liquid fermenting at room temperature. **NB** – before altering the kitchen, be sure that your wife is prepared to let you have it all to yourself occasionally, remembering that drinking needs to be backed up by replenishment in regular batches because home brewed beer is best not stored for too long. With practice it can take less than an hour to prepare a new lot of two gallons and to rack and bottle the previous batch. Most of Alan's wine is made from various types and makes of concentrated grape juice (largely bought at discount in six gallon lots). The rest is a wide miscellany including low cost and seasonal fruits, such as pear and banana – the bananas acquired 'black' at 6d. a lb from a local greengrocer who was delighted to find a buyer. One neighbour gave 14 lbs of hard pears which soon became soft enough to transform.

Wine can be prepared in large, medium or small quantities (one gallon and five gallon containers are generally easily available and most convenient) so it takes its place as a less demanding hobby. A consumption of three bottles a week by the family – there are four teenage children – and their visitors requires a total stock of about 50 gallons if one aims at a two year maturing period. This sort of stock allows plenty of wine for cooking (his wife is strictly a consumer not a brewer) and the rest of the bottle can be tipped away without feeling that it would be extravagant not to drink it up then and there.

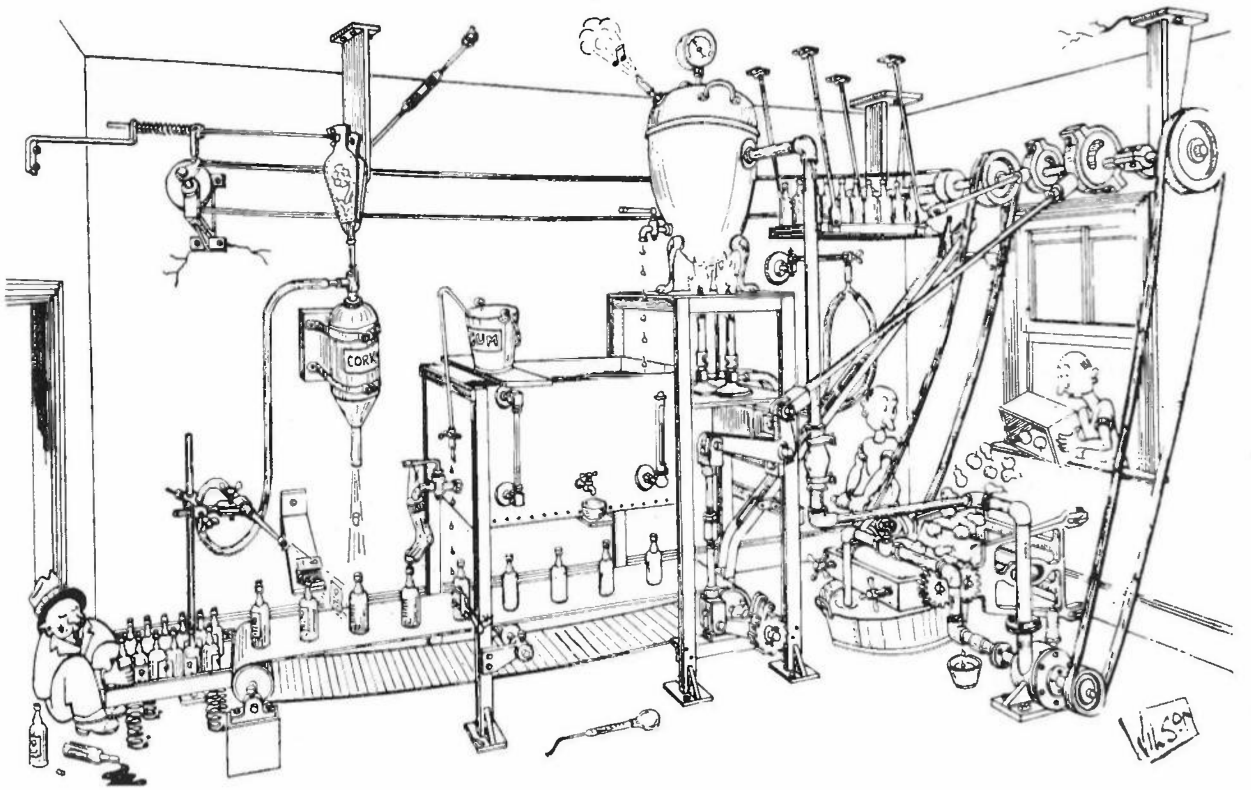
As with 'antique' furniture there is a short cut for people who hate to have to wait until the wine matures. Alan tried it out for the benefit of members new to his local wine circle who thought waiting would be the greatest drawback. By use of a thermostatically controlled and heated container and an 'aging' ingredient, he produced a clear and apparently mature wine in no more than a month. Both old and new members agreed it was good and the method was rather 'clever' but the arguments on the ethics were protracted and unresolved. Perhaps it is rather a commercial trick to play on oneself.

Things are not always what they seem. A 'one gallon' jar may hold 8 pints or it may take 9 or only 7 and bottles may be 26 fl oz or 20 so their halves can be 13 or 10 or even 8. Such minor irritations should be turned to good account – *viz* opened wine can be decanted into a smaller container where,

The subject of this article declined to have his photograph taken but did agree to be represented by the cartoons which are reproduced by courtesy of the 'Amateur Winemaker'.

without air, it will keep better. If every empty jar is well rinsed with tap water then rinsed again with sterilising solution and restoppered, it will be standing ready for use. (**NB** – but don't rinse with tap water *after* sterilising!) However, some will argue that this sort of sterilising is sheer hocus pocus.

It is best on the whole not to take the process too seriously or the memory of the small accidents may loom darkly behind the latest success. On one occasion one of Alan's children, then aged ten, spent an almost sleepless night worrying because he heard his mother shrieking, as he thought, 'Alan! Alan! Swine! Swine! When he crept in to breakfast, looking miserable, he was told what had happened – to cheer him up. With the coming of Spring and rising ambient temperature (not, as some would have it, the breaking into bloom of the flower on which the wine was based) a doubly stoppered gallon of wine had started to ferment again and at midnight from its cupboard high on the wall it had suddenly cascaded in torrents just as his mother passed. She certainly shrieked as she ran but what she shouted was 'Wine! Wine!' It was three in the morning before all the mess was cleared up and the next day another 15 gallons of wine had to be started to use up



ingredients wetted by the deluge, before they went 'off'.

If you have read this far to try to find out how to brew a drop of the hard stuff, we will whet your thirst by saying that you can make liqueurs for as little as 10s to £1 for a whole bottle, although the initial outlay for the high proof spirit may be 55s for $\frac{3}{4}$ pint plus a few shillings for liqueur extracts, each of which is supplied with its own recipe, and pennies for the sugar. There is a method using wine from which some water has been removed (but not, in this case, 'distilled') which you can find out from your nearest home brewer – and there are quite a lot of them around in SRC.

That is all *Quest* is prepared to say at this stage about the connoisseurs' delight, in case some innocent soul should be led astray and laid out by the crock of gold before he has learnt how to find the rainbow. We shall be happy to give more space to the whole subject in future if it turns out that a large number of our readers are not teetotal. Indeed we will go so far as to suggest that SRC socialities should run a competition for the best recipes and invite us – purely for journalistic interest – to taste the prize selection.

Quest Quarterly Quote

hard times

'Gentlemen,

We have an immediate need for a copy of "Research in Britain: a Non-weeping Formula for Living on Tight Funds" by Sir Brian Flowers. Please send us a copy, without charge.'

Request from an American University following the Chairman's recent speech at Nottingham University.

(2) strangers in the night?

'Employees who are in subsistence classes B or C, and who are required to travel by rail alone at night, may occupy a 1st Class sleeping berth if the alternative is to share a 2nd Class berth with a stranger.'

from SRC General Notice 15/70

stop here . . . . I'm getting out

Laurie Lintern

'Juliet 13, taxi, first solo – Juliet 13, you are clear taxi – runway 21 left hand, the QFE 1004. Standby fire tender, crash crews'.

So here I was, nine months after leaving the Rutherford Laboratory, about to do my first solo flight. An intense interest in flight coupled with a childhood love of the sea and ships added up to the decision to fly in the Royal Navy. The forms went off and a few weeks later I found myself facing the Naval interview board. Three weeks later came the news that, to my great delight, I had been accepted for training as a pilot.

After a life of comparative ease (?) at the Rutherford Laboratory for five years, I looked forward to Britannia Royal Naval College Dartmouth with some trepidation. A gloomy June day saw my arrival at Dartmouth to join 21 Flight of naval air cadets. Within half an hour my civilian clothes were in the locker and I was wearing naval battledress. Our initial basic training was to last six weeks, during which time we did not leave the College. I began to feel like a prisoner although at the same time I did actually feel better for getting up at 6.30 a.m. and going to bed at 10.30 p.m. The Parade training (square bashing) and gym went on and on, hours per day.

Very soon it become obvious that I was going to be the worst drill pupil for some time to pass through Dartmouth. I couldn't march, I didn't know left from right, my co-ordination was awful. When I stood to attention one shoulder was higher than the other, especially with a rifle. I think I brought more trouble on other people because they laughed at me than I brought on myself. It was several weeks before I could laugh at myself, and as I walked around in my spare time I used to practise marching, turning and saluting, which most people found simple but which I found immeasurably difficult for some reason. The amount of trouble I took to sort out my mistakes was rewarded at the end of term when – by a supreme effort – I managed to survive the purge of ham-fisted individuals prior to the review by Earl

Mountbatten, of officers passing out. This was to be his last review while a serving naval officer.

The main difficulty at Dartmouth was the fact that the discipline was more suited to cadets at the normal entry age of 18. For people of my age, then 24 (and some cadets were older), the discipline came as rather a crunch. As the Chaplain observed after returning from visiting a colleague at Dartmoor: 'Those chaps' (the inmates) 'have a darned sight easier life than you'. If the discipline was strict there were many compensations. Every afternoon we did an activity – which usually meant taking a boat out on the River Dart or out to sea. This I found great fun as I was keen on watersports and the scope was tremendous. I learned to sail – from dinghy to ocean racing yacht – manoeuvre a twin engined picket boat and even take charge of an inshore minesweeper, which we took to the Scilly Isles. The minesweeper was kept at Dartmouth for training air cadets on their condensed course in practical seamanship. After the first six weeks we were allowed 'ashore'. (One always goes ashore from a naval station, shipborne or on dry land). The shore leave amounted to about two evenings a week on average and, of course, we really lived it up in local pubs during the time available. The hand of discipline was still with us though: we had to be back at the College by 10.30 p.m.

During our time at Dartmouth we had our first flying experience on Tiger Moths. These were the last few the Navy possessed and we were one of the last courses to use them, as they changed to Chipmunks shortly afterwards. It was great to be in the air at last, in fact it was the first time I had flown. I didn't have very much trouble learning to fly the Tiger Moth, only at one stage my landing approaches weren't too good. As my instructor observed: 'Most pilots aim to put their aircraft down on the airfield; now maybe you have some new idea about flying or something but I can't quite understand why you always aim to put it down on the field *before* the runway!'

With the Dartmouth course finally completed after eight months basic naval training, I passed out as Sub-Lieutenant. At last we were going on to serious flying, alhough I looked back on my time at Dartmouth as being very enjoyable despite the tough discipline and continual slog. We went next to RAF Linton-on-Ouse in Yorkshire to join No 128 Royal Naval fixed wing pilots course. Here we would do our basic flying training up to wings standard in the Jet Provost. The life was quite a change from Dartmouth: the men called you 'Sir', saluted you and you even had a cup of tea in bed and your shoes polished! Discipline was more relaxed and it became obvious that this was necessary with the pressures that an intensive flying course puts on one. Flying, and particularly learning to fly, can make one very tired. After two weeks basic ground school where we learned about all the aircraft controls and systems we were at last airborne, firstly for an hour's work-free ride looking at the area and how the aircraft performed. This is perhaps the only full trip where one can sit back and look out of the canopy. The trip thrilled me tremendously, up there above the cotton wool clouds, climbing, diving, turning, looping and finally recovering through the cloud on radar. The next trip was down to business with only 10 to 15 hours to achieve your first solo flight. After a couple of trips I did my first take off, which was one of the best I did pre-solo. This initial period of training was a marvellous time and the chatter among friends after the day's flying went on for hours in the bar.

Then came the time for first solo. To be ready to fly solo certain basic points and skills had to be learned but basically if you could take it up, do one circuit of the airfield and bring it down safely you were OK. To recognise and take action in a stall or

The author – seen above left and on right beside a Tiger Moth – is an Experimental Officer at the Rutherford Laboratory in the Cambridge University team engaged in an experiment on Nimrod. How he got back there is another story – to be continued.

Jet Provost Mark IV
(photo by courtesy of the Ministry of Defence)

spin is essential. Then you have to know all the emergency procedures, how to take off and climb, turn, fly straight and level and descend at the correct rate for a safe landing.

All this seems to take a short time until, suddenly, while taxi-ing around for your next take off your instructor says: 'OK Stop by the tower, you're on your own' or 'Stop here, you're getting too dangerous for me, I'm getting out'. You sit there for about five minutes with the engine still running while the instructor's ejector seat is made safe and strapped down. This seems to take hours and you continually watch your fuel and engine instruments. But all keeps running well and you call the tower using your own call sign for the first time. 'Juliet 13, taxi, first solo'. '13, taxi, runway 21, left hand, the QFE 1004'. Handbrake off, pull away nice and straight, mustn't make a fool of myself now. You halt at the holding point before the runway, do your checks, call for take off. Your clearance comes and you line up with the large centre lines of the runway. Not much time to worry about it really. Full power, fire warning light out, RPM, JPT, oil pressure – all OK. Brakes holding. Right, go. You let off the brakes, build up speed, lift the nosewheel and up you go, a nice steady climb up to 1,000 feet, throttle back and commence a level 180° turn.

Then, suddenly, just before you do your downwind checks for a landing, you notice the instructor's seat is empty and it looks *very* empty. This is the first time you have had time to think about it since take off and the thought comes as a revelation: 'I've got to get this thing down'. You rush through your downwind checks, calling: 'Juliet 13, downwind to land' adding perhaps under your breath 'I hope'. Then you start working again, checking the wind to decide the best place to turn in, then throttling back, entering a descending turn – the woods and fields rushing below you and looking closer and closer. Then you are lined up and on the glide path, full flap down and speed right, over the boundary fence and 'bump' onto the runway, nosewheel down and 'phew, made it'. Then you remember you have to brake. You push hard on the brakes and your legs feel like jelly.

With your first solo over you approach flying with a great deal more confidence and you spend the next five hours doing nothing but circuits and 'bumps', or roller landings where you continue and take off again. This is done in various configurations to simulate all cases of emergency. After your five hours circuit consolidation you go out of the circuit for an area reconnaissance. This consists of flying around the local area, picking up the landmarks you have already been shown and returning safely to the airfield. There is a direction-finding facility worked on the radio transmission from your aircraft which enables air traffic control to give you a course for home.

The life was very enjoyable at Linton-on-Ouse and we had a very close-knit course. We were a good team both in the bar and on the sports field and sometimes even in the air. We had started flying in earnest, had gone solo and many of the initial worries were overcome. The way ahead was now clear.

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in loving memory of –

In loving memory of –
Who?
Who are we bidden remember?
H.L.W. and M.C.W.
Forgotten initials and forgotten
names.
They put the trough there
Thinking that horses last forever,
But horses, like men,
Become out of date.

And so the trough chokes up
A loving memory
Soon forgotten.

AP

newsfront

Congratulations to Mr. James Hartshorn who received an MBE in the Birthday Honours list. Mr. Hartshorn retired from the SRC London Office on May 31, 1970, after a long and interesting career in the public service.

Born on October 1900 in Calais, France, of English parents–his father was born in Nottingham (famed for its lace) and was a manufacturer of high class novelty laces* – he was educated in France and Switzerland then entered his father's business. In 1930 he became the British Pro-Consul at Calais and from 1934-40 he was Vice-Consul. But on May 21, 1940 he had to close the Consulate and evacuate the English colony on the HMS Venomous, under heavy fire of enemy planes and the advance of German troops.

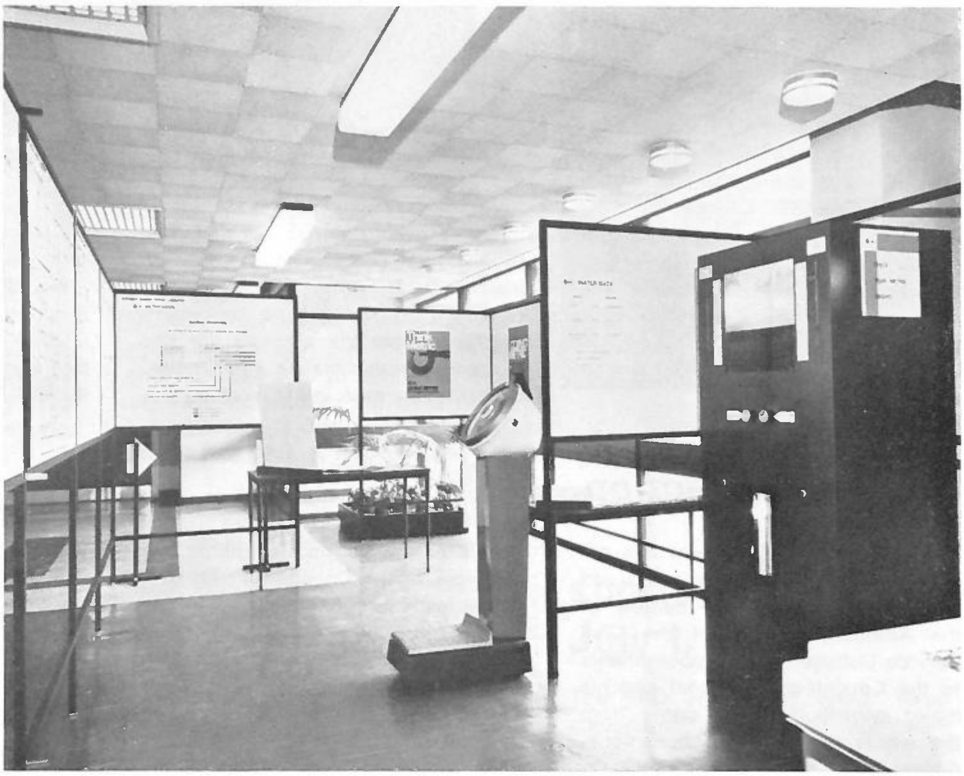
While in Calais he was sub-agent for the General Steam Navigation Company and, for many years, church warden of the English church. He married Margaret Elaine, who is a teacher and the daughter of the late Dr. Rayner, Senior Radiologist and Physician of Preston.

Early in 1941 he joined the Ministry of Economic Warfare (MEW), then the Foreign Office, the Control Office for Germany and Austria, the Board of Trade (TIDU) and finally DSIR (also LLU) where he came over to the SRC in 1965.

Mr. Hartshorn has made wide and detailed historical research relating to the English influence, the Colony and the celebrities of Calais. He is a member and correspondent of the 'Amis du Vieux Calais' and the Historical Society of the North of France. He therefore looks forward to a very busy retirement!

** (Nottingham made cotton laces (Malines and Valenciennes) while Calais went in for the silk, rayon and tinsel evening dress laces such as Chantilly.)*

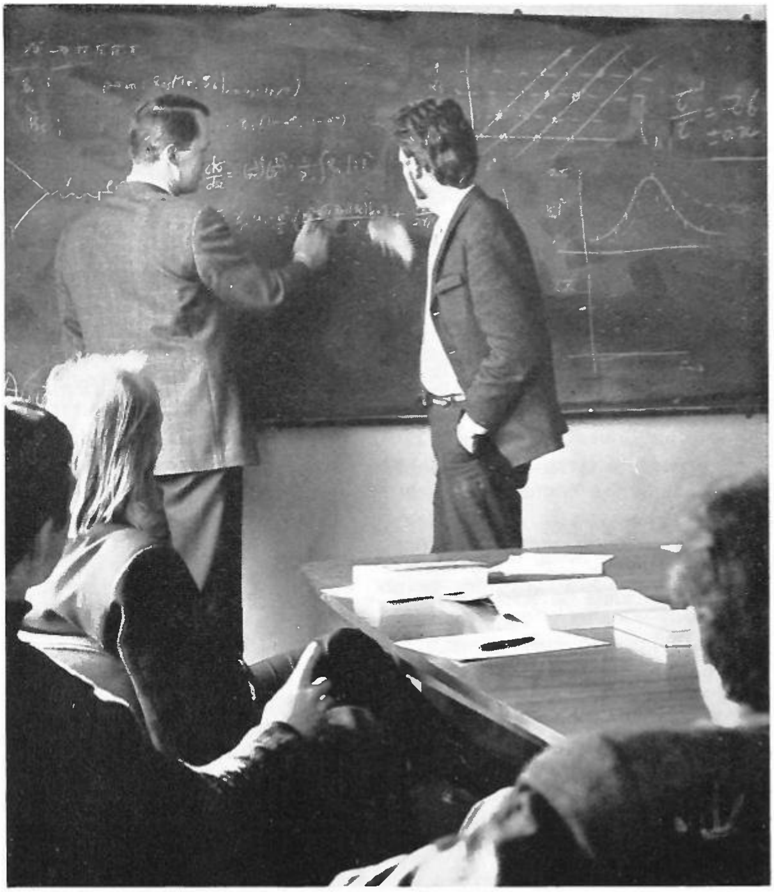
a measure of things to come



Metrication was the theme of an exhibition held at Daresbury on 1–5 June. The Exhibition presented metric units and measures and was specially devised to encourage direct thinking in metric terms, and so metric/imperial conversion factors were deliberately excluded.

Static display and working models, from a fashion model (vital statistics) to a colourful water flow rig, served to illustrate the basic and derived units. The weighing and measuring machines to check personal metric statistics (seen in the picture above) helped to drive the message home (by shock tactics we presume, since a mere 10 stone (imp.) equals 64 kilos!).

new theory group



On right, members of the recently formed Theory Group at DNPL discuss an application of the 'Veneziano model'. The group functions under the leadership of Professor A. Donnachie of Manchester University. (photo Arthur Pickett DNPL)

Congratulations *to Dr. R. W. P. McWhirter of the Astrophysics Research Unit who has received a special merit promotion to Senior Principal Scientific Officer, for original research work of a very high standard. The promotion was recommended by the special panel which reviews the work of scientists conducting research of high calibre, in Government and other public service establishments.*

Dr. McWhirter has carried out fundamental research in the field of plasma spectroscopy with particular reference to the atomic processes involved when the plasmas are not in local thermo-dynamic equilibrium. Of particular note is his work on the statistical mechanics of such systems and his experimental determination of electron impact excitation functions for multiple ionized ions.

SRC is also pleased to note that this is our eleventh special merit promotion – a very good record!

fultonism in action

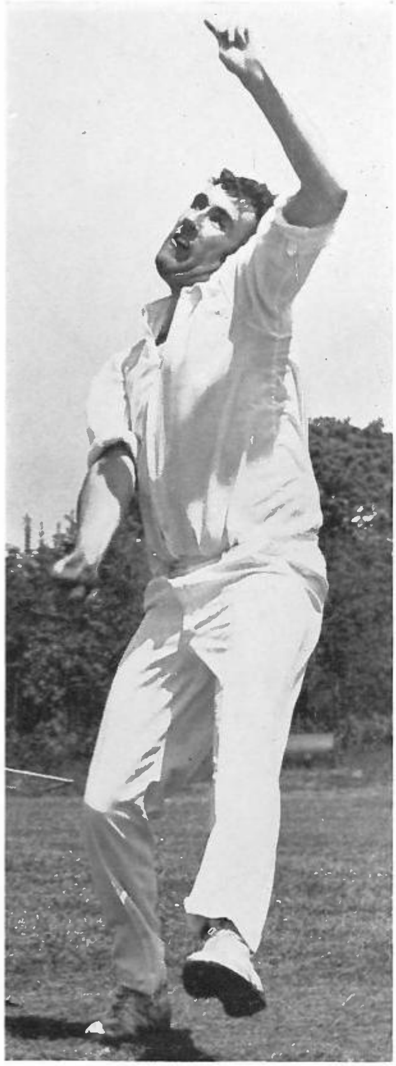
Professor Sir Brian Flowers has accepted an invitation from the Lord Privy Seal to become a member of the Advisory Council of the Civil Service College. While appointments to the Council are personal and his major contribution will come from the whole of his experience, nonetheless the invitation to the Chairman of SRC reflects the Council's standing with the Civil Service Department on training and other matters.

The recommendation to set up a Civil Service College to provide a central training centre for the Civil Service was one of the major proposals of the Fulton Committee. As the work of the College will be vital to the fashioning of the Civil Service of the future, the Advisory Council will be widely representative, with members from universities, business schools and polytechnics, local government, business management institutions, the National Whitley Council and senior members of the Home Civil Service and the Foreign and Commonwealth Office. Sir William Armstrong, Head of the Home Civil Service, is chairman. Mr. E. Grebenik, former Professor of Social Studies at Leeds University, is the Principal of the College with Mr. J. H. Taylor, formerly Director of Training and Education at the Civil Service Department, as Deputy Principal.

The College, which opened in June, has three centres at Belgrave Road, London SW1, Sunningdale Park, Ascot, and Atholl Crescent, Edinburgh. Its function is to provide central management training for both specialists and generalists. In the first year the College will provide courses and seminars for some 8,000 students and considerable expansion is planned for the future.

well done, sir!

We sometimes wonder what people are up to when they disappear into the fields around SRC's countryside establishments, but there is no doubt about the intentions of cricketer John Philcox of RGO, on right, photographed in action. Someone's stumps are going to be terrifically stirred for a long, long walk back to the pavilion!
(photo David Calvert RGO)



long service

Our best wishes go to Mr. B. F. Offen and his wife, photographed below, on the occasion of Mr. Offen's retirement from the Royal Observatory, Cape Province, South Africa.

Mr. Offen, a senior technician, served the Observatory for 32 years and for a previous eight years he was a technician at the Boyden Observatory in Bloemfontein. He also spent five years in the Royal Navy and sailed the Atlantic in armoured merchant cruisers in World War I. Married in 1918, he celebrated both his Silver and Golden Wedding Anniversaries at the Royal Observatory. In 1966 Mr. Offen received the British Empire Medal for services rendered to the Admiralty (the Observatory's parent organisation until it came over to SRC).

observed position

The most up-to-date Ordnance Survey map of the grounds of Herstmonceux Castle was published in 1909 long before the Royal Greenwich Observatory moved in. A new survey of the Observatory and the immediate surrounds has now been arranged, to be carried out early next year, and some work in the early stages of the project has already been completed by OS surveyors.

In response to requests for information made to the Observatory, the Ordnance Survey has determined the following values for the National Grid co-ordinates of the centre of the building housing the Isaac Newton 100 inch Telescope:
E 56S 086 92   N 110 089.94

stop press

sports day July 1, 1970

The SRC Sports and Social Association no doubt wish you were there!

'Down Your Way' on BBC's Radio 4 network recorded at the Royal Greenwich Observatory – June 15.

QUEST

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QUEST

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Vol. 3 No. 4

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Cover picture shows an operator, Elizabeth Gillespie, studying a display screen which is connected on-line to a computer at the Daresbury Laboratory. A description of how the system works is on page 6. Photo Arthur Pickett, DNPL.

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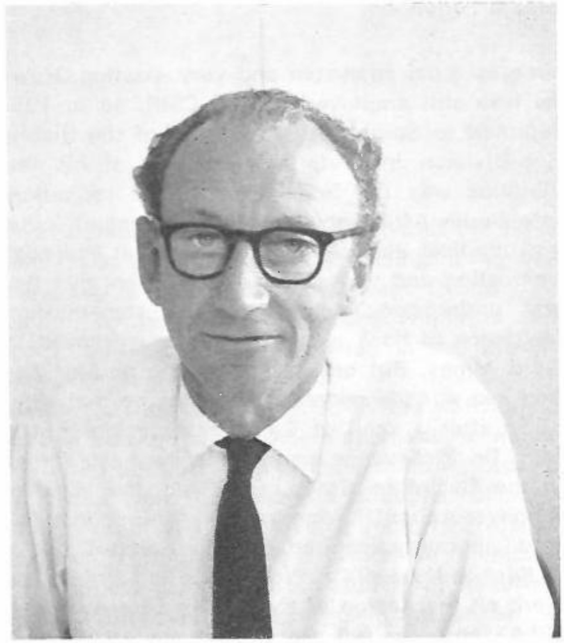
profile

Dr. G. H. Stafford, Director

Rutherford High Energy Laboratory

'The Science Research Council is a very exciting organisation to work for, concerned as it is with fundamental research in conjunction with University scientists. It has great potential in the future for one has faith that some form of fundamental research will always grasp the imagination of scientists and that the Rutherford Laboratory will be associated with this work. Our work at the moment is very exciting, but we must have the necessary flexibility to change wth the science.'



Exciting organisation; exciting work; potential; flexibility; faith; one feels that these words are the key to the mind of this quiet spoken man. His deep and genuine interest in everything that is happening at the Laboratory at all levels is apparent from his habit of quietly visiting various sections of the establishment to see and talk to people about their work. His insistence on good communication as a basic essential of the successful running of the Laboratory is also evident. He is very approachable and has what is an invaluable asset for those in command, the common touch. He has a mind which has been described as both probing and analytical. This probing mind, as many people can testify, can be devastating in a discussion as the slightest suspicion of a weakness in any statement is demolished immediately.

Dr. G. H. Stafford, Director of the Rutherford Laboratory for the past year, was born in England in 1920 and moved to South Africa with his family at the age of eight. There he attended the Rondebosch Boys High School then continued his education at the University of Cape Town. Life in those early days was not all study, as he played both rugby and soccer, although his favourite pastime was surfing at the Strand Beach. He took his M.Sc. in physics in 1941 having spent some of his final year on research into cosmic rays resulting in the publication of his first paper on 'The Second Maximum in the Rossi Curve' in *Nature*, April 1942 and his second 'The Production of Cosmic Ray Bursts by Mesotrons' in the Proceedings of the Royal Society in 1944. Further studies were interrupted by the second world war when in 1941 Godfrey Stafford joined the South African Naval Forces as a Lieutenant Electrical Officer concerned with de-gaussing work in the southern hemisphere. The Temporary Commander of the South African Naval Forces from 1941-46 was Professor Goodlett who had taken the Chair of Electrical Engineering at Cape Town in 1940, eventually leaving that post in 1950 to take up an appointment at the Atomic Energy Research Establishment (AERE) Harwell as Head of Engineering Research and Development, a post he held until 1956. In the early days of his naval service, Lt. Stafford was based on Robben Island, which before the war had been a leper colony. Since the war it has become a prison camp! He then moved to Durban to take over command of a new de-gaussing unit. After 18 months' service in the southern hemisphere he came to England (in 1943) to undertake research work on radar at the Admiralty Research Establishment near Haslemere in Surrey, but after a period on dry land decided that a sea-going appointment was preferable. His final move in his Service life came when he joined, on recommissioning, a fighter direction ship based first in home waters and later with the East Indies fleet.

With the end of hostilities came the opportunity to resume his education and he entered Gonville and Caius College, Cambridge, as Ebden Scholar of the University of Cape Town, obtaining his Ph.D. in 1950. During his time at Cambridge he had become interested in nuclear physics, but his future career was still somewhat obscure. As he says himself: 'Nuclear physics was mostly a shot in the dark as I could have chosen a number of other lines, including crystallography.'

At the end of his time at Cambridge he accepted a post with the South African Council for Scientific and Industrial Research (CSIR) under Sir Basil Schonland who was at that time President of the Council, and later Director of AERE. Dr. Stafford came to AERE, Harwell, under this appointment in 1949 and stayed for just over two years. For the last part of this period he worked on the Cyclotron under the Group Leader, Dr. Pickavance. He recalls this time as most enjoyable and very exciting. However, he was still employed by the CSIR, so in 1951 he returned to South Africa as Head of the Biophysics Sub-Division in Pretoria. Here part of his responsibilities was the importation of all radio-isotopes into South Africa and the development of industrial and medical applications. The work at Pretoria was interesting and varied; for example, an investigation was undertaken using radioactive tracers into the incidence of hook worm in natives employed in the Gold Mines. But one feels that the nuclear physics bug had already penetrated deeply, so that when, in 1954 after a spell of $2\frac{1}{2}$ years in Pretoria, a letter from Dr. Pickavance arrived offering a job at Harwell in the Cyclotron Group, CSIR lost the Head of its Biophysics Sub-Division and the then unborn Rutherford Laboratory acquired a future Director.

Back at Harwell Dr. Pickavance had already started work on the design of the Proton Linear Accelerator (PLA) and the full story of those early days has already been told (see *Quest* Vol. 3, No. 1, Profile of Dr. Pickavance, and *Quest* Vol. 2, No. 3, Research at Rutherford). The Rutherford Laboratory came into being in 1957 with Dr. Pickavance as the first Director and Dr. Stafford as the Head of the PLA Group. The PLA was still under construction at this time achieving its first full energy beam in 1959. By 1963 with the PLA a well established machine he extended his activities and became responsible for the high energy physics programme for Nimrod.

In December of that year a large reorganisation took place at the Rutherford Laboratory resulting in the formation of a number of Divisions in place of the original group structure. Dr. Stafford became Head of the High Energy Physics (HEP) Division whilst still retaining control of the PLA until some time in 1964.

The completion and commissioning of Nimrod made 1963 a year of intense activity and excitement. The experimental programme had to be prepared ready for the full operation of the machine and the HEP Division, as it became at the end of 1963, was and still is responsible for the organisation and the co-ordination of the high energy research programme on Nimrod. This brings the Division into close contact with visiting teams from universities and other research establishments, especially as a large percentage of the research physicists and supporting staff in the Division are attached to visiting teams. The setting up of such an organisation was a mammoth task, but his experience in setting up a similar if smaller organisation in the PLA obviously proved of great value.

On the first of April 1966 Dr. Stafford became Deputy Director whilst continuing as Division Head of High Energy Physics. During this period he also worked as a member of one of the research teams on Nimrod. For many years he has had a close association with CERN, the European Organisation for Nuclear Research, and still attends the CERN Nuclear Physics Research Committee. He was a keen supporter of the idea of a European Physical Society (EPS) and became a Member of the Steering Committee for its formation. He later acted as Scientific Secretary to the Organising Committee for the inaugural meeting of the Society which was held at Florence in April last year. At the present time he is Chairman of the Conference Committee and as such attends meetings of the Executive Committee and the Council of the EPS.

He regularly attends major conferences throughout the world, has found time to visit all the leading laboratories and has written over 40 papers. This intense activity has given rise to many a story that (a) he never sleeps and (b) he lives at the Laboratory. Readers are assured that he does have a house in Abingdon and he has in fact many interests outside physics.

In 1950 Dr. Stafford married Helen Goldthorp Clark, an Australian biologist, who is at present having a year off from teaching. He has a son of 19 who has just finished his first year at Cambridge where he is reading mathematics, at his father's old college, Gonville and Caius. Twin daughters of 17 complete the family and they are attending the John Mason School at Abingdon.

Motoring has always been an interest and during his years at Harwell he owned three Rileys. The first was one of the famous Monaco fabric bodied cars, and this was followed by a rather obscure 6 cylinder model. The final Riley was the 1.5 litre, the last of the conventional models. *Who's Who* lists camping as one of his recreations and this interest and a growing family brought a change in his motoring, so the Riley went and in its place appeared a Mark VII Jaguar. These days he is seen around in a red Hillman Imp.

He confesses to a liking for holidays in Italy, remarking on the need 'to dry out once a year'.

He is also very fond of exploring the English countryside, in particular stately homes and churches. An outward sign of this is a brass rubbing by his son which hangs behind his desk. However, the demands on his time limit such trips to the nearby Cotswolds. Music is another interest and he is a regular supporter of the Abingdon and District Musical Society. He is a keen theatre goer and he and his wife visit Stratford-upon-Avon whenever the opportunity arises.

Asked by a journalist what his aim in science was, Dr. Stafford said: 'A better understanding of the world around us.' One feels that 'the world' is not limited to nuclear physics but includes human beings as well.

council commentary

£1M A YEAR FOR ATOMS MOLECULES AND PLASMAS ++ BEST DATA YET FROM SKYLARK SPACE
PROBE IN SOLAR ULTRA-VIOLET SPECTRUM ++ SYMPOSIUM ON ELECTRON AND PHOTO INTERACT
++ £59,000 HARDWARE FOR MULTI ACCESS COMPUTER SYSTEM ++ BRITISH EXPERIMENT IN ORI
ING SOLAR OBSERVATORY OSO-G ++ FIRST LUNAR SAMPLES FOR BRITAIN ARRIVE AT SRC ++
FOR CONTROL ENGINEERING RESEARCH ++ ANGLO-AUSTRALIAN TELESCOPE CONSIDERABLE CONTI
BUTION TOWARDS SCIENTIFIC DISCOVERY ++ RSRS PARTICIPATES IN UK4 SATELLITE TO MEA
INTENSITIES OF ELECTROMAGNETIC RADIATION ++ DEVELOPMENT IN ANALYSIS OF BUBBLE CH
BER PHOTOGRAPHS BY SWEEPNIK AIDED BY SRC GRANT OF £40,473 ++ SUCCESSFUL LAUNCH OI

June. Following the earlier discussion at the May meeting, the subject of the future of co-operative European space research was taken up again and advice was tendered to the Government on the issues arising at the forthcoming Ministerial meeting of the European Space Conference.

Six grants recommended by the ASR and NP Boards were approved. These included the continuation of support at £200K p.a. or more each for three large groups; Professor Boyd's space science group at University College, London, Professor Cassels's bubble chamber film analysis group at Liverpool and Professor Wilkinson's electrostatic generator group at Oxford. A grant of £65K over 2 years continued the support of the exciting cosmic radiation studies by Professor Fowler (Bristol) using photographic emulsion exposed at balloon altitude, in which some of the tracks appear to have been made by elements heavier than uranium. The Council endorsed a proposal to carry out at a cost of £240K a design study for a possible major nuclear structure facility at Daresbury. Finally, a draft of the annual report for 1969/70 was considered, and its completion and issue was authorised.

July. As so often at the last ordinary meeting of the academic year, the agenda for July was long and varied. There was an interesting discussion of a proposal that the SRC ought to support short courses for its research students, to develop their interest in and aptitude for work other than research. An interim panel, with Dr. D. S. Davies as Chairman, was set up to develop the proposal.

Increases in the estimated cost of the S-68 experiment to be installed in satellite TD-1 have been a cause of concern to the Council, and earlier in the year the Chairman had appointed a committee of enquiry into the matter. He was now able to report the committee's recommendations, aimed at preventing any repetition in future projects. The full review of the design for the experiment had also been completed, and a revised cost estimate of £1.2M was submitted. Taking into account the international commitments involved, continuation of the experiment on this basis was approved.

The draft report of a joint working party of all the Research Councils on pollution research was considered, and with slight amendment was accepted for publication jointly with the other Councils. This will be the first such joint publication on a matter of common interest. The Council considered the Royal Society's report on postgraduate training in engineering and technology (the Lighthill report) and comments on it by the Engineering Board. The latter were accepted, and are to be published in the Board's forthcoming programme review.

Nineteen grants, recommended by the ASR, Engineering and Science Boards, were approved, while one was referred back for further consideration. Most of these grants were of moderate amounts, but they included a grant of £300K over 5 years to Professor P. B. Hirsch (Oxford) for the development of electron and ion optical techniques for studies of materials, one of £215K over 3 years to Professor M. W. Thompson (Sussex) to provide a 3 MeV accelerator for solid state and ion implantation research, and one of £176K over 3 years to Professor J. F. Coales (Cambridge) for work on the adaptive control of industrial processes. The Council also accepted a proposal to give some support to the Institut des Hautes Etudes Scientifiques, a high level research institute in France which is considerably used by British mathematicians, and is becoming more and more international. For the Atlas Computer Laboratory, additional equipment costing £170K was approved and for the Royal Observatory Edinburgh, upgrading of the electronics of the Galaxy machine was approved at a cost of £60K.

The conclusion of the industrial productivity agreement with the Trade Unions was reported, and was welcomed by the Council. The Council also heard a report on the successful visit by representatives of the French Centre National de la Recherche Scientifique, headed by their Director General, Professor Curien, for discussions with the Chairman and staff, and visits to SRC and university laboratories.

Quest Quarterly Quote

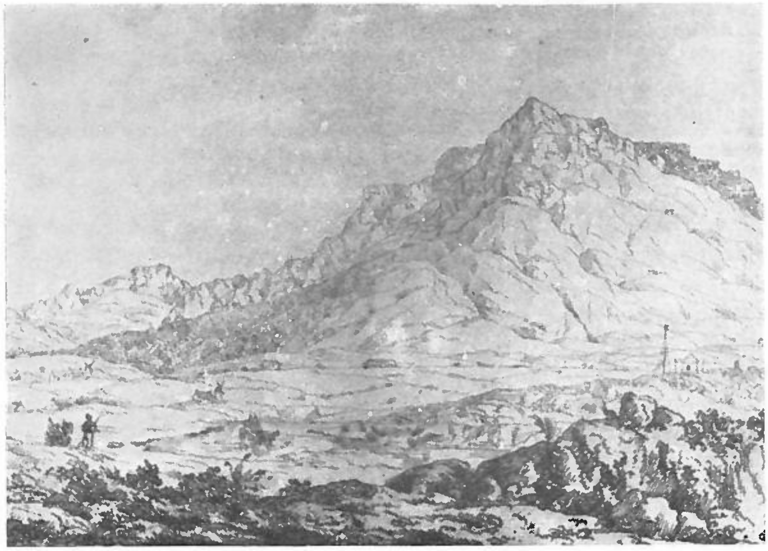
'What does it cost?

These [grants] pay University fees and £530 p.a. for a young single fresh graduate and up to £955 for a married man of 24 with a child and approved experience'.

from a University brochure sent in for SRC to approve before publication

150 years at the cape

G. M. Harvey



Devil's Peak, as seen from a point close to the Observatory. The drawing is by Sir Charles D'Olyly, made on May 17, 1833. This is a scene which all Cape staff remember, except that now, of course, the flat ground, and even the lower slopes of the mountain, are covered with suburbs and freeways.

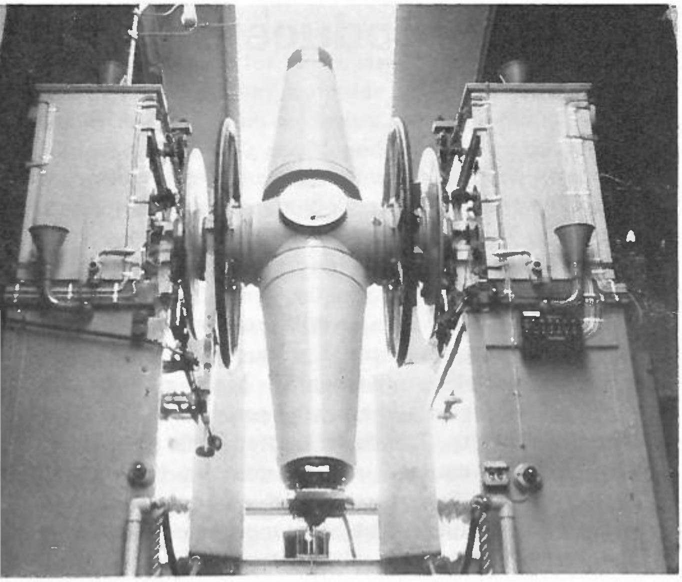
This year the Royal Observatory at the Cape of Good Hope celebrates its 150th Anniversary. Although an excellent article by John Alexander about the Cape Observatory appeared in *Quest* two years ago (Vol. 1, No. 4, pp. 6-9), it was felt that the Sesquicentenary could not be allowed to pass by without mention – hence this review.

The Royal Observatory was established in October 1820 'for the improvement of practical astronomy and navigation', and was placed under the control of the Admiralty. The Reverend Fearon Fallows was appointed the first HM Astronomer at the Cape of Good Hope, and on his arrival he set about selecting a site for the Observatory. He chose Slangkop, an isolated, rocky rise in the ground about three miles east of Cape Town. The name is Dutch for Snake Hill and was all too appropriate, as the creatures abounded there, as did mosquitoes from the marshes nearby, and a variety of other hazardous wild animals. However, it satisfied two requirements, sufficiently close proximity to Table Bay to enable time signals made at the Observatory to be visible from the harbour, and sufficient distance from the 3500 foot Table Mountain and Devil's Peak to afford an unobstructed meridian. Construction of the Observatory buildings took some years, during which time Fallows, in addition to his astronomical work, opened a school and taught the children of neighbouring farmers, the fees being one load of soil per lesson. The soil was used to cover the rocky site, helping to cut down the number of snakes and allowing vegetation to be grown.

Although some observations had been made in the intervening period, it was not until 1829 that the transit instrument, mural circle, and a new Harrison clock were ready for operation, and observing of star positions commenced in earnest. With these instruments, Thomas Henderson, Fallows' successor, obtained data which enabled him to make one of the first determinations of the distance of a star, a significant event in the progress of observational astronomy. The instruments were used until 1855 when they were replaced by an 8-inch Airy Transit Circle, twin of the one at the Royal Observatory, Greenwich, and this telescope remained in service until 1950. In 1905 a reversible transit circle, designed by Sir David Gill, was installed, and, with modifications made in 1950 and 1960 it is still in regular use.

Gill, who was the fifth HM Astronomer, realized the immense power of photography as an astronomical tool, and initiated a program which led to the publication of the Cape Photographic Durchmusterung, a catalogue containing the positions and magnitudes of nearly half a million southern stars. This was followed by an international project of a similar type, but on a much larger scale – the Carte du Ciel. A new telescope, the Astrographic 13-inch refractor was obtained for this programme, starting its service in 1892.

At the turn of the century the Observatory was presented with a fine instrument, consisting of two refractors, a 24-inch and an 18-inch, with an 8-inch guider, all on one mounting. Initially it was used for spectroscopy, but since 1926 its main use has been for the determination of stellar distances, motions, magnitudes and colours by direct photography. Direct photography, both for photometric and astrometric (positional) work, is also carried out on the MRM



The Reversible Transit Circle used for determining star positions.

The Observatory

(Multiple Refractor Mounting), which was acquired in 1964. As its name suggests, this instrument also consists of several telescopes on a single mounting.

The more modern technique of photoelectric photometry is exploited on several of the Observatory's instruments, most notably the 40-inch and 18-inch reflectors, both of which are in continual use for this type of work. Photoelectric photometry is a relatively slow method of obtaining stellar magnitudes in that it takes between five and ten minutes to obtain one set of measures of a single star, whereas one photographic plate exposed for, typically, thirty minutes, yields data on many, perhaps hundreds of stars. The advantage of photoelectric work is its much greater accuracy, essential for some aspects of astronomical research.

Until recently the Observatory was involved in a large programme of spectroscopic work, particularly radial velocities, using observations made with the Radcliffe 74-inch reflector at Pretoria. Photographic plates for sunspot counts have been taken for many years, and a solar flare patrol started at the time of the International Geophysical Year is still carried on. In 1967 a kinetheodolite was moved to the Cape from the Royal Greenwich Observatory and is used for tracking artificial satellites.

Thus, in its 150 years of existence the Royal Observatory at the Cape has always been involved in the broad advance of scientific knowledge, often well to the fore. To celebrate this Anniversary, an Open Day is being arranged towards the end of the year, when the Observatory will be open to the public. Those attending will be able to see the telescopes and have some of their questions answered. The pre-

G. M. Harvey is an experimental officer from the Royal Greenwich Observatory. He is at present on a three year tour of duty at the Cape Observatory (picture in 'newsfront')

-ceding afternoon is planned as a VIP occasion when distinguished scientists and administrators from all over South Africa will be invited to visit the Observatory. They also will be shown the various instruments, and have the work of the Observatory described to them. Following refreshments in the late afternoon, there will be a popular lecture.

In addition to these events, a special commemorative booklet, compiled and edited by Mr. J. D. Laing of the Observatory, is to be published in October. Copies of this will be sent to all SRC establishments and those interested will be able to read about the history and work of the Observatory in much greater detail than in the present article.

What lies ahead? With the amenities of a city close at hand, and the many material advantages of a technological society, the life of a Cape astronomer today must be very much more comfortable than that of his predecessor. However, the suburban sprawl of Cape Town, which has long since overtaken the Observatory, has meant not only the departure of the more dangerous of the local fauna, but the ruining of the sky by industrial haze and the glare of street lights, which make it impossible to use the instruments to their full potential. A most desirable step, clearly, would be to remove to a site with a better 'astronomical climate', a step which incidentally would serve to enhance the astronomer's appreciation of material comforts. Such a development we trust will come — but not even astronomers can foretell the future.

from the computers

The next four pieces are from computer folk – at work and play.

1. film analysis

At Daresbury, as at many other high energy physics laboratories, machines used for the manual measurement of pictures taken with bubble and spark chambers have been connected on-line to a computer. A programme in the computer is used to direct the operators and to check their measurements, with a view to eliminating errors which would otherwise result in the event being measured failing to pass through the subsequent analysis programmes.

The Daresbury system has been built up in modular form using standard components wherever possible. All forms of local output (*eg* punched cards, punched paper tape) have been eliminated, and communication between operator and computer is achieved by means of visual displays and keyboards rather than by the use of typewriters. The computer programme has been written in Fortran to facilitate programme modification and testing.

One machine has been equipped with a storage display scope, on which the display can be built up piece by piece and retained throughout the measurement of a picture. The operator's instructions are successively displayed, and a reconstruction of each measurement is made on the display, together with a representation of each track as determined by the computer from the measurements. Thus, at any instant, and in an easily understood way, the operator is shown not only what she should do next, but also all that she has already done. Any errors detected by the computer are brought to the attention of the operator by means of an audible alarm, and an error code displayed on the screen.

The photograph on the cover of this issue of *Quest* shows an operator studying the scope screen, on which are displayed the instructions (on the left hand side), the reconstruction of the measurements (crosses), and the representation of the two tracks the operator has finished measuring.

2. film producers

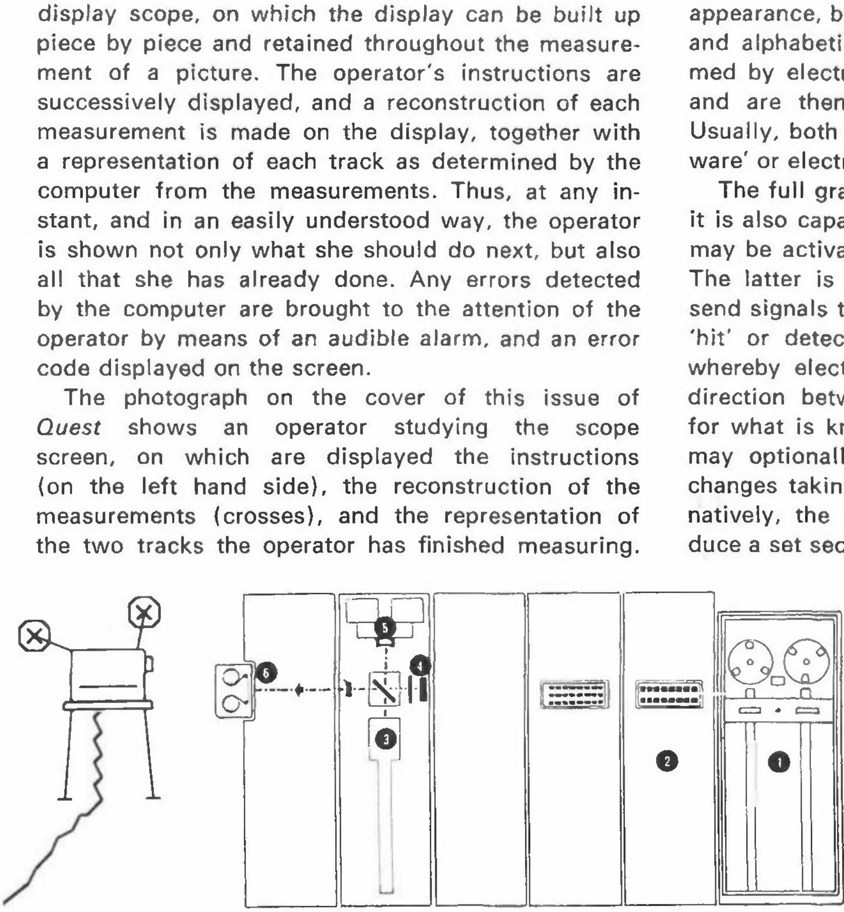
Paul Nelson

To many people, computer output means reams of fan-folded paper containing numbers and cryptic messages. The words are generally in one case only, *ie* capital letters, and to read very much of this soon proves irksome. This particular form of output originates from line-printers and still provides for the bulk of directly readable material produced by computers.

Sometimes electro-mechanical graph plotters are used as a means of summarising previously extensive numerical results. Trends in plotted data are readily seen and, of course, objects may be drawn and viewed from different angles. If character sets are made up using lines then both upper and lower case characters, as well as different alphabets, become freely available.

Although reasonably priced, the electro-mechanical graph plotter is not always fast enough to cope with some requirements. Recently, the more expensive Cathode Ray Tube (CRT) terminal has come to the fore. The simple form known as a Visual Display Unit or VDU is somewhat similar to a television set in appearance, but is only capable of displaying numbers and alphabetic characters. These characters are formed by electronic processes on computer command and are then displayed on the face of the CRT. Usually, both case sets are provided for in the 'hardware' or electronics of the terminal.

The full graphics terminal is more elaborate in that it is also capable of producing lines at any angle and may be activated by using a keyboard and light-pen. The latter is able to detect the displayed data and send signals to the computer as to the location of the 'hit' or detection point. Connected in this manner, whereby electronic signals are transmitted in either direction between computer and terminal, provides for what is known as 'on-line interaction'. The input may optionally be used to modify the output, the changes taking place virtually instantaneously. Alternatively, the computer may be programmed to produce a set sequence of pictures.



SD-4020 Microfilm Recorder (left)

1 Magnetic Tape Deck
2 Buffer Unit
3 Cathode Ray Tube
4 Forms Flash Unit
5 16mm or 35mm camera
6 Photo-paper camera

These terminals with no mechanical inertia to overcome provide for high speed output. The graphics terminal can display complex drawings in seconds and it is from such a device that cine-films can be made. A camera is positioned in front of the screen (see diagram) and is set off in synchronisation with the picture changes. The general appearance of these films is mainly one of lines, alphabetic characters and symbols on a high proportion, in area, of uniform background. They have more in common with cartoons than of normal, or continuous tone, films. The lines and characters may be positioned as the result of highly complex mathematical calculations carried out by the computer, which an ordinary animator would find virtually impossible to match. And it is in this area that computer films are of importance in the teaching and scientific applications field. Artists are also becoming increasingly interested in these products as a means of expression.

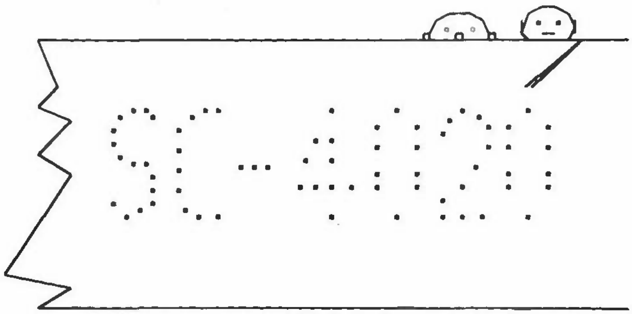
Graphic Terminals are not generally suited to quantity production of high quality film output and machines have been specially developed. One such device known as a CRT microfilm recorder manufactured in the USA by Stromberg DatagraphiX is installed at the Science Research Çouncil's Atlas Computer Laboratory, Chilton.

The microfilm recorder operates from instructions prepared on magnetic tape, produced by programs running on an ICL Atlas computer. In some installations these recorders are connected 'on-line' to the computer, *ie* connected by information-carrying cables, for immediate response. Standard programs save the user knowing in detail how lines and characters are specified to the recorder. For example, he could draw a cross by punching the following statements on two program cards:-

```
CALL LINE (300, 500, 700, 500)
CALL LINE (500, 300, 500, 700)
```

The commands are then automatically recorded on the magnetic tape in the form required by the recorder. The information is later read from the tape into a buffer store, and after decoding electronically, the electron beam within the CRT traces out the two lines in rapid succession.

Pointing at the tube face are either a 16 mm. or 35 mm. camera and a camera containing photo-recording paper for enlarged 'hardcopy' prints. In addition to lines, characters formed by extruding the electron beam through an etched matrix can also be displayed and recorded. The aperture setting remains fixed for a particular type of film, and since the CRT and cameras are in a light-tight cabinet the shutters generally remain open during the time a job is running. The time-interval between frame advances varies depending on the information content of the frame or picture. Whilst the film is being advanced under tape command, further display instructions are held up until the film is again stationary. Typically, lines and points are plotted at the rate of several thousand per second.



To produce a cine-film, the 16mm cine camera is used with black and white negative stock in 400 foot cassettes. It is possible to use colour stock, but as the phosphor of the tube emits light mainly in the blue region of the spectrum, the colours that can be obtained are rather restricted. By making use of a form slide projector, provided for superimposing constant information on the displayed data, but using colour filters, the blue trace may be combined with a coloured background in order to provide colour variations. The addition of a second, different colour filter, replacing the shutter itself allows for further modification in the colours. Opening and closing the now translucent shutter at suitable instants during the production of a frame give two colour plots on a third background colour.

The black and white film is processed in a small 16mm/35mm table-top microfilm processor at either $3\frac{1}{2}$ or $2\frac{1}{2}$ feet a minute, but colour film, when used, is sent to a commercial film processing laboratory.

Cine-films of any length are readily produced from short sequences by printing from A and B chequerboard rolls which is a method for preventing joins on the print from showing on projection. Some difficulties have been experienced with high contrast prints made on silver stock since the line work is very fine in certain instances. Although Diazo film appears suitable for printing on, at the moment sprocketed feed printers do not seem to be available. This material is exposed to ultra-violet light and processed in ammonia vapour at a speed of approximately 20 feet a minute for this type of work.

In order to retain interest, camera effects such as zooms, wipes, mixes and fades are possible on the displayed objects using suitable computer programs provided for manipulation.

A film made to illustrate the routines available has been produced with a sound-track on magnetic stripe running at 16 frames per second. The professional who made the sound-track did so under protest as

from the computers

from the computers

the film industry standard is 24 frames per second. However, as computing costs are high, the small drop in quality in this instance with this particular sound track can probably be justified!

The film uses the forms-flash to show a background picture of the Atlas Computer Laboratory with the title of the film – 'FOCUS' – drawn by the microfilm recorder, superimposed. Various routines provided for simulated camera effects and for achieving other necessary functions, such as line-thickening, are shown. Then follows a sequence describing the method used by a contouring routine for handling randomly distributed points having known values. A dramatic view of the earth rotating produced from a program originating from the American Space project, and generated from over eight thousand pairs of numbers representing the coastlines of the world, is accompanied by suitably stirring music. This gives way to a sequence of the British Isles being rapidly drawn as if by hand. The information representing this map contains even more points or pairs of numbers than that used for the whole world in the previous example, giving much greater detail. These values were obtained using a digitiser, a machine that automatically punches out the co-ordinate as a hand-held pen traces the outline. A zoom-in settles on the Atlas Computer Laboratory again and a final 'mix' brings up the word 'END'.

Paul Nelson is a programmer with the Atlas Computer Laboratory. The film 'FOCUS' which is described here was shown at the 1970 British Industrial Film Festival, held at Brighton in June. Copies are available on loan from the ACL Library.

3. fish to watch

Adrian Buckel

I keep fish as a hobby; and when one day in February another member of our shift suggested having an aquarium in the entrance hall of the Atlas Laboratory, I agreed to help set up the tank and look after the fish. The Director and department Heads were all willing, so work was started and Mr. Roberts (Admin) and his staff were very helpful in setting up the aquarium. A poster describing fish that would live happily together in a community tank was hung on the entrance hall inviting volunteers to buy them. The response was very good – despite requests for Piranhas!

The tank measures 54 ins x 10 ins and is 15 ins high. It holds 29 gallons and has two under-gravel filters. We only have one heater as the tank stands above two radiators but usually a tank of this length needs two to keep the temperature between 78° and 80°F. The fish are fed twice a day by my wife Gaynor *(see picture)* who also switches the lights on at 8.30 a.m. and off at 5 p.m.

At the moment we have six different types of plants in the aquarium. They are Crypocoryne, Echinodorus, Vallisneria, Synnema and Micranthemum, also Aponogeton which has grown very well and has flowered many times. By this time next year the plants should be well settled and growing much thicker and faster.

After having trouble with fin nipping by Tiger Barbs, weak fish dying, and very hard water, the fish are settling down now and the guppys are breeding regularly. None of their fry have survived as there is not yet enough cover for them. A pair of Zebra Danios have spawned (the eggs being eaten), and a

4. computericks

INTRO
If FORTRAN is incomprehensible
And to speak it, you feel, indefen-
sible:
Then just read these verses
In our tongue(?) from Atlas –
And their FORTRAN seems less
reprehensible!
ED

1 There was a programmer from
Cuidad
Who made love to an engaged
card-reader; he'd
Scarcely begun
This ILLEGAL FUNCTION
When it monitored C TIME
EXCEEDED.
FRED

2 There was a nice punch girl
called Dora,
Whose dress shimmered like the
aurora,
The card reader action
Was a fatal attraction –
'Twas a difficult job to ignore
her.
APOLLO

3 There was a young coder from
Aix
Who fed the computer cream
cakes
When it started to burp
They gave it some turp –
Entine and ran the LOG.
FRED

4 One Supervisor was a woman,
The other wasn't quite human,
When they ran off together,
SHE was as light as a feather,
But IT had to come in the van.
APOLLO

5 *(Written on discovering the perpetrator of some unrepeatable doggerel about 'Fred' and 'bed' chalked on the author's blotter).*
There is a Yank student called
Rosenthal
Whose dog-ends on my floor
are oft squozen. Till
He happens to light
Some old gelignite,
We shall have to endure his vile
prose and all.
FRED

pair of Red Platys may soon have some young. These three types of fish are the only ones in the tank at present that will breed there: all the rest must have special conditions to breed. Except for guppys and platys, most of them are egg layers.

Below is a list of the fish we have. A little about them each is headed by the scientific and the popular name of the fish.

***Lebistes Reticulatus* or Guppy**

The Guppy is one of the best known tropical aquarium fishes. Most of the males are very colourful: no two have the same coloration. The Guppy is a live-bearing fish: it has up to 70 fry a time, and a female is fertile when only three months old.

***Xiphophorus Maculatus* or Platy**

The Platy is another live-bearing fish, having up to 70 fry a time, but not quite so colourful as the Guppy. There are red and black Platys in the tank.

***Hyphessobrycon Flammeous* or Flame Tetra**

Sometimes called Rio de Janeiro Tetra as they are found in rivers in Rio de Janeiro. We have not got any Flame Tetras yet, but they have been requested.

***Hyphessobrycon Innesi* or Neon Tetra**

This very pretty little fish found in Peru and Western Brazil is seen in the community tank in many homes. The rear lower part of the body is red, the throat (as you could call it) is white and a blue/green neon line runs from the eye to the caudal peduncle (base of tail).

***Hyphessobrycon Gracilis* or Glowlight Tetra**

Coloration is the only difference between the Glowlight and the Neon: the Glowlight has an orange instead of blue/green line, and the rest of the body is silver. Origin Guiana.

***Gyprinocheilus Aymonieri* or Sucking Loach**

The worker of the tank, origin Thailand, called Sucking Loach because of the sucker around it mouth which enables it to stick to the sides of the tank or leaves of plants. Is a very good scavenger so helping with the maintenance of the tank. The Sucking Loach has not been bred in captivity.

***Corydoras Paleatus* or Mottled Catfish**

A request for a catfish was made so I chose the attractive C Paleatus which often sits at the front glass and amuses onlookers with a frequent wink of the eye. Unfortunately our little catfish died which I was on holiday.

Adrian (picture in 'newsfront') and Gaynor (seen left) are Computer Operators at the Atlas Computer Laboratory.

***Brachydanio Rerio* or Zebra Danio**

Zebras are egg-laying fish from India, not so colourful but very active. One pair have spawned in the tank.

***Barbus Tetrazona* or Tiger Barb**

As mentioned earlier Tigers tend to nip fins; despite this drawback they are very colourful. Origin Thailand, Sumatra and Borneo.

***Rasbora Heteromorpha* or Harlequin**

These little fish look very nice in a school of a dozen or more in a well planted tank. Origin Malaya and Sumatra. Not easy to breed, but when they do they lay their eggs on the under side of leaves.

***Gymnocorymbos Ternetzi* or Black Widow**

Black Widows are found in Paraguay. They are egg layers, and very good community fish.

***Betta Splenden* or Siamese Fighting Fish**

In Siam these fish provided sport, much the same as cock-fighting did in England before it became illegal. The wild Bettas are found in Paddy Fields in Thailand, Cambodia and Indonesia. When breeding, the male Betta builds a bubble-nest at the surface and the eggs are put into this nest and cared for by him. Our Betta died from dropsy only two weeks after we bought him.

***Pterophyllum Eimekei* or Angel Fish**

Another well known tropical fish, with one drawback: they grow to 5 ins which is twice the size of any other fish in the tank, so we may have to move them and get some smaller ones later.

from the computers

why bother with contracts?

The following letter has been drawn to our attention by the Contracts Section at London Office and is reprinted, by courtesy, from 'Purchasing Journal', the official publication of the Institute of Purchasing and Supply:-

The Amateur Buyer

To the Editor of *Purchasing Journal*.

For more years than I care to remember, I have had trouble with the Amateur Buyer. Following a recent brush with one of our more senior AB's it occurred to me that young purchasing men, new at the game, might be glad of a viewpoint against which to examine their own. I realise the procedure will differ with each organisation but the principle, and the effect, is exactly the same.

Amateur Buyer contacts supplier and places unofficial order. In due course supplier despatches goods – without an order number. Goods receiving department has no record so when consignment is received it is placed to one side.

By and by, AB realises the goods he ordered have not been received so he asks purchasing department to find out where they are. When he has calmed down buyer rings supplier who says – 'What the hell, they were despatched two weeks ago'. Again, buyer loses his cool and forcibly points out that supplier had no right to accept without an official order – and he had better not do it again. Buyer checks with goods receiving department – consignment has been there for some time. You say buyer should have done this before ringing supplier. He, naturally, thought AB had done it. And AB? It would not occur to him.

Buyer contacts AB and tells him goods in stores. Asks for purchase requisition to cover.

AB goes round to stores and persuades storekeeper to release consignment. Promises to have official order raised at once so that delivery may be recorded. Alas, like mortal man the world over, AB having got the goods forgets to buy the mink coat, or in this case raise a purchase requisition.

Invoice section now ring buyer and want to know what to do with this invoice about which they know naught. Buyer calling upon gentlemanly instincts almost forgotten, restrains himself. Tells them AB

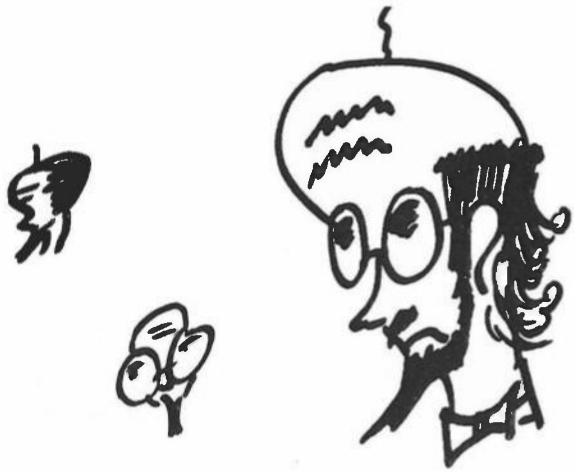
anglo-australian meeting

from the record

On 3-5 August 1970 the Anglo-Australian Telescope Joint Policy Committee met in State House. The Committee comprises Professor Fred Hoyle (Chairman on this occasion), the Astronomer Royal and Mr. Hosie for the UK and Dr. Bowen (Chief of Radiophysics, CSIRO), Professor Olin Eggen (Director, Mount Stromlo and Siding Spring Observatory) and Mr. K. N. Jones (Department of Education and Science, Canberra), for Australia. The meetings were also attended by Mr. W. Goodsell, the newly appointed Project Manager (formerly of MPBW) and Mr. H. Minnett, the retiring acting Project Manager (of CSIRO, Sydney). The secretariat was provided by Mr. D. Cunliffe, the AAT Executive Officer, assisted by SRC staff. Various consultants, including Professor Redman from Cambridge and Professor Gascoigne from Australia attended some of the sessions.

from the unofficial record

'Great hairy jumping roos!' Australians don't really talk like this, but you try to write in strine. It was the Wednesday before the Anglo-Australian Telescope Joint Policy Meeting. The occasion was a visit to Freeman Fox Partners (consulting engineers). A taxi laden with the AAT project team threaded its way through tourist London to Alliance House. ('This is *not* the entrance to the Caxton Hall. Freeman Fox, second



floor'). 'Great hairy roos!' for it was still the good old days and it was very hot and the mini skirts varied between micro and nano and the Australians were exceedingly impressed with London.

For about three weeks, the thirteenth floor of State House became travel bureau, post office, hotel booking service and general nursemaid service. At least five lots of visitors of different status were staying for different periods, all needing a private room, with bath, next door to State House as well as a large office with shapely secretary and good view.

Most of them had to settle for just the view . . .

The day of the meeting came: 09.55, five minutes to go – Could we have a shorthand typist to do just a has promised paper work but failed to keep word and would they please remind him.

A member of invoice section now contacts AB who says he will deal with it at once, which is quite funny, really. Supplier now rings buyer and asks why his invoice is being held up. Buyer, adrenalin surging through his veins, marches off to see AB. Raises hell and gets requisition made out there and then. But only after both have had such a row that they are capable of little productive thought for the rest of the day.

I realise I have exaggerated. Even so, the above is much too close to the truth for comfort. Something like it happens in most factories every day.

It creates an enormous amount of unnecessary work and wastes a lot of money. Breeds dislike and distrust between departments. Strains relations between buyer and supplier. Not to mention that no attempt has been made at price negotiation or cost saving and AB places no restrictions on the extent of his wheeling and dealing.

In my opinion, no company, regardless of size, can afford even one Amateur Buyer. That, of course, is a dream. He will always be with us. He is tough and resilient and when he cannot pull rank he will use charm, guile, bluster, or any other means at his disposal. And, as you may have gathered, I dislike him intensely.

You can't join him – not and run an efficient department – so you have no choice, have you?

H. SALLABANKS,
Purchasing and raw materials control manager.
Jas. A. Jobling & Co. Ltd.

It couldn't happen here? – well just read on.

Seen in a recent RL bulletin :

'UNDELIVERABLE GOODS. Will the person who ordered 6 single Welders Gauntlets from 'Greenham Tool Co.' by phone in May 1970 please contact Mr. D. B. Howe, Ext. 580 as soon as possible'.
Incidentally, who ordered the 3' x 2' x 4' Hopper currently awaiting collection in Offices Services Section at London Office?

perhaps that's why !

nutcracker no. 1 – studentships

The day after the committee meeting, five professors descended on the secretary. 'It's an outrage!' cried Professor Battie, 'I hear that I have 10 studentships, while Hazelnut has 6, Greenstick 7, Danton 8, and that rogue Ravage 11.' 'According to my sources,' said Danton, 'Ravage has only 7, while Battie has 8, Hazelnut has 9, Greenstick 11, and myself a paltry 10.' 'I wish that were true,' said Greenstick, 'but I hear I have only 10, Battie has 11, Ravage 12, Hazelnut 14, and Danton only 6.' 'My sources give Danton 7,' said Hazelnut, 'while I have 8, Ravage has 9, Battie 10, and Greenstick 6.' 'No, no!' exclaimed Ravage, 'As I hear it, Battie has 6, Hazelnut has 7, Danton 10, myself 11, and Greenstick 12.'

'We protest!' they cried in unison.

'It seems there are more false rumours than usual this year,' said the wise, honest and magnanimous committee secretary, 'in fact, each of you has given exactly one professor the correct number, and put precisely one professor in his correct place in the order. Needless to say, I can't divulge the actual numbers, but no two of you have the same number, and if you're worth your chairs, you should now be able to work out how many each of you has.'

How many studentships did each professor have?

Hint: Work out the order first. There are two possibilities. Solution on *page 28.*

(This is the first of a series of problems devised by Peter Casey, an SO at London Office on the Chemistry Committee. In certain quarters the various anagrams, puns and, in this case, personal references will no doubt strike a response of their own.)

little letter? (actually 4 pages, and, being Australian, having to be typed upside down). Could we have 7 copies of this by ten minutes ago? I don't seem to have brought my cigars. Has anybody seen Professor Hoyle? Will Dr. Bowen take a call from Sydney?

'Good morning gentlemen, shall we begin? I should like to start by welcoming to the meeting . . .'

It is always a good thing with all-day meetings for the members to be offered beer with their lunch. This ensures that the afternoon session proceeds at a pace more suited to the needs of the Secretariat (who, incidentally, should partake sparingly of the ale). At the end of the three days which the meetings occupied I had 28 pages of notes, including three attempts at a caricature of Professor X (enclosed), a very fine sketch of an air balloon and a drawing which would be of great interest to my psychiatrist. My Australian colleague had pages of notes including lots of clever points which I missed while drawing Professor X.

So there we were, four days to write the minutes – or else! – and they had better not be as long as the last lot. (I was already quite clear on that point anyway, for it is difficult to produce 50 odd pages of beautifully typed minutes out of 28 pages of scribble, including the Mongolfier plans). Well we did it and the Secretary has flown back to Australia – though why one *flies* to *down under* I don't know. *Secretary*

Wallingford, Berkshire, population 6,000, a small but thriving market town on the banks of the Thames, is of great historic interest. Its origins go back to the Saxon times and in fact the early fortifications in the form of earth mounds are still standing. The Danish King Sweyn destroyed the town in 1006, but by 1066 when William the Conqueror arrived on his way to capture London, it was a busy and prosperous place. The sensible folk of Wallingford threw open the gates of the town as William approached and thereby gained a unique right to extend its curfew until 9.00 p.m. each day – an hour later than any other part of the country. The curfew bell still rings every evening as it always has since that time.

The castle was built in 1071 and Henry II held a

the mayor of wallingford

Alec Goode (left) and above the Mayors' Party in the stainless steel car on their way to the Saluting Base.

Parliament there in 1154 and gave the town a charter in 1155. In 1349 the plague disrupted life leaving only 44 houses standing and further destruction followed during the Civil War when fighting raged through the town and the castle was demolished. A disastrous fire occurred in 1675 which destroyed many of the medieval houses.

The office of Mayor dates back to the 13th century and has been continuous except for a few years during the Civil War. On 21st May this year Alec Goode, Head of the Building and Mechanical Services Group at the Rutherford Laboratory was installed as Mayor of the Ancient Borough of Wallingford. Alec joined the Laboratory from the Capenhurst Works of the UKAEA and took up residence in January 1958. He was elected to the Borough Council in May 1963 and also represented Wallingford on the Berkshire County Council from 1967 to 1970.

In June, very early in his term of office, Alec and his wife visited the USA to take part in the Tercentenary Celebrations of the foundation of the town of Wallingford, Connecticut. The invitation for the Mayor and Mayoress to attend this function had been received in 1969. By the time the visit took place it had become necessary to charter a Boeing 707 at a cost of £9,500 to carry everyone.

On 26 June, 153 people travelled to the States, half the Council went, husbands left wives behind and wives left husbands behind – even the Mace was taken. Free accommodation was generously provided by the people of Wallingford, Connecticut. The party was met at Kennedy Airport by coaches and taken to their destination, 90 miles away, through a part of the States where the towns have such familiar names as Oxford, Plymouth, Bristol, Durham, Manchester, etc.

The celebrations started on the next day, Saturday, and lasted for a week. During this time Alec and his wife were kept very busy and in fact only managed one break, of only three or four hours, to themselves. The opening ceremony on Saturday afternoon commenced with a procession to the saluting base, led by the Mayors of Wallingford England and Wallingford Connecticut and their wives. The body of the car in which they travelled was made entirely of stainless steel and was valued at 58,000 dollars. Wallingford Connecticut, population 36,000, apart from being famous for its silver ware is an important centre for the production of stainless steel.

But to return to the opening ceremony – on arrival at the saluting base, the party which included the

First Councillor from the British Embassy and the Deputy Governor of the State witnessed one of the largest shows ever seen in the county. There were 450 units in the procession which took $4\frac{1}{2}$ hours to pass the saluting base. A barbeque followed and the first day ended with dances held all around the town – Alec and his wife visited four.

Sunday was given over to the religious aspects of life when they both attended two church services and three church receptions.

On Monday, a visit was arranged to New York for all who wished to go, and this was followed in the evening by a spectacular in which young people depicted the history of their town. The next day's events included a trip to Newhaven (now there's a familiar name) where both mayors were interviewed on the radio. Events followed so closely that Alec has some difficulty in recalling everything but he does remember the main event on Wednesday. This really was an unusual affair as a joint meeting of the councils from the two Wallingfords took place in front of a large crowd. During this meeting momentoes were exchanged, Alec Goode as Mayor of Wallingford, England presented his opposite number with an illuminated address and received in return a silver bowl.

And so the week passed with visits to fairs, theatres, Yale University and concerts. At one school Alec was presented with the Stars and Stripes which had been flying over the school. The flag will now be flown once a year at Wallingford, England on American Independence Day.

The final event, a dinner and ball was held at Choate School which is, one gathers, in the top bracket (the Eton and Harrow of the USA) and numbers amongst its former pupils John F. Kennedy and Adlai Stevenson. Here in the presence of the State Governor, local Congressmen and many other dignitories, Alec made his final speech.

The party returned home on Tuesday, 7 July having experienced hospitality that was both warm and generous.

Alec has some amusing stories to tell of this hectic visit such as the astonishment expressed that the Mayor of Wallingford, England received no pay. His opposite number serves for 4 years, is paid 11,000 dollars a year, and is head of the fire brigade and the police. This last office proved to be of great use as everywhere Alec went (with police escort) it was green lights all the way.

He got to know the police escort very well and consequently had a lot of questions to answer about the British police. Alec is still chuckling over their amazement when they learnt that their British counterparts did not carry pistols, not even when making an arrest.

All in all, a momentous start to Alec Goode's year of office; did he enjoy his visit – 'Yes, very much', was he glad to return to the ancient borough – 'Oh yes', – or was it 'OYEZ'.

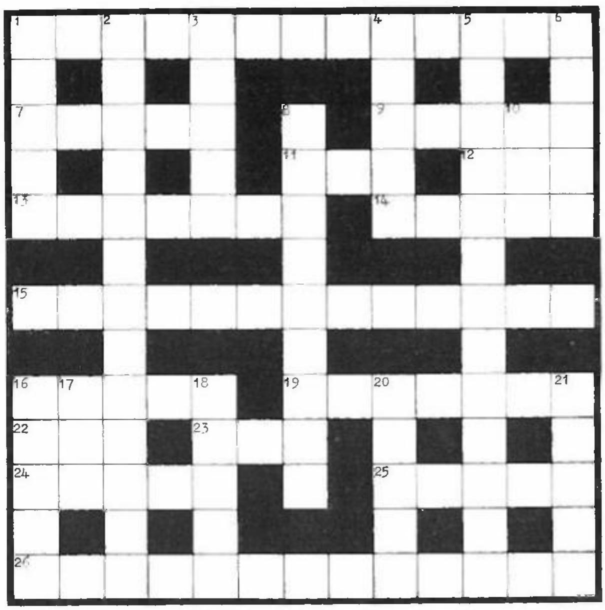
crossword

Across

1 More common but unusual (13)
7 Extend broken care followed by hard beginning (5)
9 A frontal plate far away initially followed by US intelligence (5)
11 Sappers contain nothing from the fish (3)
12 Owns a mixed ash (3)
13 Church of England following a German town to reality (7)
14 Smiling boy in a little right (5)
15 Bury the groups where they cross (13)
16 Gather one Weight (5)
19 A boy with a lob back gives a game of chance (7)
22 One of 17 down, or fifty with two points (3)
23 On foot to the east (3)
24 Bury among? (5)
25 Farewell a french god (5)
26 Inca die at pact confused and helpless (13)

Down

1 A point before a backward Ireland, strange! (5)
2 UK to USA or vice versa (13)
3 Pale like a chicken (5)
4 Deduce an inferno without negation (5)
5 Digger of the past (13)
6 As yet if mixed will rise (5)
8 Quietly felt bitter and gave (9)
10 Scot of 14 across (3)
16 Somewhere else, but I bail confused (5)
17 22 across and 10 down (3)
18 Razor sharp after its use (5)
20 Intended food containing pole (5)
21 Gauged, lost a note, became confused, and fell ill (5)



Set by Robert Marsh, RSRS (Assistant Experimental Officer in the Satellite Orbits and Predictions Group)

Solution on Page 28

London Office . . . where's that?

moving on

Having been very loth to leave the tremendous view behind, not to mention the tremendous extremes of temperature and the colossal down-draughts, some of the London Office staff in SUGA and the finance and establishment divisions have been moved down the road to 5-11 Holborn. Now that they are there, in the historic City of London, in a building ⅔ of a century old, very few would be pleased to move back again from their 'chambers' to the State House block. No regrets except that during the August downpours (and this year they seemed pretty heavy even for August) some of those back from early holidays did wish that the building had been made waterproof. The sound of tiny drops pattering into buckets made them quite home-sick for the shingle of the South coast. Old Bailey. Enterprising youngsters may be interested to note the proximity of Hatton Garden, the underground car park to hide the wagon until the bother (bovver?) has died down and it can be flogged in the Euston Road, and fifteen floors to hide the sparklers. Also, no doubt some honest citizens who would trade the chance of reward money for a share in a profitable concern. 5–11 Holborn has no place in history that we know of, unless it is as part of the trend to overthrow the four storey block in favour of the State House type of thing. But State House is quite well known round about London to people who remember when it was a rare sight, – like a lone pine amid the alien corn or perhaps, according to prejudice, a latter day Tower of Babel. Nowadays tower blocks increase and multiply (to continue in the style of the Authorised Version) at a rate that threatens afforestation on a Manhattan scale. We look for divine intervention – in 'their' direction, of course, not ours. They interrupt our uninterrupted contemplation of the panorama.

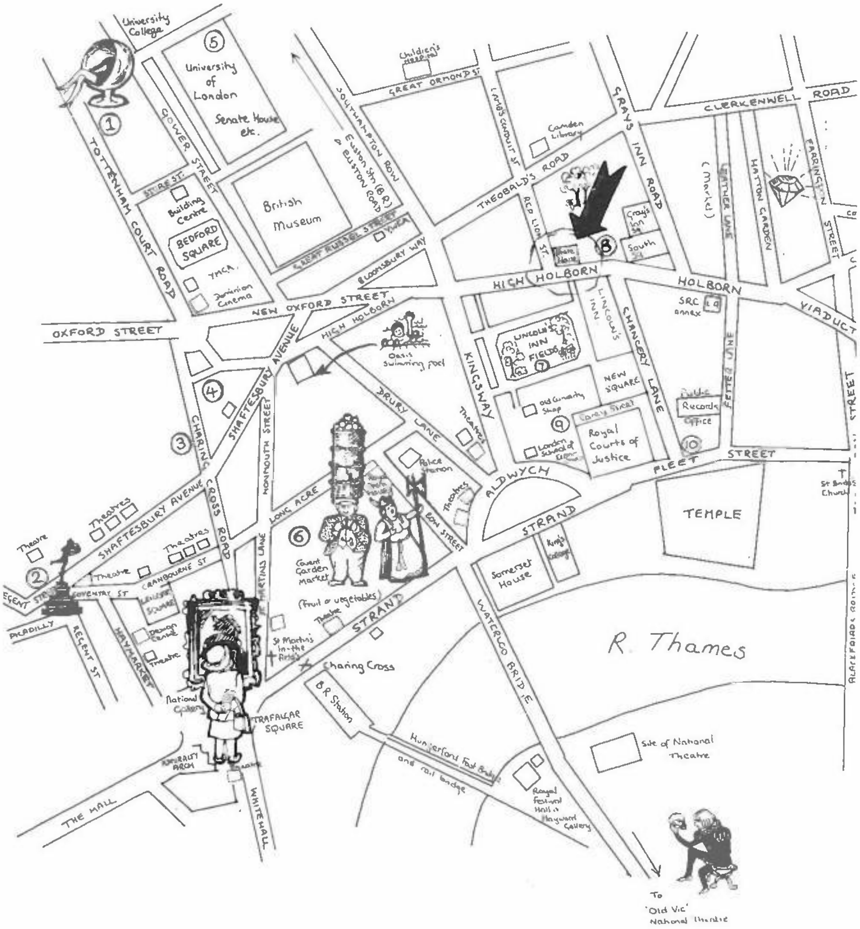
Picture on right: State House as seen by the man in the street (with a crick in his neck), the roof of which played a part in the film 'Herostratus' shown recently on TV – which was not, we thought, for the squeamish. Some think the encircling bands were a last minute save-all added by the builders, others that they are intended to spring apart when the balloon, so to speak, goes up. We wish we knew.

Picture on extreme right shows the venerable 5–11 Holborn. No, not that old! – it's the building second from right. Ye Olde Shoppes (nearest the camera) are 500 years old.

here 'tis

Being, as ever, concerned with the practical, we show the geographical position of SRC's London Offices.

The map is not so much a guide as a record for the benefit of your children to show the position of Dad's London office in relation to such historic places as the Tower of London, Piccadilly, LSE, and the



Anyone fancy an envelope?

We recently received one of those unopenably complicated American envelopes bearing the legend

'Columbian Natural Clasp no. 90N'

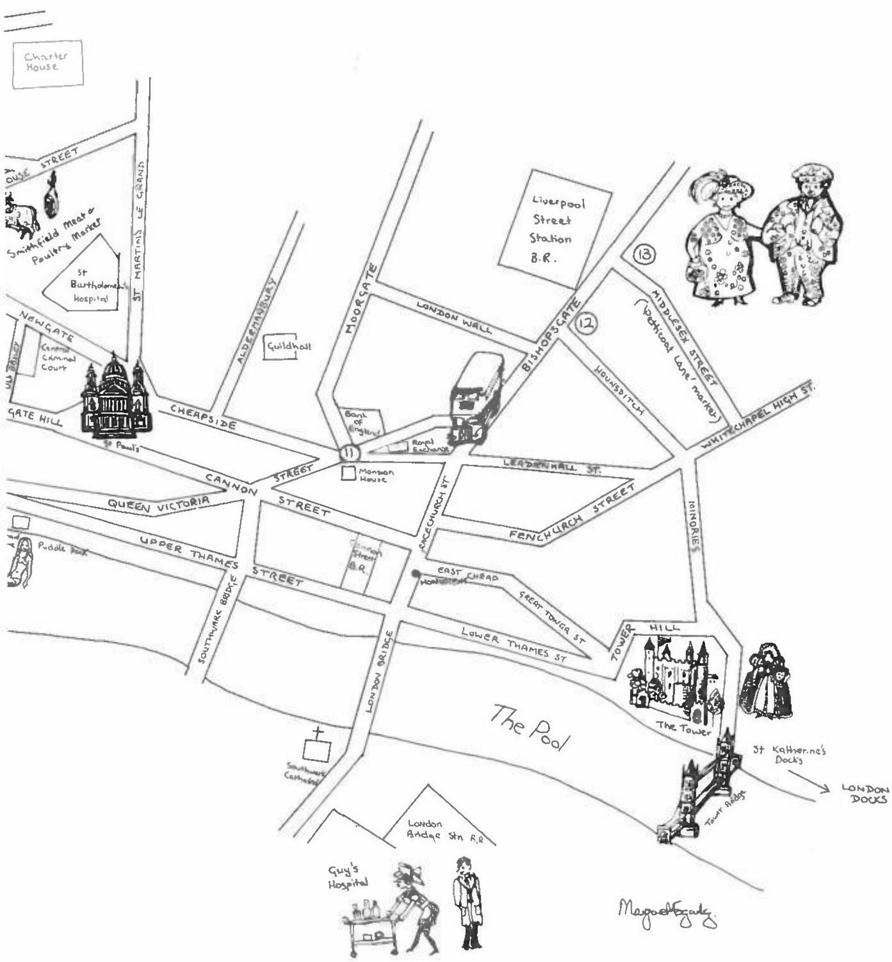
Wonder what they call the other 89 positions?

(from Fred Lunnon, Atlas)

Or a politically sensitive typist?

'VISITS BY PARLIAMENTARY CANDIDATES. The three candidates for the Abingdon constituency will address members of staff in the Lecture Theatre on the following dates :-
Thursday 11 June, 1.00 p.m.
Airey Neave – Conservative
Friday 12 June, 12.45 p.m.
Normal Price – Labour
Monday 15 June, 1.00 p.m.
Caradoc Evans – Liberal'

(from RL bulletin 30/70)



map references

1 Tottenham Court Road – *a byword in furnishing*
2 Piccadilly Circus – *where IT seems to be AT*
3 Charing Cross Road – *for the bookish or the film voyeur*
4 Denmark Street – *'tin pan alley'*
5 University of London – *seat of learning supported (partly) by SRC*
6 Covent Garden – *where prima donnas sing to rows of (sic) cabbages*
7 Lincolns Inn Fields – *the miniest minis on view in the swinging city.*
8 Inns of Court – *where suits are very expensive*
9 Carey Street – *London synonym for 'Queer Street'*
10 Fleet Street – *a dangerous place for a haircut*
11 Threadneedle Street – *a safe place*
12 Houndsditch – *wholsesale warehouses*
13 Petticoat Lane – *wholesale pigs in pokery*

Map drawn by Margaret Fogarty of the Service Unit for Grants and Awards (SUGA), London office, who is by training a graphic artist.

1

Our research programme is aimed at understanding

the forces of nature

and the laws that they obey

forces - what are they? Forces hold bodies together or apart; the forces (or interactions) between particles, atoms and molecules govern the properties and behaviour of all matter.

forces - how many? Probably four:
Gravitational (Relative strength 10^{-40})
Electromagnetic (Relative strength 10^{-2})
Strong (Relative strength 10)
Weak (Relative strength 10^{-6})
each described on later panels (nos 2-5)

forces - how studied? At this Laboratory, all the forces except gravitation are investigated by means of high energy physics experiments using our proton accelerator Nimrod, which, together with the techniques of high energy physics is introduced on later panels.

rutherford laboratory

On 2 and 3 July 1970, some 600 visitors from Universities, Government Departments and Industry, travelled by car, train or coach to the Rutherford Laboratory. On Saturday, July 4, families of the Laboratory staff and associates had their turn and an estimated 1500 people took advantage of the opportunity to tour the many displays. The Open Days theme this year was 'The forces of Nature and the laws they obey.' The photograph (1) is of the first of a number of display panels which were set up in the reception tent as an introductory exhibition interlinking the other specialised exhibits by showing where each fitted into the Laboratory's research programme.

Amongst the many exhibits in Hall 3, the concrete insulated magnet display attracted a lot of attention (photo 2). Organic based magnet insulating materials are subject to radiation damage whereas inorganic materials are not affected. Considerable progress has been made in the use of cementaceous aggregates as an insulation binder. Labourers who were involved in some of the early work in mixing these aggregates, 'commented unfavourably' on the precision measurements of the relative quantities of materials used in these mixes. Unfortunately those comments, are, one is told, unprintable.

Another exhibit which was a must for the many visitors was the superconducting magnet display (photo 3). The technology required for the successful development of these magnets has received special attention at the Rutherford Laboratory. In collaboration with Imperial Metal Industries, the research team has developed a new type of conductor consisting of a twisted array of very fine superconducting filaments embodied in a matrix of normal metal.

The last photograph shows a small part of the new experimental hall (Hall 3) and in particular the π 8 experiment (Westfield College and

2

3

open days july 1970

RHEL) which is shown set up at the top of the photograph. The experiment will determine whether charge conjugation invariance C is violated in electromagnetic interactions. Or for those suffering from scientific indigestion – are positive and negative charges treated alike at short distances.

Space is too short to permit more than a random sample of the many exhibits on show throughout the Laboratory. To visit them all required a considerable feat of endurance and the demands for cups of tea *and* comfortable chairs grew as the hours went by.

4

For a last word on the Rutherford happening we include the following. The muse, unfortunately, had 'gone to lunch'.

Lochnessery at the proton laboratory

(by an arts girl in search of Science)

Now Rutherford did open doors
For everyone (n^2) to see
A 7 Ge' Synchrotron
And SUPERconductivity.

From north they came – electronwise,
From south and east with open eye,
To climb the mound, to poke around,
To follow tracks of energy.

Trails of sparks and flying spots
Were traced on cathode tubery,
By scanners scanned and fed on-line
To rapacious computery.

We felt that we had seen it all
– Real cool magnets, beam-line benders,
Scattered pion-proton action,
The latest thing in bubble chambers.

But as we homeward read our way
Through each descriptive article
We stopped in wild surmise – gasped – Why
We never saw the Particle!

the undiscovered particles

M. G. Albrow

Dr. Albrow wrote this article when working at the Daresbury Laboratory with a team from Manchester University. He is now a research fellow at CERN in Switzerland.

In the early 1930's it seemed to physicists that they had reached a point where the structure of matter could be understood, at least in principle, in terms of only four basically different particles. All atoms were known to consist of a tiny central nucleus composed of positively charged protons and neutral neutrons, surrounded at a relatively large distance by layers of very light, negatively charged electrons. Atoms could emit or absorb energy in packets of electro-magnetic waves, the particles of light known as photons.

Nevertheless, there were some difficulties that required clearing up, and the solution of each seemed to require additions to the initial list of four. Firstly, it appeared that in the radioactive decay of an atomic nucleus, a neutron spontaneously transforms itself into a proton and an electron, but when the process was quantitatively investigated it seemed that neither energy nor angular momentum were conserved. This uncomfortable situation was resolved by the slightly less uncomfortable hypothesis of Pauli that the energy and angular momentum that appeared to be lost were in fact taken away by a new neutral particle, later called the neutrino. This particle was finally found 25 years later.

Secondly, Paul Dirac found that when he tried to bring quantum mechanics into line with relativity theory, the equation describing the (negative-charge) electron had a second solution describing a positively charged electron. This antielectron or positron was later discovered by the tracks it made in a cloud chamber. Were there also antiprotons and antineutrons?

This question was answered in the affirmative in 1955 when the particle accelerator at Berkeley came into operation. The list grew. The third puzzle, and by far the most difficult, was that the protons in the nucleus should violently repel each other by virtue of their positive charge. Yet the nucleus was stable, so presumably there was a much stronger force than electromagnetism binding it together. As we believe that forces require some object to transmit them (electromagnetic forces are transmitted by photons), perhaps this strong force was transmitted by another particle. Yukawa correctly predicted the properties of this particle, the π meson. It was expected to exist in three charge states (positive, neutral, and negative) and to be some 250 times more massive than the electron. However, this turned out to be a gross simplification of the strong force, and many other particles were found which play a part in transmitting the force among protons and neutrons.

The preceding brief history of the rise of particle physics shows how theoretical or experimental difficulties in our understanding of matter can often be resolved by supposing the existence of new particles, the properties of which can generally be predicted in advance, and that sometimes these particles are only detected decades later. The present state of particle physics appears to be extremely complex, with over a hundred objects known. Many of these hardly deserve the name 'particle', being so unstable that they disintegrate after an extremely brief existence (about 10^{-22} seconds); but there is no sharp dividing line between these so-called 'resonances' and the relatively stable particles such as π mesons.

The undiscovered particles described below have mostly been proposed to resolve theoretical difficulties in our understanding of how the known particles interact between themselves, and if discovered would therefore enjoy a rather high status in the particle zoo. Others are 'predicted' simply because we can see no reason why they should not exist, and generally speaking anything that can happen in physics does happen. As Gell-Mann put it . . . 'That which is not forbidden is compulsory.' The list below is not exhaustive, the selection being made either on the basis of how important the particle would be in our understanding of matter, or of the faith held by physicists in their existence.

quarks

Undoubtedly the experimental discovery of the quarks q would have an enormous impact on physics. This is because it would be possible by taking various bound combinations of the three different quarks p,n,λ and their antiparticles $\bar{p},\bar{n},\bar{\lambda}$, to construct all the known particles that take part in the strong nuclear force. Thus a proton would be made of two p quarks and one n quark (ppn), a neutron would be (nnp), a negative K meson ($\lambda\bar{p}$), etc. As the known number of strongly interacting particles is of the order of one hundred, such a scheme is highly economical.

quark properties	Q	B	S	*anti-quark properties*	Q	B	S
$\bar{p}$	$+\frac{2}{3}$	$+\frac{1}{3}$	0	p	$-\frac{2}{3}$	$-\frac{1}{3}$	0
$\bar{n}$	$-\frac{1}{3}$	$+\frac{1}{3}$	0	n	$+\frac{1}{3}$	$-\frac{1}{3}$	0
$\bar{\lambda}$	$-\frac{1}{3}$	$+\frac{1}{3}$	-1	λ	$+\frac{1}{3}$	$-\frac{1}{3}$	$+1$

The properties which the quarks would be required to have are unusual in that the charge Q and the baryon number B ($B=+1$ for a proton, -1 for an antiproton, 0 for a meson) would be fractional. These properties are shown in the table, along with a third property called the strangeness S; the properties of the antiquarks are identical numerically but have the opposite signs. One simply adds the Q, B, and S numbers to obtain the properties of the composite particle.

Quarks were first proposed in this form by Murray Gell-Mann in 1961, and, whether or not they really exist, the quark model has enabled many satisfactory predictions to be made concerning the behaviour of the known particles. Each quark would have a very high mass M_q at least five times the proton mass M_p, but if three came together to form (say) a proton, nearly all this mass ($3M_q - M_p$) would be released as energy according to Einstein's relation $E=mc^2$. To smash a proton into its constituent quarks we would have to provide this energy, and as yet we have no particle accelerator powerful enough.

There are, however, cosmic rays with such energy, and quite recently (September 1969) C.B.A. Mc Cusker at Sydney claimed to have observed five tracks in a cloud chamber produced by cosmic-ray particles with a charge of only $\frac{2}{3}$. However, these tracks are not sufficiently free from alternative explanations to be widely accepted as quarks. A 300 Gev accelerator would enable the search to be extended up to about eleven times the proton mass, so perhaps the next generation of big accelerators will provide a clear-cut answer one way or the other.

'exotic' particles

On the quark model, the strongly interacting particles can only be formed in the combinations ($q\bar{q}$), (qqq), or ($\bar{q}\bar{q}\bar{q}$). Any hypothetical particle formed by any other combination is called an 'exotic particle'. So far, none has been found, but the search continues as a test of the model. One such particle, the Z^*, would have $B=+1$, $S=+1$, and the reader will see from the quark table (along with the antiquark table) that it would have to be exotic. The experimenters are trying to see if a K^0 or K^+ meson ($B=0$, $S=+1$) can be made to stick to a neutron or proton ($B=+1$, $S=0$) for long enough (10^{-22} seconds would be quite long enough!) for the combination to be considered as a particle in its own right. So far there have been a few indications of this happening but the interpretation of the results is frustratingly ambiguous.

intermediate vector bosons

We know that when two particles act on one another through electric or magnetic forces, photons are exchanged between them. These photons are not exactly like the photons in a beam of light or X-rays, which are called 'real photons'; they differ in that their momentum and energy are not identical in value and are called 'virtual photons'. Similarly, when particles act on one another through strong nuclear forces, π mesons and other particles are exchanged, as mentioned in the introduction.

There is a third force in nature which can act between particles. Known as the weak force, it is responsible for the decays of radioactive nuclei, π mesons and many other particles. The neutrino can feel only this weak force (and probably gravitation), which is why it is so hard to influence or detect. Is there an intermediate particle, analogous to the virtual photons and π mesons, which is exchanged between particles acting on each other with this weak force? We call it the intermediate vector boson, for want of a less clumsy name, label it W, and know that it would have to exist in three charge states W^+, W^0, and W^-. We also know that it would have to be quite massive, this being because the range of a force is inversely related to the mass of the exchanged particle.

Thus the electric and magnetic forces have an infinite range because the photon has zero mass, while the strong nuclear force has a rather short range (about 10^{-13} cm) because π mesons are quite massive. If we knew the range of the weak force we could estimate the mass of the W, but we only know that it is considerably shorter than 10^{-13} cm. This may be another particle that will require more powerful accelerators, like the 200 GeV machine being constructed in the United States, before we can produce it.

gravitons

The fourth, and by far the weakest force known to act between particles is gravitation. The gravitational force between two protons is 10^{-36} of the electrical force between them. Owing to this weakness, the force of gravity is always completely negligible in experiments with high-energy particles. Nevertheless, we believe that it does act between particles, and the intermediate exchanged particle of this force has been termed the graviton. Because the force of gravity has an infinite range, gravitons must have zero mass and therefore always travel with the velocity of light. Like the other zero mass particles, it would have an intrinsic angular momentum or 'spin' – neutrinos have $\frac{1}{2}$ a spin unit, photons one unit, and gravitons two units (although gravitons with zero spin are considered possible in some theories).

At present, the possibility of ever detecting single gravitons seems hopeless – neutrinos were hard enough to detect and gravitons interact some 10^{25} times more weakly. On the other hand, the detection of gravity waves, composed of intense streams of gravitons (perhaps), is not only a possibility but may even be history. Last year (1969) Joseph Weber observed simultaneous induced vibrations in large aluminium cylinders, one in Chicago and one in Maryland, which he claims are caused by gravity waves from an astronomical object possibly situated at the galactic centre.

tachyons

These extraordinary particles have been predicted fairly recently in an attempt to make the laws of the universe more symmetrical. A tachyon (named by Feinberg in 1967) is any particle with a velocity exceeding that of light (c). Ever since Einstein formulated the Special Theory of Relativity, it was commonly accepted that no particle could have such a velocity, for to accelerate any particle up to the velocity of light would require an infinite amount of energy.

This is true, but does not prohibit the existence of a class of particles whose velocity *always* exceeds c, any more than it prohibits the existence of photons and neutrinos whose velocity always equals c. Such 'superluminal' particles would have imaginary 'rest mass', but as rest mass is hardly a meaningful concept for particles that can never be brought to rest relative to an observer, this is no problem. A tachyon would always appear to have a positive energy, but unlike the particles we know, it would accelerate as it lost energy. At zero energy it would have infinite velocity, and therefore would have a completely uncertain position in space.

Two different observers in motion relative to each other can disagree on the sense of the direction of motion of a tachyon (*ie* right to left, or left to right) and hence on whether the tachyon was absorbed or emitted at a given point. Although different observers may thus give different accounts of physical processes, they would both be equally correct and neither would see any violation of causality (the principle that 'causes' must precede 'effects').

Searches for charged tachyons have commenced, so far with no positive results, but the experimenters have very little to go on. One method is to measure simultaneously the energy E and momentum p of a particle; if p exceeds E, the particle must be a tachyon. Another method attempts to measure the velocity directly by the Čerenkov light that a charged tachyon would emit (this is analogous to the acoustic shock wave emitted by a supersonic aircraft). Neutral tachyons would be much harder to observe, but could possibly be detected from the effects of super-rigidity they could give to nuclear particles, a zero energy tachyon being able to transmit impulses instantaneously. If tachyons really exist, two-way intergalactic communication is no longer a physical impossibility, merely a practical impossibility!

magnetic monopoles

In 1931, Paul Dirac realized that the existence of particles which were isolated north or south magnetic poles was not only compatible with quantum theory but would make Maxwell's equations of electromagnetism symmetrical and explain why charge is quantized, appearing only in multiples of the electron charge. Just as a spinning electric charge (*eg* an electron) behaves as a magnet with N and S poles, so a spinning monopole would behave as an electric dipole with a positive charge on one hemisphere and a negative charge on the other.

The mass of the monopole can be estimated from theoretical arguments to be at least twice the proton mass, and presumably they could be produced in proton collisions if enough energy could be provided. Experiments at accelerators have so far produced null results, indicating with a high degree of confidence that if monopoles exist they must be at least 2.5 times as massive as protons.

Monopoles would be fairly easy to recognise from their tracks in spark chambers placed in magnetic fields; another elegant detection method is to measure the change in the electric current flowing round a superconducting torus when a monopole passes through the centre. Searches are being made for monopoles trapped in deep-sea sediment, meteorites, and lunar rocks, and several cosmic-ray experiments have been tried without success – which is a pity, because if stable monopoles could be collected in sufficient numbers they could be accelerated with simple inexpensive apparatus to energies well in excess of those now envisaged for the next generation of accelerators.

In this brief review there has been space to mention only a few of the objects which we know may exist. The search for these objects constitutes a small, but exciting, part of the work done by high-energy physicists, and intensifies their need for accelerators of higher energy.

clear for sonic run

L. Lintern

Hunter T Mk 8 of 759 Squadron Royal Navy which the author flew on his advanced flying training at RNAS Brawdy.

'Aberporth Radar – this is Brawdy 62 Overhead base at flight level 400, heading 030°, request clearance for sonic run on 240°'
'Roger 62 – wait one'

However it would take another year to achieve my first solo sonic run, breaking the sound barrier. In the meantime, the story continues (*Part 1 appeared in Quest, July 1970*) with the activities at RAF Linton-on-Ouse. As our basic flying training course proceeded the flying became more exciting with aerobatics coming into the syllabus. On the other hand there was the precise science of instrument flying which few enjoy but which is very necessary for flying in cloud or bad visibility. You may spend a whole flight of an hour under a visor so that you cannot see outside, while you fly the aircraft on the instruments from just after take off until just before landing.

The importance of good instrument flying was brought home to me at an early stage when returning to base one day and simulating a descent through cloud. I followed the normal pattern of descent and under air traffic control, although as we had done little instrument flying we were supposed to remain visual. The controller gave me the heading to steer and told me to commence fast rate descent. I then saw a large thundercloud dead ahead. I thought: 'Oh well, I won't be in it long – might as well plough on'. As soon as I entered it the aircraft buffeted violently and I did a foolish thing – I looked up from the instruments (a thing one should never do) and saw the screen covering rapidly with ice. Then I was startled back into action by the controller saying: 'Juliet 13, turn left at 8000 feet heading 280°'. I said: 'Roger, 13' and rolled left.

Then it all started happening: I became disorientated, rolled too far left and before I knew what was going on I was in what is lightly termed an 'unusual position'. I quickly tried to remember all I had been told about recovery but the air speed built up, the buffeting increased and the altimeter was unwinding rapidly. My first feeling was 'eject', so I began to reach for the bottom ejector seat handle. Then I thought, 'must call base'. With the R/T call on my lips I thought, 'No, don't panic' and hurriedly swung back to controlling the aircraft. I managed to level the wings and pull up – but too far. The next thing I knew I was below the stalling speed and probably on the way into a loop. I pushed forward and the speed crept up very slowly. Then I found that, although I appeared to be straight and level with full power, the speed was hovering just above the stall and I felt such a buffeting that I thought I must still be stalled. Then I remembered I still had the airbrakes out. A quick flick and in they came, the speed built up and in a few seconds the cloud parted. 'Phew!' I quickly called base for the inbound heading and no one was any the wiser, except me of course, and very much so!

As our course proceeded we became much more confident in handling the machine and went on to the more powerful Mk. IV Jet Provost. We did more aerobatics and intricate manoeuvres and high altitude flying. Perhaps the most exciting part of the syllabus was formation flying. It looks an impossible art when you are first given control, with another aircraft bobbing gently alongside you. The first thing that happens is that you lose him by slipping in one of the six directions you can move, or a combination of them – left, right, up, down, back and forth. After an hour

clear for sonic run continued

though, you can usually hold on to the other aircraft, in straight and level flight at least. Turning is more of a problem but is soon solved. Then comes the real ultimate in flying an aeroplane – the 'dogfight' or 'tailchase' as it is called. In learning the manoeuvres the idea is to follow the leader without hitting him or falling too far behind. Gentle manoeuvres are practised first, leading to full aerobatics. It is very satisfying to sit glued to the tail of the lead aircraft through loops, barrel rolls, and manoeuvres on the edge of the stall. Violent buffeting shakes the aircraft as you hit the leader's turbulent wake, and full control movements are required to keep up with him. This is real flying!

Flying wasn't the only thing that made life enjoyable for us. We were a close knit course, all keen on sport of any description but not particularly adept in any of it. Our keenness brought us through though, and we won most of the games we played through sheer team spirit. Then we decided to buy a course mascot and to choose something useful. As many of us were keen motorists, a vehicle of some peculiar nature was indicated and, after rejecting a suggestion of a fire engine, we chose a hearse in the form of a huge 1934 Austin 20. The engine was a large six cylinder with all six never firing: as one chap put it – 4 cylinders on main and two on standby. Now the idea was that when the course went out for a night's drinking one person would be nominated to drive and would remain sober. There was plenty of room for all in the hearse as we removed the central coffin table leaving a well so that people could sit on each side with their feet in the well. There was a black top hat for the driver to wear and a selection of bowlers for anyone else who sat in front. The picture was completed by an old horn-type gramophone playing in the back. We were amazed at the number of people who raised their hats in genuine respect as we approached.

We became accepted on the local scene and soon the local press arrived to take photographs and write an article and they were followed up by the national dailies. At Christmas time we fitted fairy lights around the inside of the hearse and went carol singing for local charities. The trouble was that at every call we were invited in for a drink, so the singing appeared to us to get better and better but maybe not to our audience.

Very soon we found our time at Linton-on-Ouse running out and we passed out as qualified pilots in January 1967. We decided that the hearse would have to fit into our Wings Parade somehow. When the day arrived it was wet and the parade was held in a hangar. The prizes and wings were duly presented by the reviewing officer in the presence of all station officers and the families of the passing out course. We all wore our best uniforms and ceremonial swords. As soon as we marched out of the hangar everyone ran to the other door where the hearse was parked. All but two scrambled in and on top of the hearse and a smoke bomb was fused on the roof. The remaining two heaved on the mighty door winding handles and as they parted the hearse roared in. Everyone was still gathered, the reviewing officer on the dais, as the hearse went past with a bang as the smoke bomb exploded and smoke began to envelop the proceedings. The senior officers all took it very well really and there was nothing but smiles and laughter.

After six weeks interspersed with leave and attendance on various courses we joined RNAS Brawdy, our first naval station, for a year where we were to do our advanced flying training on Hunter aircraft.

It was good to be on a naval station at last and very soon we were all solo on the Hunter, a beautiful aeroplane to fly. Shortly after we arrived the Torrey Canyon incident occurred and there was great excitement as the Buccaneer aircraft which did the bombing always stopped at Brawdy to refuel and 'bomb up'. The station was often called on to investigate oil slicks approaching the Bristol channel. I did a great run checking on reported positions, in the Hunter, flying low over the sea. This was not quite the aircraft for the job as it goes too fast but great fun for the pilot.

The hearse went with us to Brawdy where it again did useful service as course transport. Handling became more difficult, though, with mediocre steering and brakes, but legal of course, coupled with its width and the narrowness of the Welsh lanes. We never had an incident but many drivers were surprised to find its black shape hurtling towards them at 60 mph as they rounded a tight corner in a narrow lane. It had a hinge up door at the rear and so if you were late out of a pub you could run like hell to catch

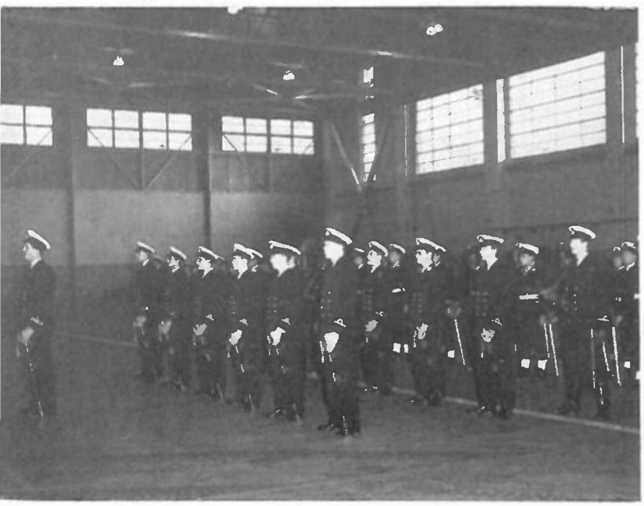
Pictures: left 'the hearse' and company with the author, second from right (photo Yorkshire Evening Press). Below 128 Fixed Wing Course at RAF Linton on Ouse, at the presentation of wings ceremony (author nearest camera).

it and jump in the back. One night we had to leave it in a country lane as it ran out of petrol. On our return in the light of day we found we had parked it in front of a farmers milk churn stand. It wouldn't start up and when we located the fault it meant a walk to the farmhouse and considerable haggling with an irate Welsh farmer before we got our rotor arm back for ten bob.

Life wasn't all roses at Brawdy though, the flying training was still intense and a failure in one flying test usually spelt doom. This was noticeable at Brawdy: many of our friends were 'withdrawn from training' to use the official phrase, or just 'chopped'. It was disheartening really and didn't help the rest of the course. My turn came when I failed an instrument rating test, so here I am back at the Rutherford Laboratory.

Was it only 3 years ago – 'Brawdy 62, you are clear sonic run on 240°, advise complete' – '62, will advise'. Right, lower, the nose, full power, check engine instruments, speed rising 0.90 – 0.95 – 0.98 – rudder tramp, slight hesitation and through, 1.05. O.K. recover, throttle closed, airbrakes out and raise the nose and up she comes, G coming on. Level out at 25,000 ft. – 'Brawdy 62, sonic run complete, angle of dive steep, max speed 1.05 levelling at flight level 250 and manoeuvring in this area'. So my first solo sonic run was completed: the culmination of two years of intensive training and the realisation of an ambition nursed since the age of ten.

'Wake up Laurie!!! It's 6.30 a.m. we're getting the beam back, check magnet currents – counter EHT's – spark chambers on and computer ready' . . . *'Brawdy 62? . . . level out 25,000 ft?* . . . Was it all a dream?



plantophobia

How to become an expert without really trying

Florrie Bunnda

There are three essentials in gaining a reputation as a house-plant expert:

(a) A couple of good reference books,
(b) A love of all things green and beautiful,
(c) An ability to 'chat up' the plants.

If the plants don't like you then you might as well give in with a good grace. My husband is firmly convinced that, if not actually a 'nut case', I am at least teetering on the border-line – with good cause, I must admit. After all, it must be a little alarming to enter a room and overhear one's spouse addressing a bunch of leaves or a fierce-looking collection of prickles, with such words as 'And how's mummy's baby this morning then? Do you want a little drinkie then?' But as all house-plant addicts will bear witness – it works. They blossom and flourish with cossetting!

My husband long ago gave in with a good grace – in fact he now comes home on occasion with the odd pot to increase the 'family' (totalling 90 at the last count!) He's still a little wary at times though – there is one large pot of what looks like green clutching fingers which he is convinced is going to seize him one day if he doesn't maintain his guard. There is also a very large 'totem-pole', desert-type cactus, too large to stand anywhere but on the floor, which makes an excellent house-guard. Affectionately known as Old Bill, he waits beside the front door to catch the unwary, bending. Moral – never bend over too close to Old Bill – he will get you in the end!

The 'mania' began with me some years ago when a friend came to dinner and brought as a gift a pot containing four cacti and succulents. Of course, they died, I killed them with kindness by drowning. However, the seed was sown, the damage was done and I soon began collecting and propagating, learning at first by trial and error.

A good memory is an asset when acquiring one's (albeit spurious) reputation as an expert. Every time a new plant comes into the house, I consult the authority and learn the latin name. How much more impressive it is when somebody comes to you and says 'I'm having trouble with my rubber plant' and you reply 'What have you, a Ficus Decora or a Ficus Elastica?' Mind you, it does earn one the odd sidelong glance! Seriously though, part of the fascination of plant-growing for me is knowing the specimens by name. My own particular weakness is for cacti and here it is a little more difficult to classify them. There are so many specimens to a group name – I

plantaphobia continued

have a Cereus Winterianus and Cereus Peruvianus and they are not really a bit alike! Take the Opuntias also. I have an Opuntia Subulata and an Opuntia Tunicata and various odd specimens of common or garden Prickly Pears but the similarity ends with the name. And what a collection of Mammillaria there are!

If you intend to take house-plant growing as a serious hobby, the reference books are absolutely vital. Each new plant you acquire should be 'read-up' and its likes and dislikes noted. So many plants wither from under-watering, over-watering, lack of light, being placed in strong sunlight, lack of heat, too much heat, not enough humidity, draughts, *etc, etc*. Some plants like a daily spray with tepid (never cold) water, some must never be watered from the top because the leaves will rot (African Violets and Peperomia for instance).

Some enthusiasts prefer to prepare their own soil but I have found that the purchase of a bag of Levingtons is quite adequate. All plants appear to flourish in this soil. For propagation, Levingtons rooting compost is ideal, later moving the rooted cuttings into Levingtons potting compost (I assure you, I am not being paid commission by Levingtons for this advertisement).

As I have said, one learns by trial and error and I have discovered by bitter experience that if one owns a large collection of plants it is advisable to avoid adding plants subject to attack by aphid. I have found two such plants recently – Cinneraria and Fuschia – the little beasts seem to love them, and once well established on the plants they are almost impossible to vanquish.

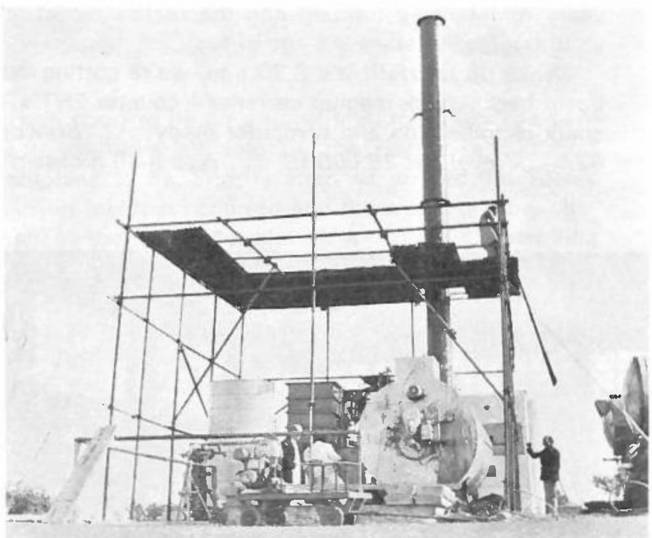
Regular feeding with a good liquid manure such as Bio is very beneficial to most succulents and flowering plants – not the cacti, it's a little rich for them. As a rule, feeding is only necessary in the growing season, as the majority of plants have a rest period during the winter months (I must remind my various ivies about this – they went mad last winter!) The plants, of course, do not always obey the rules. I have been waiting patiently for about a year now for a cutting of a 'Shrimp Plant' (Beloperone Guttata to you) and I am still waiting because the stupid plant refuses to stop flowering. 'The Book' says quite distinctly that 'the plant does not flower during the winter', but it seems that this particular Shrimp Plant has not read The Book. The circumstances however, are a little unusual because this plant is owned by a friend (in the Typing Office) who can grow flowers on plants on which nobody else has ever been able to grow flowers!! I don't know by what magic incantation she does it, but there they are, blooming away for all the world to see.

A word about pots. In my experience, clay are preferable to plastic pots. It's probably just one of my fads and fancies but the plants appear to be happier in clay pots – probably because, being porous, there is not so much chance of the roots becoming clogged if one is a little heavy-handed with watering.

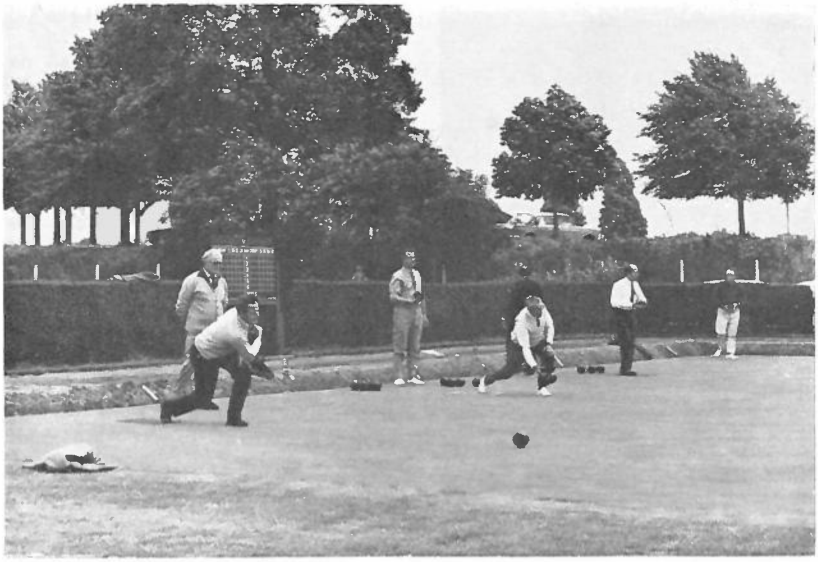
I could not, of course, complete this article without a mention of the fine display of attractive plants adorning the windowsills of our typing office. The 'green-fingered' lady who owns them, Eileen Barnes, has contributed to many a collection of plants by the cuttings which she so patiently cultivates and distributes among RSRS plant addicts.

the pen name hides the identity of Patricia Elvins, Typist I at RSRS

It will never get into orbit



Many hoped that the above project would be the British candidate for the Space race but regrettably no funds for further development were forthcoming from the Science Research Council whose annual report was published on 23 September. For technical details see page 28.



sports day 1970

netball

A great deal of shouting made the netball final easy to find *(picture on left)*. The game's first appearance at Sports Day proved it a top choice. The final fought out between teams from RGO and Atlas was one of the most exciting of the day. Spectators lined the court yelling determinedly for one side or the other–or both– and the goals went 1—0, 1—1, 2—1, 2—2 with RGO just taking the lead until Atlas broke through at 12—12 to go 13—12. With the ball whipping from end to end and the players changing direction and formation with lightning frequency, RGO held on, drew level and, in the very last seconds of the game, scored one last goal to win by 14—13. Netball is definitely here to stay!

football

'Fast and furious' would describe many of the games in the six-a-side football touraments. It was a 'knock out' tourament in more than name. There were ten teams, including one from ROE (for the first time) and three from Rutherford – who were obviously keen to win. And so they did with the C team beating their own A team in the final by 15 points (3 corners + 3 goals) to 11 (3 corners + 2 goals).

cricket

Cricket (in 15-over matches) ran well into the evening, winding up with a very good final between the Daresbury and Rutherford Laboratory elevens. Daresbury, having led off to a good start, began to lose wickets to accurate bowling from the holders of the cup (1969), but with a determined push for extra runs by their tail end, they managed to carry it off for 1970. The game with the best scores however was the Rutherford – RGO semi-final which finished at 87 for 5 to 86 for 8 – a very close result and a good match.

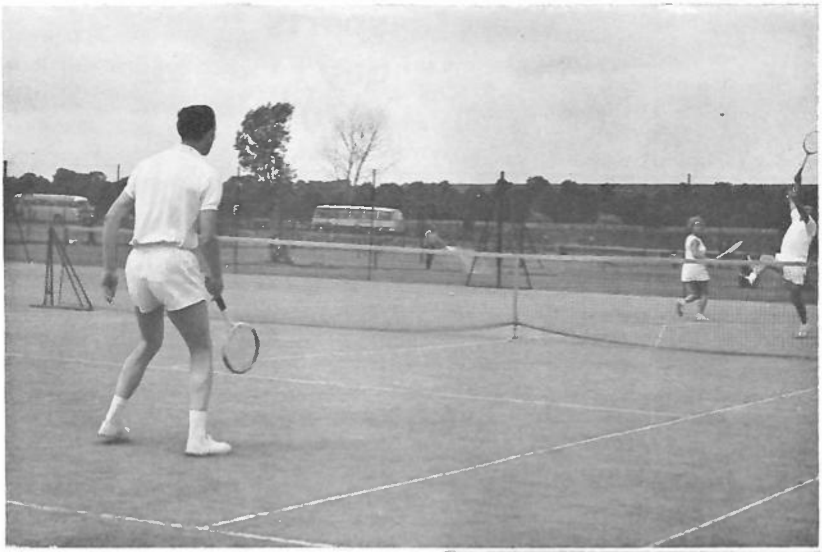
bowls

Bowls (picture above) attracted the crown greeners from Daresbury this year but the match, played as before on a flat green, was won by Mr. J. T. Pike and Mr. A. J. Johnson, both flat green experts from RGO.

Photo Peter Hicks RSRS

tennis

The strong winds kept the tennis players on their toes. In the men's doubles, played on a league system a clear win went to Mr. A. C. Gordon-Smith and Mr. A. C. Roberts of RSRS. The mixed doubles was played in two leagues with the winning couple in each meeting in a final. They turned out to be well matched – Mr. B. Yates and Mrs. Robson of Daresbury against Dr. and Mrs. Horner of RSRS (last year's winners). This time the Daresbury couple won the day.



So every trophy had been well defended but each one had changed hands. Dr. W. L. Francis, Secretary of the Council (see Quest, April 1970), presided at the presentation and Mrs. Margaret Francis (known to many in the London Office) presented the prizes. A social evening followed which continued, with drinks, light refreshments and dancing until 10.30 p.m. – closing time.

In thanking all who took part in a very successful day, we should mention in particular Dr. and Mrs. Francis, the SRC Sports Association (who organised it), the protagonists

In the picture above the Horners are countering a tricky shot from Mike Claringbold and Lorna Green of Atlas on their way to the final. Photo P. Hicks.

Picture on right shows a goal save in one of the early football matches. The Sports Pavilion is seen in background. Photo P. Hicks.

Below some RGO supporters at the netball final, willing their side to win.

(who provided the spectacle), the spectators (who gave encouragement, and even advice where they thought it was needed) and the Civil Service Sports Club (who provided the sports and catering facilities) and their catering staff. We also thank Bill Butler of Rutherford, a member of the St. John Ambulance Brigade, who rendered first aid throughout the day and treated no less than 18 victims of the sports!

Next year we hope the former champions will stage a come-back and 1970's victors will fight 'to the death' for their laurels against all comers.

properties

for sale

Upper part of prominent London office block, comprising 129 reception rooms and 57 toilets on 4 floors. Extensive panoramic views across London. To be sold lock, stock and barrel including period furniture, 17 tons of assorted paper, one Royal Charter and a unique collection of inhabitants.
Apply 01-242-1262 Extn. 60 ... ... (Accommodation)

'15th CENTURY CASTLE with outbuildings and extensive grounds – Herstmonceux 3171 . . .'

Did you make an offer for that property advertised in the Times on August 7 only to find that it was put in by an RGO vacation student doing his own thing which included a 'FOR SALE' board at the main gate. Among national press comments, the Daily Mirror reporter estimated that with everything as found, including a resident Astronomer Royal, the place would be a snip for £6M. But he quoted a Times man as saying 'I suppose you couldn't really put a price on it . . . I mean the sky's the limit for a place like that' . . .!

the trouble with students

This is not the first time a group of students at RGO have gained notoriety. Last time they renamed the roads in the grounds – using proper street signs they had acquired somehow – and people were startled to be confronted with Woolley Way and Eggen End. Professor Eggen, by the way, happened to be in England on both occasions (this time for the AAT meeting reported on page 10) so the Australians must hear some funny stories about us. Another lot used the South quadrangle to teach country dancing – to their Austin sevens!

Once the students laid an elaborate plot against one of themselves. He was rather studious and not very sociable and his main lone was to go off every evening to use the computer. He wanted above all to compute the orbit of a comet.

Getting wind of this, the others tried telephoning a comet report into the RGO using the correct IAU code but with completely fictitious figures. This fell a little flat however as he just continued to compute. So someone suggested it would be a great joke to kidnap him and turn him loose after dark in the middle of Pevensey marshes. First, however, the group insisted on holding a dummy run with the ringleader acting as victim. As he was big and strong they made a good job of the handcuffing and blindfolding before driving him by car deviously round and about by the longest way possible.

It wasn't until he was alone among the silent, dark marshes that he realised he was indeed the victim!

This wasn't the end of the story. The 'victim' capped their achievement by thumbing a lift back from the marshes at night – wearing handcuffs! He then dumped the chap responsible in the castle moat and for the rest of the night held the stairs to the student's quarters shooting at anyone who approached with a water hose.

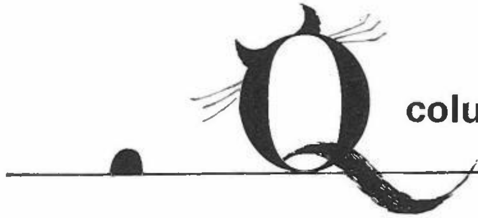
No doubt his character has been without stain ever since, likewise the driver of the car, then one of the RGO staff, now at London Office.

the loss of a best friend

Michael Reordan, LO, with Carla, until lately his guide dog.

Carla had her own ideas on many things. One winter for instance there was the usual power cut but, unusually, this one befell before the end of a dark afternoon, only 'They' forgot (or perhaps not) that in buildings like State House you need a lift to get down by. Carla took one look at the vast array of stairs stretching down into the depths and thereupon became the first member of LO to stage a sit-down strike.

Carla had to be put to sleep at last because of heart trouble, aged 12, after nearly ten years as his guide and family pet. She is also missed by many around the office who she liked to chat up on the offchance of a biscuit or a kind word – very successfully too.



column by 'observer'

If you wonder, as well you may, about some of the entries in this issue of Quest, just remember that it was put to bed during what is after all known in the trade as the silly season. Some of our chosen contributors were persuaded (with some editorial force) to wring out their copy in a highly euphoric state, not yet fully aware that they were back in a hard, cold office with their 10 sun soaked days on a foreign shore over and done with.

We also got some altogether unsolicited entries from those left behind who were only too apt – following the arrival of a postcard from some sunbaked genius –to go down to the local. At about the eighth pint they would exclaim with sudden insight – like Archimedes hopping out of the bath – 'Now why don't we write something for Quest' and then, it seems, spend the rest of the afternoon chewing the pen and bellowing at their own jokes. Have you tried (sober) to turn down an offer from a man who's had upwards of ten pints. Well we didn't.

ideas that pay

For the second time within a year an award of £100 has been made under the Rutherford Laboratory Suggestion Award Scheme. On 7 July, the Director, Dr. G. H. Stafford, presented a cheque for £100 to Mr. G. McGee, a skilled craftsman employed in the Mechanical Installation and Maintenance Group of the Nimrod Engineering Department.

Mr. McGee, who lives in Didcot, came to the Laboratory two years ago after working for a firm in the North of England. He is mainly employed on the assembly and commissioning of particle separators but when skilled assistance was required for the development work on field monitoring equipment he was appointed to assist.

A problem at the time was the encapsulation of magneto-resistors in epoxy resin. Owing to the extremely fragile construction of the magneto-resistors and the high viscosity of the resin mix, damage can occur under normal injection methods. Mr. McGee suggested a way out of the problem by making the mouldings first in two halves, each with a cavity to take the magneto-resistors and then bonding the complete assembly together. His suggestion proved to be technically sound and entirely successful in batch production; it also assists in making it suitable for sub contract production off the site.

Here then is an example of, to quote the Director 'a relatively simple suggestion' which has solved a difficult problem, has resulted in financial saving AND encouraged others to emulate George McGee and pocket a nice cheque.

George in expressing his thanks said that on behalf of himself and others he would like to thank the Director for the operation of such a scheme.

stop press

'the Cape'

(article on page 4)

The Science Research Council and the South African Council for Scientific and Industrial Research (CSIR) have just reached agreement on a joint astronomical venture. They are to set up a new observing station in the Karroo near Sutherland which will be known as the South African Astronomical Observatory and will operate as an institute of the CSIR with an astronomical base at the present Cape Observatory.

Manpower and equipment resources will be pooled by the Cape Observatory and the Republic Observatory in Johannesburg, both of which are unsuitable for further development as observing sites because of their situation in large cities. ...

The Astronomer Royal, Sir Richard Woolley, OBE, FRS, (see picture, also 'Profile' in Quest July 1970), who will retire from that position at the end of 1971, has accepted an invitation from the CSIR to be the first director of the new observatory which will come into operation from January 1, 1972.

It is the intention to build up a facility which can make a major contribution to astronomy in the Southern Hemisphere.

Sir Richard Woolley

Solution to nutcracker on page 11

Battie had 9, Danton 10, Greenstick 7, Hazelnut 8, and Ravage 12.

Solution to crossword on page 13

Across

1—Extraordinary; 7—Reach; 9—Facia; 11—Roe; 12—Has; 13—Essence; 14—Riant; 15—Intersections; 16—Amass; 19—Tombola; 22—Len; 23—Toe; 24—Inter; 25—Adieu; 26—Incapacitated.

Down

1—Eerie; 2—Transatlantic; 3—Ashen; 4—Inter; 5—Archaeologist; 6—Yeast; 8—Presented; 10—Ian; 16—Alibi; 17—Men; 18—Strop; 20—Meant; 21—Agued.

first see foot of page 24

To tell the truth ('it will never get into orbit') we must admit that the picture shows the emergency steam supply rigged up in the car park at Rutherford Laboratory in September. It provided steam for various services for a few days while the AERE supply had a shut down to repair their chimney stack. The hopeful many were of course the onlookers.

interest in things ionospheric

Some visitors to the Radio and Space Research Station exhibit at the International Radio Enginering and Communications Exhibition which was held in London in August. The exhibit under the heading 'The influence of the earth's atmosphere on radio communications' showed displays on (l to r in the picture) Auroral Electron measurements, Rocket experiments in the D-region of the ionosphere, Application of Satellite Data to radio communication problems, Tropospheric experiments at Chilbolton and (not in picture) Radiometer studies of the sun and troposphere.

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farewell to a pioneer

Harry Chandler of Rutherford Laboratory retired on 24 July for the second time in a working life spanning 50 years. However retirement in his case is a temporary phase as he will shortly be taking up a new appointment.

Born 26 July 1905, Harry left school at the age of 13 and in 1920, at 15, joined the Royal Navy. For the next 28 years he saw the world from above and below the oceans and his stories of life during that period are fascinating, endless and often unprintable. There is no doubt that the training and experience gained during this period proved to be of great value in his work at AERE and RHEL. His solutions to problems were often, to say the least, unorthodox, but highly successful.

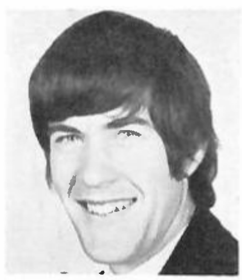
Harry's first retirement came in 1948 when he left the Royal Navy with the rank of Warrant Officer. He joined AERE the same year and became a member of the EM Separator Group in Hanger 7. In 1953, with Leo Hobbis, Ted Harrison, Bob Fowler and John Brown, he moved over to what was to become the Rutherford Laboratory site, to work on the Ion Source and Injector for the PLA, so he can certainly claim to be one of the pioneers of the Laboratory. It is reported that the facilities on site consisted of one office, one laboratory and one chemical toilet! He moved on to the Nimrod Injector Group, then to the General Physics Group and finally in 1966, to the Vacuum Section of the Nimrod Engineering Department.

On his last day at the Laboratory, he received a presentation (see picture) from the Director, Dr. G. H. Stafford, on behalf of his friends and colleagues. We join them in wishing Harry a successful future in Part III of his career.

contributors

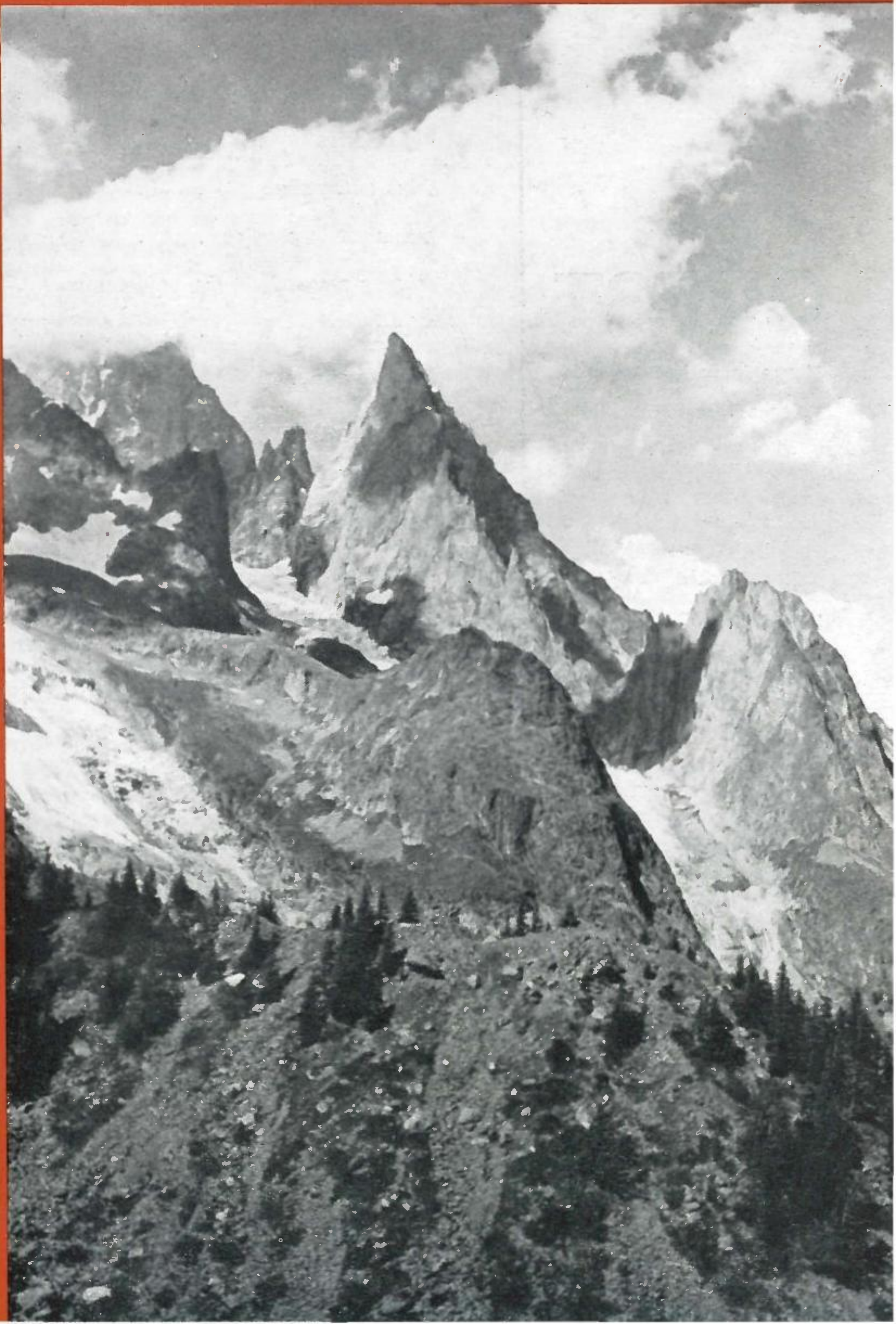
G. M. Harvey, Cape Observatory. See page 4.

Adrian Buckel, ACL see page 8



Other contributors appear with their articles

QUEST



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QUEST

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Vol. 4 No. 1

January 1971

contents

cover picture is a view of the Aiguille Noire de Peuterey on the Italian side of Mont Blanc, photographed by Allan Ridgeley of the Astrophysics Research Unit. An account of his walk around Mont Blanc appears as part of the holiday feature on pages 9–13.

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£1M A YEAR FOR ATOMS MOLECULES AND PLASMAS ++ BEST DATA YET FROM SKYLARK SPACE PROBE IN SOLAR ULTRA-VIOLET SPECTRUM ++ SYMPOSIUM ON ELECTRON AND PHOTO INTERACT ++ £59,000 HARDWARE FOR MULTI ACCESS COMPUTER SYSTEM ++ BRITISH EXPERIMENT IN ORI ING SOLAR OBSERVATORY OSO-G ++ FIRST LUNAR SAMPLES FOR BRITAIN ARRIVE AT SRC ++ [illegible] ++ MAJOR SRC G FOR CONTROL ENGINEERING RESEARCH ++ ANGLO-AUSTRALIAN TELESCOPE CONSIDERABLE CONTI BUTION TOWARDS SCIENTIFIC DISCOVERY ++ RSRS PARTICIPATES IN UK4 SATELLITE TO MEA INTENSITIES OF ELECTROMAGNETIC RADIATION ++ DEVELOPMENT IN ANALYSIS OF BUBBLE CH BER PHOTOGRAPHS BY SWEEPNIK AIDED BY SRC GRANT OF £40,473 ++ SUCCESSFUL LAUNCH O

council commentary

September

As usual, there were no regular meetings of the Council in August or September but, as last year, a week-end meeting was held at the end of September with representatives of the Boards and of the senior London Office staff. This time the venue was Derwent College on the attractive campus of the University of York. Participants were again invited to bring their wives, for whom York proved to be a popular centre. This was an opportunity to bring the Council and Boards together, to consider the changing circumstances, in particular the coming expansion of higher education and the prospective national requirements for scientifically trained people, and to develop ideas about the kinds of policy for post-graduate training and research support that will guide specific decisions throughout the year.

October

300 GeV. At the October meeting, the Council discussed very fully the new CERN 300 GeV accelerator proposal, 'project B'. Among the many advantages of this proposal, the siting at CERN not only contributes to a substantial reduction in initial cost, but will make it very much easier to find the effort for later increased exploitation by transfer from the present CERN facilities, thus increasing the confidence with which the long-term estimates of the total contributions to CERN can be regarded. Although the UK contribution to the new project would be substantially less than would have been required for the original 300 GeV project of 1968, and although satisfactory limits to any possible escalation had been negotiated, the proposal had to be viewed against the expectation of a much lower rate of growth of the Council's funds than was expected in 1968. Nevertheless, the Council reaffirmed its recommendation that the UK should join the project.

Students. Another topic in October was the proposal to provide short courses for SRC research students to show them something of the interest and challenge of careers which scientists can follow in industry and Government outside research and development laboratories. The Careers Research Advisory Centre, which has run one or two such courses very successfully in conjunction with the SRC in each of the past few years, has now offered to run six one-week courses in 1971. The Council accepted the offer, and also asked for the study of such courses to be continued.

Grants. One large grant recommended by the Engineering Board was approved: a grant of £290K over 4½ years to Dr. J. V. Oldfield of the University of Edinburgh for work on interactive computer graphics applied to electrical and electronic design.

Concerning grants in general, the Council's normal role is to help to initiate new projects, and when the grant comes to an end, support is usually taken over by the University, sometimes with the help of an earmarked UGC grant for the next quinquennium. At the end of the last quinquennium in 1967 the Government implemented a new policy of deducting the totals of these earmarked grants from the budgets of the Research Councils, and it was reported to the Council that in view of the reduction in their ability to initiate new research which this entailed, officials of all the Research Councils and of the UGC had consulted together and were recommending against any 'take-over' with transfer of funds in 1972. The Council accepted this recommendation.

November

Finance. By the November meeting, the Government's financial policies had been announced in outline, and the first major item concerned the matching of programmes to the restricted resources that might be expected under these policies. New draft Estimates

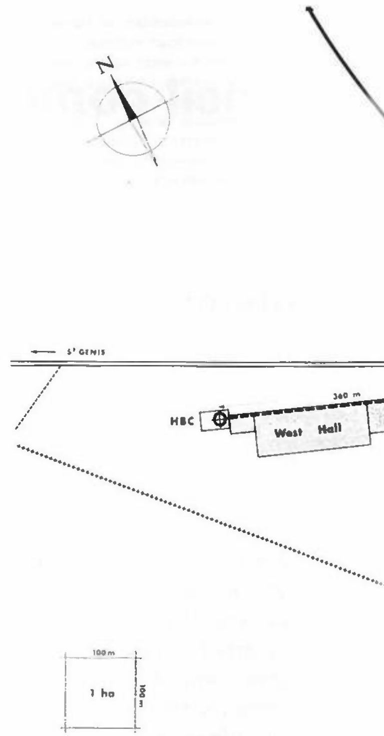
Dr. John A. V. Willis, who writes this column, has left us to become secretary of the British Association for the Advancement of Science (on secondment terms). Quest is very sorry to lose him as a contributor and he will be much missed at London Office. Previously secretary of NIRNS Dr. Willis became secretary of the Nuclear Physics Board when the SRC was formed in 1965, then he succeeded Miss Morris as head of the Council Secretariat.

for 1971/72 including provision for entering the 300 GeV project B were considered and endorsed; the total represented an increase of about 4½% in real terms over that of the previous year. Preliminary consideration was also given to the Forward Look for the following five years, and in this connexion the Chairman was invited to discuss with the UGC and the other Research Councils the principles upon which scientific research should be supported in the difficult circumstances of increasing university numbers coupled with restricted financial growth.

The next topic, a closely related one, was a consideration of the criteria for reviewing activities, which were given fresh emphasis in the recent White Paper on the Reorganisation of Central Government:– 'Is it relevant?' and 'must it be done by central government'. Like other public bodies we shall have to justify our activities and our expenditure against these criteria.

Student awards. Next, there was a report on the award of studentships in 1970, a complicated exercise which succeeded in meeting most if not quite all of the aims set by the Council at the beginning of the year. The total number of awards offered and accepted turned out almost exactly as planned although with rather more research studentships and fewer advanced course studentships than had been proposed. It was possible to give awards to all applicants with first-class honours, but the Council's wish to give awards to all fully-qualified candidates in the Engineering Board's field could not be fully met in the case of all who applied for research studentships. They were all offered advanced course studentships however.

Visits. Among other matters at this meeting, the Chairman reported on his recent visit to the USA and Australia, where he had had valuable discussions of science policy with leading national scientific advisers and administrators, and also had the opportunity of consulting leading astronomers on the management of large telescopes. The Council also received a report on a working-level visit to the French Centre National de la Recherche Scientifique (CNRS) by Mr. J. D. Walsh, the Council's newly-appointed Training Officer, who recently spent two weeks working with the CNRS and was able to give a very interesting account of their work and methods.



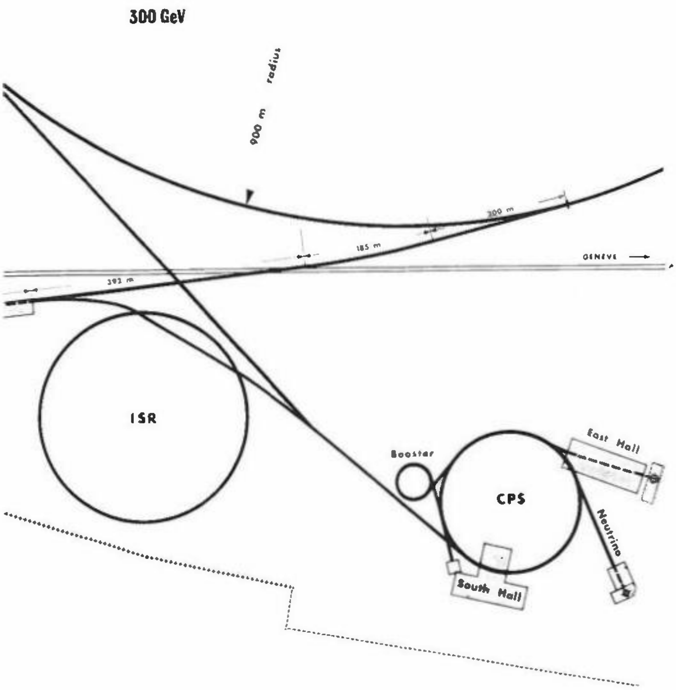
big science

HOUSE OF COMMONS DECEMBER 4 1970

Mrs. Margaret Thatcher, Secretary of State for Education and Science, said 'We have decided that the United Kingdom should participate with the other European countres which are members of the European Organisation for Nuclear Research (CERN) in building a 300 GeV accelerator near the existing CERN site at Geneva. A careful appraisal of priorities within the civil science budget has made it possible to meet the cost of the project without additional public expenditure.'

So CERN's 'missing magnet' design (see *Quest* July 1970) had brought the 300 GeV accelerator proposal within reach of our budget. It will cost only about half as much as the earlier project which the UK declined to join in 1968, and the latest proposal permits savings in the existing CERN programme. The UK share of the cost, spread over eight years, is estimated to rise to an annual figure of some £3.3M. But with the savings in the existing programme this should be reduced to £2.5M. *(For the Council decision see 'Council Commentary'.)*

Joining the project will mean having to make some savings in our own national research programme in high energy physics, as it is current policy that expenditure on nuclear physics should take a diminish-



a plan of the present site, showing the proposed site of the 300 GeV accelerator. HBC indicates the High Field Bubble Chamber; ISR the intersecting storage rings, and CPS the 25 GeV proton synchrotron.

ing proportion of SRC's total resources. On the credit side, however, access to the new machine would provide for facilities in the forefront of this field for several decades to come.

The proposed CERN machine is a proton synchrotron, circular (about 2 Km/1¼ miles diameter), in which hydrogen nuclei will be accelerated to very nearly the speed of light. In machines of this kind, as particles approach the speed of light most of the added energy appears not as speed but as mass. At the same time, as particles gain energy their effective diameter becomes less so they become better tools for exploring in finer detail the fundamental natures of the components of atomic nuclei and of matter itself.

Over an eight year programme, the machine will be built in a tunnel of 2.2Km major diameter, bored some 30m underground and adjacent to the existing CERN Laboratory. The present CERN synchrotron will be used as injector for the new machine while continuing to provide experimental particle beams at the 25 GeV level and, at periodic intervals, filling the Intersecting Storage Rings (another important new facility already under construction). Experimental facilities on the existing site will be used for the first experiments with the new accelerator at intermediate energy levels until the programme is completed by the construction of top energy facilities on the new site.

CERN plans do not end at 300 GeV. At the beginning of the construction programme, sufficient iron cored magnets will be ordered to fill half the available tunnel space so that an accelerator of 200 GeV could be brought into operation in the sixth year of the programme. Within the present budget, further magnets could be added to raise the energy to 300 GeV, the ultimate energy with conventional techniques being limited by the tunnel diameter to 400 GeV.

But if superconducting techniques, which appear promising, turn out to be practical and economic it could be decided to bring the accelerator into operation at 200 GeV and while research proceeds instal superconducting magnets in the spaces left in the ring so that when the high energy experimental facilities become available at the end of the programme, the machine will be capable of accelerating protons to 500 GeV.

It is however impossible to guarantee now that this could be achieved within the present budget, and special provision is made in the CERN agreement for this eventuality. The possible substitution, at a later date, of superconducting magnets for the iron magnets would give an energy of approaching 1000 GeV.

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stop press

At the December meeting of the CERN Council, agreement on the 300 GeV project had to be deferred because only seven out of the twelve member nations were prepard to give the go-ahead. As a result Britain's formal letter of agreement also had to be withheld because her participation depends on support and financial commitment from all the other members. The meeting was adjourned until February 19. If not all of the five remaining members have decided by then to join the project the CERN Council will have to decide whether to go ahead with incomplete initial membership. The reduced number of participants would each have to bear a larger proportion of the total cost but the seven member nations which have already agreed include the four largest countries and would contribute over 85% of the total. Britain's present contribution is approximately 22%.

think automated

G. I. Thompson

In 1919 the International Council of Scientific Unions was founded, along with four of its fifteen member unions. These are the organisations that sponsor the (now) mammoth congresses of thousands of participants, which absorb so much scientific energy. Astronomers got in on the ground floor with a vintage year foundation – the International Astronomical Union – whose general assembly at Brighton this year was as big as ever.

One pleasant derivative of the general assembly has been the practice of hiving off small specialised colloquia, which are held near the time and place of the main meeting, so they can be truly international in character. Consequently the colloquium on 'Automation in Optical Astrophysics' held at the Royal Observatory Edinburgh in August this year had representatives from sixteen countries. Edinburgh was a suitable choice – our 'think automated' tradition was established sooner than most.

Naturally, in so dedicated a company it would have been heresy to question the value of automation. A few courageous souls from the back of the hall came up with 'how many extra people do you need to maintain the equipment', or 'how much time do you spend programming' and the like. They were answered politely but firmly, to the apparent satisfaction of the audience. There appeared to be only one acceptable objection to automation. One speaker had automated a process previously done by young ladies who had now disappeared from the observatory. He received much sympathy.

The colloquium was opened by Professor Rösch, an astronomer from the French Pic du Midi Observatory. He defined automation as either saving human labour or doing work which man himself could not do. There is no mention of computers in such a definition; indeed Professor Rösch insisted that they were not necessary and warned against needless sophistication. However 90% of the papers presented described computer-based systems and the meeting was unhappy when the word was not current.

Control of telescopes is a case in point. An observation will, typically, last about an hour. During this time the telescope must be kept aligned on the stars and must therefore be driven to counteract the earth's rotation. No mechanical arrangement has ever been devised to maintain this alignment against atmospheric refraction and instrumental flexures to the accuracy required. There was a time when the astronomer himself had to observe the star image constantly to keep it centred in the field of view, correcting any drift by slow mechanical drives. This was his only function in the dome and a soul-deadening and uncomfortable job it could be. Now there is a wide range of devices to perform this task. This is automation in Rösch's definition. Nevertheless, at the Colloquium it held marginal interest only, and protests were made when the discussion came to the relative merits of worm and friction devices!

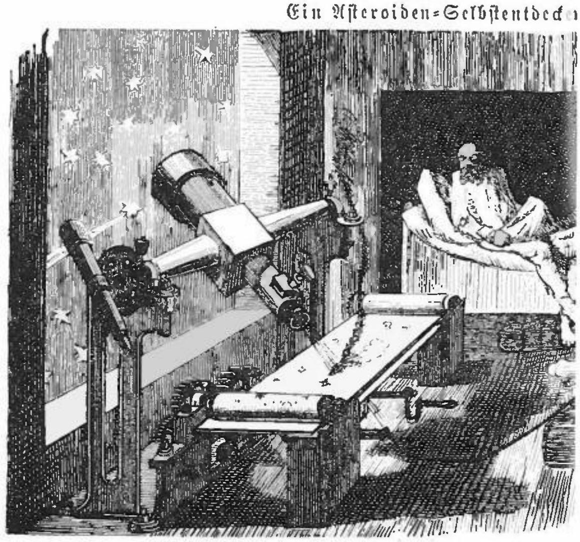
More interesting were systems in which the output of photoelectric devices at the focus of the telescope were linked to computers, such as a multiplex recorder at the focus of a spectrograph feeding a computer, which displayed the results on an oscilloscope. The astronomer could watch the record as it slowly built up – in astronomy, if it's interesting it's faint, and integration times are long. Eventually, he could choose to concentrate further observations in those channels which were turning out to be more interesting.

Another device was to store the photomultiplier output in the computer for short integration times. After some time the output was scanned to see whether a significant event, such as a flare on a red dwarf star had taken place. Presumably a gun was fired too to get the astronomer out of bed! The development of computer-controlled systems of this sort should make the role of astronomers in the dome more significant than that of keeping a star on a cross-wire.

Telescopes for observing the sun are a special

(illustration below is reproduced by courtesy of Faber and Faber Ltd. from 'The System of Minor Planets' by Günter D. Roth, MAG, translated into English and expanded by Alex Helm, FRAS.)

Ein Asteroiden=Selbstentdeck



An indication of how 'popular' the hunt for asteroids ha
by this cartoon which appeared during the latter half of the 19th
nomy: the caption points out that, in view of the vast number
Mars and Jupiter, a salvo every quarter of an hour migl

breed. They incorporate large spectrographs so instrumental control by computer becomes important. The sun is bright enough to allow the use of sophisticated observational devices, and complex enough to require them, and so provides a further field for automated control. A beautiful example is provided by the magnetograph of the Mc Math solar telescope, which can plot the pattern of the sun's magnetic field over the entire solar disc in twenty minutes.

The automation of reduction procedures, rather than observing systems, will probably be more significant for astronomy in the long run. This is particularly true of photographic information. In *Quest*, April 1970, Dr. Pratt described the problem in the case of plates taken with the Schmidt telescopes, namely the sheer volume of data to be reduced and the solution developed at Edinburgh – the 'GALAXY' machine. This machine has now been in use for nearly a year and, as reported at the Colloquium, has exceeded the specification accuracy.

The other major field of data reduction discussed at the meeting concerned stellar spectrophotometry: when digitised microphotometers get the data into machine-readable form. There were descriptions of projects for incorporating on-line control even here, but the advantage gained would hardly stand up to cost-analysis. In the analysis of stellar spectra, unlike the direct photography of star fields, the real problems arise after the data are in the computer. We heard several descriptions of spectrum reduction procedures, ranging all the way from the programming of pencil and paper operations to sophisticated applications of information theory. There is evidently a place for many different attitudes. One of the simpler approaches coupled to an interactive on-line program would be fun to use.

Unlike several other sciences, optical astronomy has been generally slow to realise the possibilities of automation. Following this very successful conference we expect the 'think automated' habit may well become more widespread.

The author, Dr. G. I. Thompson *who is a principal scientific officer at the Royal Observatory Edinburgh, engaged in the automated reduction of stellar spectra. He is now in charge of the analysis of the astronomical data which it is hoped will be forthcoming from the Edinburgh/Liège S68 satellite experiment due for launch in 1972. At present he is writing the necessary reduction programmes.*

the latest in physics

At the 1971 Physics Exhibition, the Science Research Council will be represented by nine exhibits. All are in category 'A' which comprises the most recent and original developments which an exhibitor wishes to show.

The exhibition is organised by the Institute of Physics and the Physics Society who put each entry to a panel of referees to decide whether it merits exhibition. It must qualify both on scientific merit and on its novelty in respect of the application of physical principles and the novelty or superiority of its performance characteristics. Most items accepted are therefore at the stage of research and development or prototype and early production models, although some established production items are accepted as well.

SRC will appear on the stand organised by the Department of Education and Science on behalf of the Research Councils. The nine exhibits are:

from Rutherford Laboratory

Gas purification rig

Mono-energetic electron source

Foil stretching technology

Heat pipe and liquid hydrogen target

Television cameras working in high magnetic fields

from Daresbury Laboratory

Precision magnet measuring system

Data handling and instrumentation techniques for high energy nuclear physics experiments

from the Astrophysics Research Unit

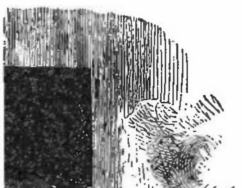
Rocket borne echelle spectrograph for high resolution studies of the solar vaccuum ultra-violet spectrum

from the Radio and Space Research Station

Millimetric radiometry in studies of the sun and troposphere.

diary note

The exhibition will be on view (and open to the general public) on April 19–22 (Monday to Thursday) at the Alexandra Palace, Wood Green, London N.22. It is open till 6 p.m. on Monday and Tuesday, till 7.30 p.m. on Wednesday and closes at 5 p.m. on Thursday.



come by that time is given
ıry. Automation in astro-
possible asteroids between
ll be expected.
egende Blätter, Vol. LIX, No. 1470

These are a few of the major grants announced by the Science Research Council during October and November, 1970. They show some of the variety of research projects supported by SRC outside its own research establishments.

space science

In October SRC made a grant of £690,000 to carry on the programme of geophysical and astrophysical research in space, being undertaken at the Mullard Space Science Laboratory (University of London) under the direction of Professor R. L. F. Boyd FRS. In the last three years the Laboratory has been supported by a grant of £519,000 and has continued its very successful programme of ionosphere and magnetosphere research, and of ultra-violet and *x*-ray astronomy, using experiments flown in rockets and satellites.

Under the new grant, studies of solar and stellar *x*-ray emission and solar ultra-violet emission will continue. Particular emphasis will be placed on the study of cosmic *x*-ray sources, using a reflecting *x*-ray telescope array in a NASA satellite (OAO–C), two new instruments in the cosmic *x*-ray satellite, now being planned as a UK/US co-operative project, and several instruments in UK and ESRO rocket payloads. A large ion probe is being prepared for the ESRO IV satellite (launch date in 1972) also low energy particle detectors intended for a geostationary satellite. Experiments launched in UK and ESRO rockets will study the coupling between the magnetosphere and the polar ionosphere, which involves the same low energy particles.

applications invited

Photochemistry is being supported by sixteen different grants totalling £235,000 over two to five year periods. The applications for grants in this field, which came to £1.1M altogether, were considered by a specially constituted selection panel of the Chemistry Committee.

Applications have been invited for the 1970/71 academic year and if sufficient good proposals are received it is hoped that funds will be available on a similar scale.

The particular topics the Council wishes to support are:

- fundamental studies of energy transfer in excited molecule reactions;
- investigations of the factors which govern the absorption, transfer and dissipation of energy;
- excited state chemistry, particularly of readily available and/or structurally simple materials;
- new syntheses based on photoactivation, particularly those involving readily available starting materials.

new balloon studies

Professor P. H. Fowler FRS of Bristol University is to carry out a new series of experiments in continuance of his outstandingly successful balloon-borne cosmic radiation studies, with the aid of an SRC grant of £65,000. A novel 'Venetian blind' arrangement will be used on a detector to be flown from Texas. This allows the launch and exposure of a greatly increased area of detector – possibly up to $100m^2$. Additional exposures with thick detector plates which will be capable of slowing down or even stopping some of the slower primary cosmic ray particles are planned for northern USA where slow cosmic ray primaries are able to pass through the earth's magnetic field. The plates will consist of sandwiches of thin plastic detectors, photographic emulsion and brass sheet, of a total thickness of around 1cm.

The balloons will be the latest polyethylene type with a volume in the region of 10^6m^3, capable of carrying a payload of just over a ton to a height of 40km and remaining there for more than 40 hours.

mathematics – applied

Functional analysis, the qualitative theory of partial differential equations and certain advanced numerical methods will be important aspects of study in the research programme to be carried out by Professor T. Brodie Benjamin FRS at the Institute of Fluid Mechanics Research. The Institute is being set up at the University of Essex with the help of an SRC grant to Professor Benjamin of £70,600 over three years.

These subjects, taken together, encompass knowledge that is central to many recent developments in fundamental mathematics and is also useful when mathematics is used to describe physical systems and analyse them quantitatively. Professor Benjamin plans to develop a profitable partnership of modern mathematics with experimentally orientated applied-mathematics research. In order to bring the newest mathematical knowledge in this field to the Institute, distinguished foreign mathematicians will be invited to take up Senior Visiting Fellowships. The subject most likely to form the initial focus of the programme is the general theory of waves in fluid systems that are both non-linear and dispersive. This is a rapidly advancing field that is becoming more important in many practical contexts – in dynamical meteorology and oceanography for instance.

Professor Benjamin, formerly reader in Hydrodynamics at Cambridge, will hold the Augustine Courtauld Research Fellowship at the University of Essex for the three years of the grant.

arc phenomena

His work on electric arc phenomena in industrial devices has gained Professor H. Edels of Liverpool University an SRC grant of £212,420 to supplement an existing grant of £20,000. His aim is to carry out fundamental research on the high current arc under conditions relevant to switchgear and furnaces, initially. This will be concerned with high current arcs at high pressures and in ultra-high vacuum and with arc interaction with high speed gas flow and magnetic fields.

The data obtained should be of assistance in the understanding and development of a wide range of arc and plasma devices in addition to switchgear and furnaces. It should eventually prove of considerable assistance to British manufacturers competing in world markets. The project is therefore being developed in collaboration with several industrial firms and use will be made of their high current test facilities. A Steering panel of senior industrialists under the chairmanship of a senior academic will review progress and give advice and assistance.

problems of enzymes

A group of academic staff and their collaborators from eight different departments of the University of Oxford are to make a combined attack on some major problems in molecular enzymology, using different approaches. They will be supported by an SRC grant of £371,000, which will be mainly spent on developing a high field multi-nuclear NMR spectrometer of the most advanced design, operating at 270MHz for protons. The Group intends to concentrate increasingly on the enzymes of glycolysis which constitute one of the simplest and most important sequential systems of intracellular enzymes.

Other grants made recently for Enzyme Chemistry and Technology are :

£36,905 for work on the synthesis of artificial lysozymes *(Professor G. W. Kenner, Liverpool);*

£15,270 for spectral studies of the mechanism of enzyme action *(Dr. M. R. Holloway, UC London);*

£30,830 for chemical engineering studies basic to the use of enzymes as industrial catalysts *(Dr. B. Atkinson, UC Swansea);*

£15,785 for work on acid-base catalysis in model systems related to enzymes *(Professor R. P. Bell, Stirling);*

£10,451 for a study of the active state of riboflavin synthesase *(Professor H. C. S. Wood, Strathclyde).*

computer program

Professor I. L. Douce of Warwick University is to extend the work at the Inter-University Institute of Engineering control, with an SRC grant of £175,000. Most of the grant will be used to provide a computing system based on the RXDS Sigma 5 computer.

'That's the trouble nowadays – no knowledge of the classics!'

(reproduced by kind permission of 'Punch')

This will be situated at the university to serve as a control research facility for the Institute and will be made available to other universities and colleges in the area as far as possible. The Institute was set up by the University College of North Wales and the Universities of Sussex and Warwick, partly in response to SRC's policy of encouraging collaboration between universities in this field. The post-graduate courses in control engineering at these universities were integrated into one advanced course which has proved very successful and is now being run for a fourth year.

There are four main areas of fundamental control research being developed within the Institute:

mathematical modelling of dynamic systems and parameter estimation;

analysis and control of distributed parameter systems;

analysis and design of control system actuators; and

application of optional and sub-optional strategies to practical systems.

These studies are linked to practical projects being carried out in active collaboration with industry and are mainly concerned with work on internal combustion engines and jet engines.

publications

Reports from Boards and Committees due out this month are:

'The Physics of Surfaces' *(Science Board)*

'Desalination' *(Chemical Engineering and Technology Committee)*

'High Temperature Processes' *(Chemical Engineering and Technology Committee)*

These reports summarise research work carried out to date and plans for future research.

nutcracker no. 2 – tiddleywinks

At the Rutherford / Daresbury tiddleywinks match, the teams in descending order of ability were: Rutherford: Alpher (captain), Bethe, Gamow, and Dirac; Daresbury: Alf (captain), Bose, Gammer, and Nina. There were four rounds, every player meeting each of the opposing team once, and since the four mats were of different quality, it was agreed that each player should use each mat once, and that he should use the best mat when playing the corresponding player in the other team. The two captains were to meet in Round 1, and Bethe and Gammer were to meet in Round 4, using the worst mat (so that they could play in the train going home). Furthermore, Dirac's principles excluded him from playing Bose either in Round 2 or on Mat 2. How were the matches arranged?

Hint Consider whom Gammer plays while Dirac is playing Bose. In which round?

Peter Casey

(answer on page 14)

why bother with contracts?

The Editor of Quest

Dear Sir,

Reading the letter in the October '70 issue of *Quest* and recognising myself as a typical Amateur Buyer, (probably in common with more than a few engineers), I must take up my pen in defence of people in a similar position to mine who are sometimes forced to short circuit the system.

I hasten to say that I do try to make use of the normal buying channels and the excellent Contracts Branch and I am the first to agree (well maybe the second to agree) that the provision and use of a recognised system of paperwork is necessary to ensure the smooth running of dealings with outside manufacturers.

For my part as a reluctant AB it is normal for me to want my goods yesterday. Unfortunately real work cannot be put into tidy piles or filed away for attention some other time like stores requisitions or expenses claims, it tends to demand attention because of sudden failures which do awkward things like putting the lights out or causing the heating to go off. I do admit to an occasional preoccupation with 'getting the job done' and the secondary task of pulling the paperwork system, with all its hangers on, along with me receives less of my attention than it might.

You see I am the recipient of the kicks if the job target is not met, and whilst A Buying may throw the system into confusion (more confusion that is), one normally gets the goods quicker. I find that in the normal purchasing procedure there are at least eight people who must progress my order though it says something for the success of the method in that it is not unknown for a supplier to receive the order in only a little over a week since I raised it. In my amateurish way I have had goods from almost anywhere in the country in my hands *on the same day* that I telephoned the order through. (How long it then takes the firm to get paid I don't know.)

There is unfortunately no standard procedure for dealing with the 'rush job' probably because the army of administrators do not wish to recognise the existence of such an inconvenient event. I once went to the lengths of physically carrying the papers from person to person in an attempt to hurry the system up but even this took me all afternoon and I was subjected to a few raised eyebrows when I explained my purpose.

On another occasion when an urgent order was not received by the supplier in 10 days I found that the clerk whose job it was to note my order number in a large book was on two weeks leave. These things happen in any large buying organisation simply because my orders receive the same priority as all the others whereas I can give them top priority.

I see that one of the comments in the letter refers to A Buyers never attempting to enter into price negotiations or cost saving, as it is inferred Contracts Branch of course would. Contracts have never initiated any reduction in the price paid for my jobs. On the contrary they are only too eager to pay up, even if a cost reduction is likely to be negotiated for some reason. One of my difficulties has been trying to hold up payment – anyone who has had a largish bill in the offing near the end of the financial year knows how difficult it is to interfere in the payment process. I have had to insist on money being returned from a firm before now because of the 'never before seen' enthusiasm of a bill payer trying to get his yard arm clear before an inspection by his chief. Engineers are of course renowned for their cunning in the field of negotiating a lower initial price or in obtaining a reduction after ordering.

Incidently one of the reasons that I have replied to the original letter and tried to put the other point of view is that I am the buyer for whom the Lost Hopper in Offices Services Section was intended. This went astray three months ago since which time the firm has sent me another. I find that in this case I followed, fortunately, the correct contract procedure but that the item was not sufficiently well addressed by the sender. (Undoubtedly another office type.)

There is another part of that order which never did appear, it is a sc ew conveyor complete with motor. If *Quest* can find this for me as well the Ed might consider starting a Lost Property column. This would be of great use to all AB's and maybe even to Contracts Branch. It might also be a further justification for the chosen name of the magazine.

Anon.

(name and address supplied)

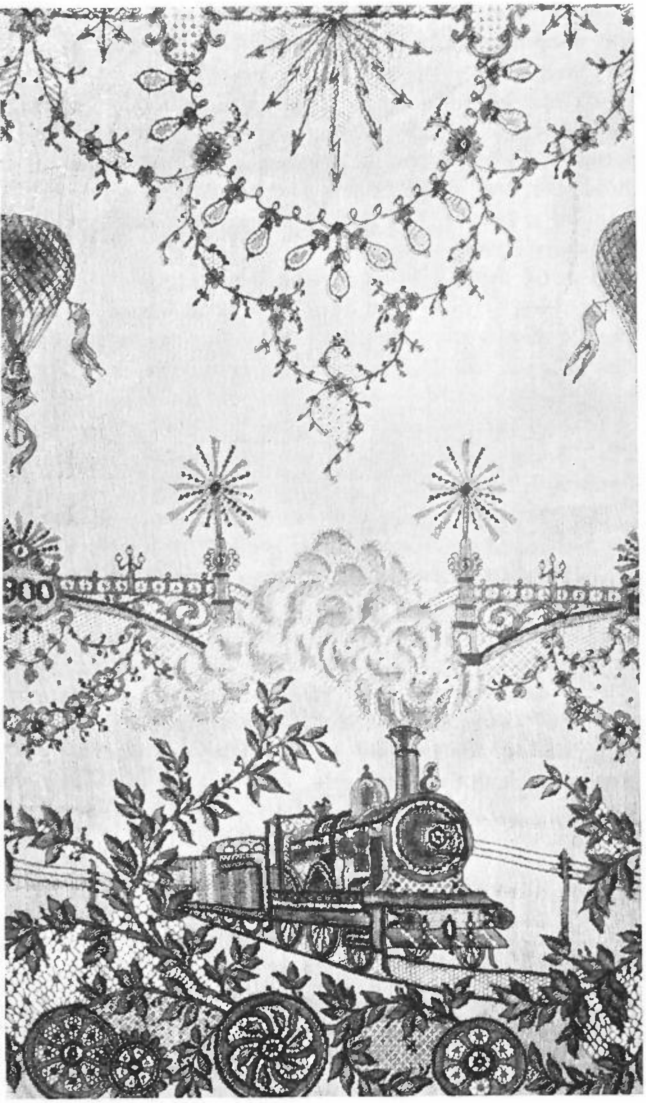
holiday special

'Staff are eligible for annual leave with pay to an extent which varies according to the class or grade in which they are employed and, generally, to their length of service.'   *CEM 4A2*

So how do we spend it when we get it? In the next five articles some of our readers recall places and pursuits which interest them. Perhaps they will help you to choose between the glossy ads which thump through our letterboxes through Christmas until Lent with the message 'Spend ye for the end of the booking season is at hand'.

Appropriately enough our first port of call is Calais – its historical background. The article is written by Mr. J. G. Hartshorn who retired from the Council Secretariat last May – *(see Quest, July 1970)*. He was the British Pro-Consul of Calais, then Vice-Consul, from 1930 until 1940 when he had to evacuate the English colony under the fire of enemy planes and the advance of German troops.

Calais and the lace trade



'Train'. Lace produced by the firm of Davenière 1900. Photo by courtesy of the Musée de Calais.

J. G. Hartshorn

When I was asked to write an article about my life in France before I joined SRC I thought that instead of the usual scientific subject for the house journal, members, especially the lady members, would be interested in the history of the manufacture of lace.

I wonder how many people passing through the town of Calais, rushing along to find the hot and sunny weather of the South of France or Spain, realize that for a great many years this town was the main centre of machine-made lace. These machines were able to reproduce the finest and most delicate designs of the old hand-made laces to perfection.

Nottingham until 1816 was the birthplace of the trade, where the first lace is supposed to have been produced by a certain Roger Clarke, a bone lace weaver who invented a simple lace in 1597. But it was not until 1800 with the invention of the Pusher machine (so called as the bars moving the threads had to be pushed by hand) that the square net used for mitts and especially for the foundation of wigs was produced. Later Heathcoat brought out the bobbin net, which reduced the price and made it possible for the ordinary person to buy it.

The trade suffered from the embargo Napoleon I imposed on English nets by prohibiting the import of them into France. To overcome this, bales of nets were smuggled across the Channel by special fast sailing boats known as 'smugglers'. To retaliate, the English Government made stringent laws against the export of English machinery. Strict vigilance was kept not only at the Channel ports, but also on the Nottingham factories.

To overcome these drastic measures a mechanic from Nottingham, James Clarke, introduced the first lace machine into Calais in 1816, by smuggling the various parts of the loom under the fish and nets of a fishing boat with the help of French sailors. He was quickly followed by two of his friends Bonington and Webster (Bonington was the father of Richard

Parkes Bonington, the celebrated water-colour artist). To embellish their net, they embroidered flowers by hand over it very quickly with a thicker thread. These were the first efforts to produce a pattern on net. A few years later in 1821 over 38 looms were in full production, all manned by English lacemakers.

The father of the hand-made lace in France was Colbert the minister of Louis XIV, who in 1665 asked a certain Madame Gilbert to set up a lace work-shop at Lonray near Alençon with 30 needlewomen from Venice. Other work-shops were opened in various parts of France, but the most important one was at the Château de Madrid in the Bois de Boulogne of Paris where the well known Point de France was made. In 1692 at the battle of Steinkirk, some French officers wore lace on their uniforms and collars. This was such a success that the fashion took on, and was known as the 'Steinkirk' style. At the same time 'The Fontange' was worn by the ladies – a high head-dress of lace which took its name from the Duchess of Fontage a favourite of Louis XIV. One day when out hunting, she had lost her hat and covered her head with a square piece of white lace.

Naturally the Flemish laces made in the 'beguinages' such as Bruges, Malines, Brussels and Louvain were considered the best handmade laces, and the lucky person who still has a piece at the present day has a priceless article.

When France tried to impose a rather high duty on these goods, and put up a strong cordon of custom posts along the Belgian frontier, a great increase of smuggling started as the demand for hand-made lace was considerable. The lace was smuggled across the frontier by specially trained dogs, who carried the merchandise wrapped round their bodies. A great many houses were built right on the frontier line, half in Belgium and half in France. The dogs would enter the house by the back door in Belgium and go out by the front door in France, when the French custom patrols had passed and all was clear. They travelled by night and kept to the fields and woods and delivered their loads as far down as St. Omer. The traffic was so great that between the years 1820 and 1836 as many as 40,278 dogs were destroyed, as per the statistics of the French Custom House.

The boom for machine-made lace really started when the machines were adapted to the Jacquard system of working the bars automatically. The Binche, Alençon, Malines and Valenciennes cotton laces were generally produced on 9 point Leavers machines with 18 bobbins to the inch, but the fine Chantilly silk lace was made on a 16 point Leavers machine with 32 bobbins to the inch. This was the fine quality article using two kinds of silk yarn which produced a beautiful and delicate open-work effect outlining the pattern filling round the vases, baskets and a combination of flowers, sprays and leaves in the design.

All the workers were extremely skilled artisans with years of practice and eyesight keen enough to notice a broken thread among the thousands of threads of the warp, beams and bobbins. They commanded a high salary, and liked moving from factory to factory for experience.

In 1854 the whole lace trade moved to the village of St. Pierre (now part of Calais) 2 miles south of the old town, on account of a by-law made by the then Mayor of Calais prohibitng the working of machines during the night, as it disturbed the sleep of the inhabitants. St. Pierre, from a small village of 933 people, grew to a large size town of 33,390 inhabitants with over 2,722 large machines.

The trade passed through many difficult times: the 1886 and 1929 slumps in prices, the world war of 1914, and especially the second world war of 1939 which with the bombing of the factories and smashing up of most of the machines, reduced the production to practically nothing.

It is sad to add that this famous and delicate article of dress is practically out of favour and is disappearing fast, killed by the modern trends of fashion such as the mini-style.

a walk around mont blanc

Allan Ridgeley

Have you heard of the Tour of Mont Blanc – a walking tour round the Mont Blanc Massif? Apparently it is very famous on the continent, and can probably be compared favourably in quality although not in distance with our own Pennine Way. The route, which passes through France, Italy and Switzerland, has many variations and this is one of its chief attractions. The tour can be completed in six days but there is sufficient interest to fill in a fortnight's holiday easily. My fiancée and I had not organised our holiday when we read about the tour in an *Observer* article. It seemed an interesting proposition so we wrote off for details, and finally arranged a fortnight's walking holiday of which the tour proper took up nine days.

Our route was 80 miles long with about 28,000 feet of ascent and descent. We must confess, however, that nearly 25 miles of distance and 13,200 feet of ascent were accomplished by mechanised means – chair-lift, rack-and-pinion railway and 'bus. On the other hand, we did have to carry rucksacs weighing 25–30 lbs all the time.

'Swan'. Lace produced by the firm of Georges Elie and shown at the Exhibition of 1900. Photo by courtesy of the Musée de Calais.

We did the route in a clockwise direction following the *Observer* example, but it is more usual to go anti-clockwise. We soon found it was necessary to speak in French to people encountered walking anti-clockwise but those walking clockwise spoke English and would have the green *Observer* pamphlet somewhere about their person.

We stayed in hotels or pensions except for one night in a mountain hut. It is possible to stay at several mountain huts on the route but it seems difficult to make an appreciable saving that way so one might as well have the comforts of the valley.

The most accessible starting point for the tour is Chamonix, reached by train from Paris or from Geneva airport. Alternative starting points are Courmayeur, Orsière or Champex. We started from Champex having walked there from Martigny but in fact there is a daily 'bus service and walking is not recommended.

The best map for the tour is the 'Gruppo Del Monte Bianco' published by the Italian Touring Club but the Swiss maps of Martigny and Courmayeur are also useful. The guide 'Chamonix–Mont Blanc' published by Constable provides a very good companion for the tour. Finally, for those who prefer to have their holidays organised for them, the Ramblers' Association is arranging the Tour of Mont Blanc as one of their walking holidays in 1971.

summer in autumn

One year finding ourselves in late August with no summer holiday arrangements and the prospects of sunshine in the UK growing dimmer, my wife suggested a Mediterranean cruise. Overcoming some suspicions of being a bad sailor I agreed, with the result that on October 5 we joined the s.s. 'Reina Del Mar' at Southampton for a fifteen-day voyage to the Med.

The weather got warmer during our first day out. We started on Thursday evening and arrived at Malaga, just inside the Med, early on the following Monday. We next tied up at Genoa (Thursday) leaving the same night for Leghorn (for Pisa) where we spent Friday. That night we left for Lisbon on the homeward trip, arriving on the Tuesday after passing Gib in bright sunlight. Leaving Lisbon that night we arrived back at Southampton on the sixteenth day. Over the cruise the ship covered 4079 nautical miles (equal to 4697 land miles) at an average speed of 16.18 knots.

At the four ports of call shore visits and excursions were arranged through Thomas Cook at reasonable rates (about £8 per full day including meals). Otherwise one could just stroll ashore, returning for lunch and dinner on the ship.

The meals were as we have come to associate with luxury cruises – a menu card that I have lists over 50 items: fruits/soups, fish/entrées, choices of main course, sweets, cheese and biscuits, fruit and coffee. We sat eight to a table, having the complete attention of one waiter, who, like most of his colleagues, was Spanish.

The preparation, cooking and serving of the food was of first class hotel standard and the portions generous. On the second day we found that we could manage only the entrée for dinner, with lunch and breakfast scaled down to home proportions, although on the first day we had attempted the full card. Tea was a rushed affair and not worth leaving a comfortable deck chair for.

The ship had a main lounge, the 'Coral', for the principal social events, including 'Bingo' in the afternoons, dancing lessons, fancy dress balls and ship games, such as horse racing without horses. The games were quite a feature of ship life and there was a tote for those seeking their fortunes.

Allan Ridgeley is an Experimental Officer at ARU Culham, working in solar physics experiments launched on Skylark rockets.

The cinema was on two levels and, owing to the projector beam having to miss the edge of the galley, the screen was too near the ceiling which produced a curiously narrow picture. Current films were shown in the afternoon and late evening and changed every two or three days. On Sunday mornings the Captain held a dignified naval-type service there, with the officers in their white uniforms in the front row. It was also used by the Cruise Purser for an illustrated lecture on places worth visiting which he gave before each port of call.

The Cruise Purser was the master of ceremonies for all social activities. Ours was a cheerful young extrovert who conveyed the impression at all times that everything was fun – including the safety drill which he conducted on the first day at sea.

Excluding the first evening and the last day, the October weather ranged from English spring to high summer, reaching about 80°F between Malaga and Genoa on the outward voyage. The ship had two swimming baths and on the way out we had the traditional Neptune ceremony. One was shallow and reserved for children under supervision of a stewardess. The larger was crowded on hot days – and hogged by the inevitable show-offs. In high summer I imagine the pools would be uncomfortably full.

When we went it was outside the school holidays, which may account for the small number of children aboard – around 40, mostly toddlers. It was also outside the main holiday period, which may be why the middle-aged were in the majority among the 851 passengers. Cruising is a lazy life and I would recommend it only for someone who feels the need to r-e-l-a-x – spelled out slowly – or who is recovering from illness. It is not for the energetic, nor for those whose prime concern is to visit foreign parts. The one-day stops give insufficient time to see much and first you have to get clear of the port area. You see more of the sea than anything else: It is certainly a dark blue in the Mediterranean and, we learned, well over a mile deep in parts.

Our ship was fitted with anti-roll stabilizers and behaved well even through the Bay of Biscay. I did take some of the proprietary pills as an insurance and never came near sea-sickness, but frankly I saw few heaving up their hearts.

Altogether the cruise for the fortnight worked out about 50% more than I would expect to pay for a fortnight at a good hotel in Europe with some travelling thrown in. At no time on board did one get the impression – experienced so often with package tours – that things were cut down to a price, nor was any attempt made to sell us anything that we did not want.

As for the prospects of romance, the proverbial raison d'être of many young ladies who cruise, I can only speculate; but the handsome Medical Officer announced his engagement to one of the lady Assistant Pursers during one of the fancy dress balls!

all at sea

I recall Sunday morning vividly. It was almost seven thirty, the sun was not beaming brightly, no one was up, and despite a night of near subconscious sleep, my bunk seemed as hard and vicious as it had the night before. I opened first one eye then the other, grunted 'Good Morning' and waited – no reaction. Though by now accustomed to the smell of Calor gas, even at that hour, I was in no doubt who slept closest to the stove. Slowly I eased my buckled frame out onto the galley floor, filled the kettle and after lighting the gas slowly summed up the effort to bellow to the sleeping huddles 'It's morning'.

This activity had the desired effect; even the clouds took fright and let a little more sun come through, and the sleeping bags extended out hands to grab the deep brown tea, by now brewed and distributed in assorted mugs. My efforts at tea making normally leave much to be desired, but especially so that morning if you include the lumps of Marvel that floated like dried peas on the muddy liquid that filled the cups. The result was instantaneous, the crew was everywhere, anxious at any cost to be up and dressed and prevent me doing similar injury to the sausage, bacon and egg set aside for breakfast. The sudden rush of activity prompted me to go on deck. Here a high level conference was developing between the Skipper and Bill, should we go around the island? The final decision was left to Bill; Harry had explained the wind, tide and weather were just right but it might get a little rough.

William, a glutton for punishment, leapt at the chance and we set sail and rolling gently ventured into the unknown. Breakfast was more usual that morning, everyone tempted by the smell of fine cooking, and close to starvation after the efforts of the day before, filled themselves with sausage, bacon, egg, bread and lashings of sauce. After breakfast the wind freshened and the journey began to get more interesting, but perhaps a little more uncomfortable. It was at this point that one of the mast stays gave way at its anchorage to the deck. Bob and I scrambled forward, Bob reaching the stay, myself reaching the

adventure courier

Or if you want a holiday which gets you to places off the usual tourist routes, you could join Dennis Fogerty of F Division's Internal Audit Section.

In 1970 he took a party – on a 'share and share alike' basis – to Turkey in a minibus. They stayed at camp sites and he showed them a lot of places which he had 'discovered' for himself in previous years (on family holidays – he has three children). This was such a success that he is organising no less than four expeditions to Turkey in 1971, although he will of course only have enough leave allowance (he has completed his 20 years and more in the public service!) to drive one himself. Each party contains 13 passengers and 2 drivers. The holidays are named 'Topkapi Safari', after the famous palace in Istanbul, and take from 16 to 24 days. Turkey is very hot then – the holidays run from June to September – and is ideal for sun lovers.

All you need to take with you is a minimum of camping gear, a willingness to take the rough with the smooth (*ie* the 'camping spirit') and an adventurous outlook. If you would like to go or to find out more, ring Dennis at home on 01-883 0915 or drop him a line at 99 Elmshurst Crescent, East Finchley, London N2. Armchair travellers can hear more about it in our next issue.

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bow of the leeward hull just in time to waste a good breakfast over the side. Acting on the philosophy that once physically sick, mal-de-mer can be forgotten, I threw myself deeper into the task of sailing the boat. On reflection it would have been simpler and considerably less painful to fling myself into the sea. The wind became stronger, the waves higher, and the shore began oscillating even more violently. Oh to be on dry land again . . .

In case you are still wondering . . .This (sea) sick tale comes from 'Chunky' Lepine and relates to a weekend cruise from Hayling Island to Cowes and back, made in a borrowed yacht by a group from RSRS. The full harrowing story first appeared in two exciting instalments in the RSRS Newsletter. Chunky is an SO in the D-region physics rocket group, working on the analysis of x-ray experiments and the effect of x-rays on the D-region of the ionosphere.

words across the sea

Ian Arnison

It is difficult for a person engaged in the field of communications to visit the information services of official and public institutions in North America without some preconceived ideas. Firstly that the methods employed are more modern and faster than ours (not true and the Americans would be the first to agree); secondly that the market for public information through newspapers, television and radio is much larger (well, that's plain hard fact) and finally that they have new answers to old communications problems (a debatable proposition). Of course there are some most interesting innovations taking place.

All the major American scientific bodies I visited have well organised public relations services run on highly professional lines. They deal with press and public, films, exhibitions and sometimes publications. Quite often the organisation, both of the departments concerned and the work they carry out, is similar – as might be expected – to our own practices.

It is when we get down to the broader issues of disseminating information (especially through the printed word) that a difference begins to appear, for the simple incontrovertible fact of distance in an area as large as North America.

In Britain we have a handful of national daily papers available throughout the British Isles each morning. In addition, there is the regional daily and evening press and local radio and regional TV services. But in California alone there are about one hundred and forty daily and evening papers (some surviving on a circulation of less than ten thousand) and dozens of local commercial radio stations. Hence the syndicated feature article sent to many papers and read simultaneously by a multitude of readers in different parts of a State, or the country as a whole. Such features can often give an "in depth" description of a subject to a very wide audience.

What of the issues involved? Pollution of the environment, student unrest, an unfavourable image of science and technology, are high on the agenda. Good communications can play a vital role but the issues are that much deeper.

Canadian experience is probably a good example of the concern being shown with the explosion of information in science and technology. In recent years a number of studies have been carried out in

Canada on various aspects of communicating information on these subjects. As a result the Science Council has recommended that at the present time, information should be collected and disseminated by 'a decentralised system . . . but collaborating together under the guidance of some coordinating body to constitute a network of services'.

The National Research Council of Canada – a body with many similarities to the former DSIR – has been given the job and it is a priority aspect of the Council's work to co-ordinate this expanding and important area. Now technical information services both for Ottawa, where the NDC headquarters is situated, and in the field come under a vice-president for scientific research, one of the four vice-presidents who form the senior staff of the Council.

The Council is concerned not only with technical information services but good lay public relations as well. In the last two years it has developed a popular style magazine called *Science Dimension* which is sent to a wide public. It is clearly and attractively illustrated with photographs supplied by the audio visual section of the Office of Information Services. (The Canadians have always had a strong tradition in this respect led by the pioneering work of the National Film Board of Canada.)

In addition the Council publishes a number of learned journals covering fields such as Biochemistry, Botany, Chemistry, Earth Sciences, Physics and Physiology. These are the responsibility of a vice-president who has responsibility also for the National Science Library.

If NRC is an example of the small well organised public information side of an official organisation, NASA is its counterpart on a much larger scale. In fact, during a manned space flight, no fewer than two hundred and fifty public information people are involved in the operation. A thesis could, and probably will, be written on their information services!

One aspect, perhaps little known here but a success in the USA, is NASA's series of popular science handbooks intended for schools and the lay public. Publications such as 'How Far a Star', 'The Shapes of Tomorrow' and 'Beyond the Solar System' have been developed by the agency in co-operation with the Office of Education. They are intended as textbooks yet written in a popular fashion and extremely well illustrated. Schools working on projects can apply for them through local education systems.

This relationship between a scientific, technological venture and schools maths and physics programmes must be unique. *next column*

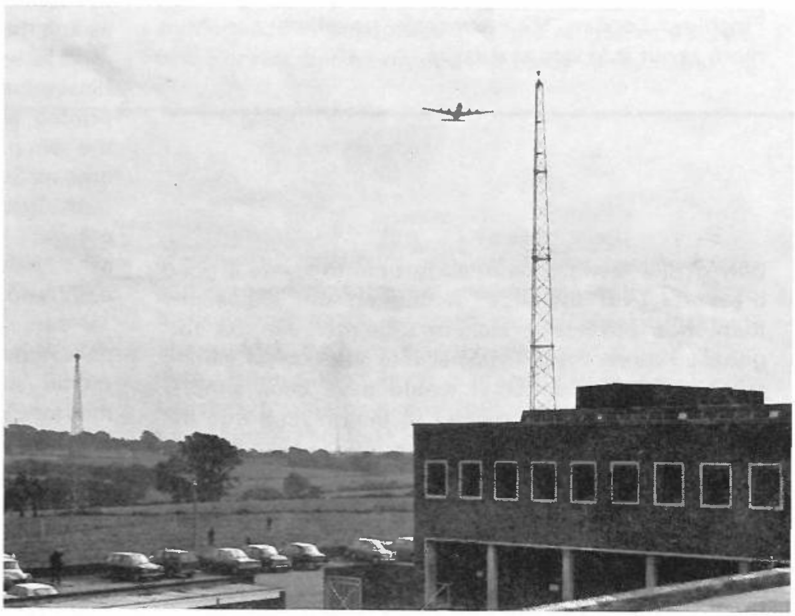
solution to nutcracker on page 8

	Rnd. 1	Rnd. 2	Rnd. 3	Rnd. 4
Mat 1	A v a	B v b	G v g	D v n
Mat 2	D v g	G v n	B v a	A v b
Mat 3	B v n	A v g	D v b	G v a
Mat 4	G v b	D v a	A v n	B v g

Key
A–Alpher, B–Bethe, G–Gamow, D–Dirac.
a–Alf, b–Bose, g–Gammer, n–Nina.

operation 'synchran'

(Synchronisation Atlantique Nord)



The DC-7C flying over the West Building of the Royal Greenwich Observatory in September.

Following the co-ordination of the national time services of the UK aud USA in January 1961, radio time signals have been co-ordinated on a worldwide basis.

From intercomparisons of national time scales, the Bureau International de l'Heure computes and maintains an international scale of atomic time, which is at present based on the atomic clocks at Braunschweig, Boulder, Hamburg, Herstmonceux, Neuchatel, Ottawa, Paris, Stockholm and Washington.

In a different context – scientists themselves endeavouring to satisfy the community's need for authoritative scientific information – they have the Scientists' Institute for Public Information.

The Institute was founded in 1963 and is incorporated as a non-profit educational corporation. It now has a small full-time staff in New York and local committees in many parts of the States. The President is Margaret Mead.

SIPI does not provide information directly to the public; this is the job of its local committees. What it does directly is to convene conferences and workshops on technical aspects of social issues for scientists to exchange information and ideas, to evaluate data, indicate and develop other areas where information is needed.

The Institute's fundamental aim is to bring information to the community in understandable terms and with scientific objectivity. Once the evidence has been presented, it is up to the community to resolve the issues which arise, through the normal processes.

The primary issues with which SIPI concerns itself are environmental conservation (air, water and soil pollution), population control, biology and sociology of race and the non-military uses of nuclear energy. Its principal publication *Environment* (well, if inexpensively, produced) is issued ten times a year on subscription. Its other publication is a quarterly free newsletter to its members and local committees. Members of all the committees serve without remuneration. The preponderance are natural scientists, as we might expect, but social scientists and laymen also participate. They do not express opinions on social policy or political programmes.

A speakers' bureau handles requests from community and student organisations while local committees testify before legislative bodies, appear on television and radio and prepare articles for publication.

Many committees develop their own information programmes; the New York committee conducted a study on the use and siting of nuclear reactors; Rochester monitored local waters for pollution and Chicago, Rochester and New York conducted case-finding programmes in lead poisoning among pre-school children in the slums.

In one way the SIPI – in its desire to make the maximum authoritative information available to a wide public – typifies the whole American approach to information work.

The author is the Council's Public Relations Officer.

The atomic clocks at the Royal Greenwich Observatory at Herstmonceux, which provide the time standard for the United Kingdom, are regularly compared with similar clocks in the USA, in Canada and in continental Europe, by means of precise measures of the signals of the radio navigational system Loran-C. Under normal conditions synchronisation to an accuracy of the order of one microsecond (one millionth of a second) can be maintained.

Periodical checks are made using an atomic clock which is carried from one station to another. For example, a clock may be compared with those at the US Naval Observatory in Washington, USA, then brought by air on a scheduled air flight (the clock occupies a first-class seat) to Heathrow, then by road to Herstmonceux. It is compared with the clocks of the Observatory, then taken back to the airport and by air to establishments in France, Germany or elsewhere. After a few days the clock returns to the USA where is is again checked against the clocks of the US Naval Observatory. In general, the 'flying' clock will agree with the clocks which have remained undisturbed to within 0.5 microsecond.

In September the Royal Greenwich Observatory co-operated in an experiment to evaluate a new method of precise time comparisons between different countries. A French organisation, the Office National d'Etudes et de Recherches Aerospatiales, have been carrying out tests on comparing land-based clocks with an atomic clock carried by an aircraft while the aircraft is actually in flight. In September they flew one in a DC-75 from the Centre d'Essais en Vol over the Paris Observatory, then to England to make 2 or 3 passes over the Royal Greenwich Observatory. The clock was then flown on to Ottawa, where the Canadian National Research Council clocks are situated, then to Washington, passing over the US Naval Observatory. It was landed and remained in the USA for a few days and was flown back over the same course.

Some equipment was made available by the French authorities, and the RAF and the Royal Aircraft Establishment co-operated on the provision of specialist equipment. The Hewlett-Packard Company made available one of their high speed printers for automatic recording of the results.

Q column by 'observer'

someone somewhere . . .
We always understood that junior administrative grades were told, strictly off the record, that if they were ever landed with the buck – irreversibly – the last resort was to address it to 'Mr. Smith, (by bag) Bombay', or 'Singapore' or anywhere that seemed far enough off. They would thus fulfil their prime function of referring the matter with the added advantage that one problem at least was unlikely to reappear on anyone's desk to cause further embarrassment. Nowadays we imagine a new Independence with an embryo civil service would be top choice.

That there were reciprocities had not occurred to us until this appeared in a recent Rutherford Laboratory bulletin: 'UNDELIVERABLE MAIL. Letters for Mr. Bohumul, Mr. B. J. Dropesky, Emesic John Simbo and A. Abdullah'.

To our no great surprise, the next bulletin announced the following: 'Thirty-two Assistant Principals of the Administrative Class on a course at the Civil Service College, will visit the Laboratory on Friday, 20 November'.

We wonder if they went to learn the latest reprisal techniques or to teach them . . .? We were not able to find out but believe that the matter has been referred.

pollution solution
One of the ways to get rid of the waste disposal problem we are told is to use the by-products of everything for something else. Not being adept to explore the chemical breakdown, we have confined our research to objects in the state of initial discard. An analysis was carried out on the contents from a random selection of the waste bins left under people's desks to be filled in those idle moments that follow a brief hour's excessive industry. ...

Keen dustbin pickers may be interested to know that our selection – taken from under the desks of high and low, male and female alike – had certain basic similarities. It did not appear, in general, that the single cells of the highly paid would yield the best bargains. We therefore suggest that you shop around and indeed you might find a wider variety for less expense of time and energy if you search in the multi-bodied departments.

The sort of collection most commonly found contained:

1. *Lots of paper (torn or crumpled)*
2. *100 (or more) holes $\frac{1}{4}$in dia, centres only (scattered in and around the bin)*
3. *Several 'action here' labels*
4. *2 yoghurt cartons (empty)*
5. *A wrapper from low starch biscuits (quite empty – not a crumb left)*
6. *2 doll's size metal hats in Spanish style*
7. *A banana skin (empty)*

All of them ruthlessly given the chuck without a thought for their future: not one that didn't have a further usefulness. Next time do think before you throw and one day you might hit on the final solution to the whole problem. If you do – let us know. Meanwhile here are some simple answers:

1. *Paper, torn, crumpled – use for stuffing windows/winter overcoats against draughts, ears against noise or cushions against hard seats.*
2. *holes, small, centres of – use to make a small bag of confetti go a long way. The disposal problem is thus passed to the churchwarden.*
3. *'action here' never stops here unless you're the President of the United States. If a lot of these labels appear on work in the 'in' tray, do not unpin but transfer both the work and the label immediately to the 'out' tray, addressed to anyone with a different name from yours.*
4. *yoghurt cartons are, of course, cactus pots and will help to solve the nurseryman's disposal problem.*
5. *wrapper, biscuits, low starch, from – should be pinned on the notice board, or circulated, to boost the morale of fellow inmates. For it would appear that the most endowed feel just the right size when they hear of others going on a diet: conversely those with smaller sursoundings have exactly the same reaction.*
6. *Spanish hats, metal, doll's size (that come in the ends of rolls of photographic paper) can be put on a doll dressed olé or worn as a minimus hat by a dolly in a maximus coat.*
7. *finally the empty banana skin. Never discard. Keep it oiled and ready for one more throw and it may well be one of the last things you will ever laugh at.*

vacancy at Rutherford?
Mr. R. M. Jenkins, the Chief Personnel Officer at RL, has a large circle of friends, acquaintances and enemies. He is curious to know which of them told the recruitment officer of the Royal Navy that he was interested in making a career in one of Her Majesty's ships.

By an odd coincidence there happens to be a naval recruiting office at the foot of State House – underneath London Office and close to the SRC training room on the ground floor.

King of the road

The animal kingdom is never far removed from us at RSRS. Its representatives are, for the most part, bovine, with the occasional rabbit or sheep calling on behalf of minority interests. And now, the silver swan has seen fit to drop out from the *Lohengrin* image and, like many another, hit the road in response to hard times at home. The cupboard is bare – or rather the moat is dry – and a-begging it must go.

The decision made, the plan has been executed with professional skill. The bird, accompanied by a suitably beguiling and fluffy offspring, parades round the building accepting charity from all. It fills in the slack time like Nebuchadnezzar – it eats grass – the very epitome of fallen majesty.

Wise enough not to degrade the noble image too much, all talking is delegated to the cygnet which cheeps continuously in the true begging cant. The mendicant pair succeed well enough. One supposes they would, for they apparently apply the aristocratic precept that it doesn't really matter what you do so long as it has style.

another side

Among all the officialese abbreviations which sometimes make life so hard to follow – to say nothing of the new style typing which leaves out stops, indentations and anything else that might help the hasty reader – here is one which fell on our desk recently. We think (having looked at it twice) that this one indicates a silver lining:

'APPROVED MILEAGE RATES
Permissive (Pub Transport Rate)...
5d pm'

(from an office note on travel claims)

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decimalisation

As our own reminder we reproduce the contents of a Training Notice issued last October :

The National Press and Television services will be giving Decimalisation good coverage but nevertheless we hope the following brief summary will be of assistance to you.

D-day is 15 February 1971.

The value of the pound will not be changed by decimalisation.

The pound will equal 100 new pence.

New penny is indicated by the letter p; thus £1 = 100p.

Decimal coins in use now (silver)
50p (present equivalent 10s)
10p (present equivalent 2s)
5p (present equivalent 1s)

Decimal coins in use from D-day (bronze)
2p (equivalent to 4.8d)
1p (equivalent to 2.4d)
½p (equivalent to 1.2d)

The banks (and the Council) will conduct business in £sd before D-day and in decimal from that day. **The ½p** will not be used in accounting by the banks (or by this Council).

Changeover period. D-day will be followed by a period not exceeding 18 months, in which it will be legal to conduct business (except banking) in either £sd or £-p. After this period, our present penny and threepenny piece will cease to be legal tender.

A final decision about the sixpence has yet to be made.

Conversion of £sd to Decimal.

There will be two conversion tables:

The whole new penny table

£sd	new pence	£sd	new pence
1d	—	1s 1d	= **5p**
2d	= **1p**	1s 2d	= **6p**
3d	= **1p**	1s 3d	= **6p**
4d	= **2p**	1s 4d	= **7p**
5d	= **2p**	1s 5d	= **7p**
6d	= **3p**	1s 6d	= **7p**
7d	= **3p**	1s 7d	= **8p**
8d	= **3p**	1s 8d	= **8p**
9d	= **4p**	1s 9d	= **9p**
10d	= **4p**	1s 10d	= **9p**
11d	= **5p**	1s 11d	= **10p**
1s	= **5p**	2s	= **10p**

The whole new penny table is provided in the Second Decimal Currency Act as the official table according to which for example bank balances and all £sd dealings with the banks shall be converted to decimal. All whole two shillings are to be converted to 10p.

The new halfpenny table

£sd	new pence	£sd	new pence
1d	= **½p**	7d	= **3p**
2d	= **1p**	8d	= **3½p**
3d	= **1p**	9d	= **4p**
4d	= **1½p**	10d	= **4p**
5d	= **2p**	11d	= **4½p**
6d	= **2½p**	1s	= **5p**

The new halfpenny table of conversions is not a statutory table but manufacturers, retailers and service industries are expected to use it wherever possible. The table applies to amounts under one shilling. Amounts of one shilling are to be converted to 5p.

from TN 11/70

measure for measure

Tony Wilson

Metrication is putting on speed. By 1975 most of Britain will be operating as a metric country. Soon the rickety old British imperial system of weights and measures will have been overtaken by the SYSTEME INTERNATIONAL d'UNITES – SI Units. Industry will be cheering. The Government will be cheering – export sales will increase due to our competitiveness in overseas markets. Scientists, engineers and technicians will be cheering – having dispensed with the ambiguous poundals, and mixture of inches, feet, yards, chains, furlongs and miles, and so for that matter will the majority of the general public.

The unique opportunity to rationalise, and harmonise with the remainder of the metric countries (nine-tenths of the world is already metricated or going metric) is now being seized. But it all could have happened 100 years ago. A Bill that would have made the metric system compulsory for all purposes in 1871 was rejected by a majority of only five votes in the House of Commons. So if only three more MP's had seen the light, we would now be approaching the metrication centenary.

Scientists, naturally, had already seen the advantages of having a rational, coherent system of international units of measurements as long ago as 1864, and there was a Metric Act which allowed the use of the system for scientific and some other purposes, but not for trade or commerce. It was not until 101 years later that Britain finally decided to go all metric when the Government accepted in 1965 an approach from the Federation of British Industries and set the 1975 target date.

industrial scene

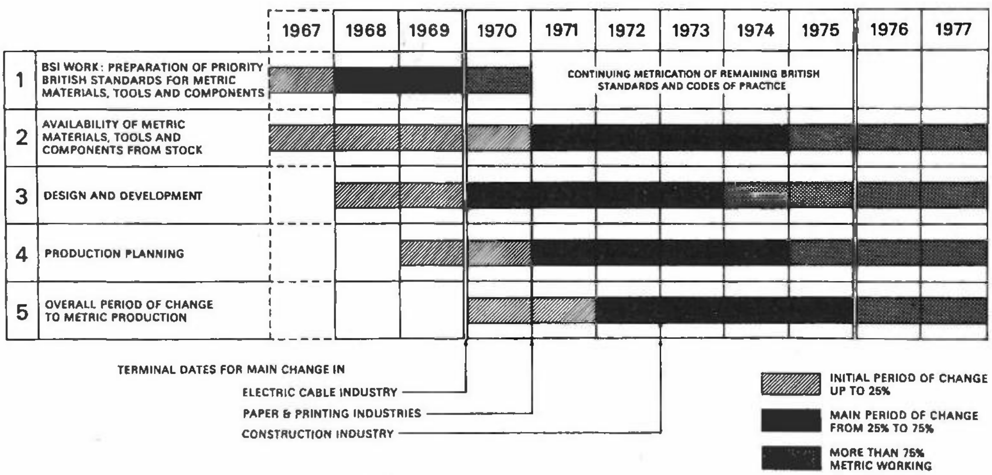
The Metrication Board, set up in 1969, have in close conjunction with the BSI prepared basic programmes for the most important sectors, *ie* agriculture, engineering, forestry, fisheries and land distribution, food and consumer goods, education and industrial training, fuel and power, transport and communication, and information policy. Table 1 shows the basic programme for engineering.

During 1970 real progress will be made in these sectors. All important metric standards relating to construction, industrial materials, engineering components and equipment will be available. Over 1600 metric standards were issued by BSI up to December 1969. Metric materials will be on the market and most metals – aluminium, lead, copper, zinc, steel bars, flat steel products and wire mesh – will be available in 1970, as will electric cables.

domestic

People will sleep more comfortably during 1971, for the bedding industry will be going metric, and metric beds are bigger. The new beds will be slightly larger than the old, with two metre beds about four inches longer than the present six foot two inches. This is good because people are coming in bigger sizes! Bed linen will be standardised to fit. 'Jumbo', 'giant' and everything deceptive in the way of packaging will be eliminated. Cost comparisons will be made easier between electricity, gas, oil and solid fuel and in the autumn of 1972 it will be easier to choose our clothes. An international standards committee is now working on a metric marking system. Imagine the ease of buying beach footwear in busy Lloret de Mar on a hot summer afternoon – instead of the time-consuming and tedious shoe-horn method – just state your metric size. It will be as simple as that.

Table 1 **THE ADOPTION OF THE METRIC SYSTEM IN ENGINEERING: BASIC PROGRAMME**



The writer, Dr. Tony Wilson is an Engineer I at the Daresbury Laboratory.

In 1973, road speed limits will be in kilometres per hour and the Ministry of Transport is working on a vast programme to change the 280,000 speed-limit signs in one week-end. The distance signs will be converted gradually over a longer time period. Of course, there is always the cynic who will suggest an interesting puzzle like 'If a van four metres high, weighing 5,025 kilos, is travelling at 65 kph towards a bridge 12' 9" high, 300 yards ahead, how long has the driver got to decide whether he would be safer plunging into a 4-hectare field?' But speed and distance signs cannot, for economy reasons, be done together and a gradual phase-in is programmed.

education

Metrication is making rapid progress in education. Mathematics in metric units becomes a less formidable and discouraging subject for the young. The imperial system was evolved out of a biological measuring kit based literally on a rule of thumb. Units derived from the average size of barleycorns and the amount of work a team of oxen could do in a day served agrarian societies reasonably well.

Today we are living in a climate of internationalism and the International System of Units (SI) is the international language of dimensions. It is a coherent decimal system with 6 basic units (*illustrated in Table 2*).

Some exasperated metrologist might be quick to point out that the kilogramme is a unit of mass, not weight. A shop cannot weigh out for you one SI kilogramme of apples, as shop scales do not show the weight of apples; they show the force exercised by the apples in that particular gravitational environment. In the SI the force is measured not in kilogrammes, but in newtons. So might we get at the supermarket cash desk 'Make up your mind, love. Do you want a kilogramme or ten newtons?' The answer is an emphatic 'No!' The Metrication Board has made it quite clear that in common usage no distinction is made between weight and mass.

Some commonly used units which are derived from basic units are given special names, *ie* unit of force = Newton; unit of energy = Joule; unit of power = Watt; but all units are interchangeable in SI, whether they are mechanical, electrical or heat energy. For example, the old horse-power of your car will be measured in watts, like the electric light bulb glowing in your home. It will be interesting, initially, to hear the comments of the cool second-hand car dealer, when a prospective client asks 'And how many watts is it?'

international scene

Everybody, even the United States, worries about the balance of trade. We in Britain are looking outwards for markets. If we, the sellers, use the same units and standards as they, the buyers, our chances in the international markets must be improved. Multi-nation projects are fashionable – how much better they would work if the basis of measurement were the same in all participating countries. One wonders whether the fact that Britain's aircraft industry worked in inches, while France used the millimetre, added to the difficulties and cost of that super plane *Concorde.*

An internatonal language for speech and writing is still a pipe dream, but an international language of dimensions is within our grasp. Adoption of the SI system of units is a reality in the UK. Some industries are well advanced and we in the Science Research Council are playing our part of that advancement. By the end of the metrication decade the entire world could be using, talking and thinking metric. Just think of Miss World 940–560–940 mm!

THE BASE UNITS

Table 2

Quantity	Unit	Symbol	Multiples			Unit	Submultiples			Supplementary Information
			G GIGA 10^9	M MEGA 10^6	k KILO 10^3		m MILLI 10^{-3}	μ MICRO 10^{-6}	n NANO 10^{-9}	
Length	metre	m			km	m	mm	μm	nm	
Mass	kilogramme	kg	megagramme (Mg), or tonne (t) = 1000 kg			kg	gramme (g) milligramme (mg) microgramme (μg)			Consideration is being given to devise a new name for the kilogramme
Time	second	s	for multiples of seconds use) Minute (min)) Hour (h)) Day (day)) Year (year)			s	ms	μs	ns	
Electric Current	ampere	A			kA	A	mA	μA	nA	
Absolute Temperature	kelvin	K				K				0 K = -273.15°C 273.15K = 0°C
Luminous Intensity	candela	cd		Mcd	kcd	cd				

new year honours

We are pleased to congratulate two members of London Office: Mr. Christopher Jolliffe, Director of the Science Division who receives a CBE, and Mr. John Down, Executive Officer in the Service Unit for Grants and Awards (SUGA) who receives an MBE.

Also Sir Richard Woolley, OBE FRS, the Astronomer Royal, who has just been awarded the Gold Medal of the Royal Astronomical Society for his contribution to observational and theoretical astrophysics, particularly in the field of stellar dynamics. *(For his Profile see Quest, July 1970).*

Atmospheric pollution is still one of the problems of the 70's but Christopher Jolliffe was Secretary to the DSIR Atmospheric Pollution Research Committee in the late 30's and to the 'Standing Conference of Co-operating Bodies in the Investigation of Atmospheric Pollution'. Combined total expenditure: £300 a year! Having joined DSIR in 1937 as a junior administrative officer (salary £247–£347) he reckons that he must be one of the two longest serving DSIR/SRC members now left – the other being Alec Gillinder (HEO) of the Astronomy, Space and Radio Division.

He read physics at University College London where he collected a degree and met his wife – 'both first class' he says. Then he trained as a teacher and became physics master at Stowe School for two years until he decided he was not cut out for teaching and joined DSIR.

From 1940–45 he was secretary to Sir Edward Appleton, when DSIR was concerned with 'Tube Alloys' (the atomic bomb project). Then he spent a few years in exhibitions and publicity, about 5 in the division concerned with the DSIR research stations and then went into Establishment Division. But after less than 2 years he was put in charge of the Grants Division and has been its Director ever since.

He has enjoyed it because he feels it is worthwhile and rewarding work. DSIR – and SRC – is what Appleton called a 'do' not a 'don't' department. He considers that the CBE awarded to himself is just as much for the Staff of the Science (and former UST) division in recognition of all they have done to help good science in universities.

John ('Dickie') Down has been in the Training Awards Section at London Office (now SUGA) for 11 years, since he joined DSIR in 1959 through the executive officer exam. for members of HM forces. Up till then he had served as an officer in the Royal Air Force. Commissioned in 1942, having joined in 1925 as an aircraft apprentice at Halton, Bucks, he had completed 33 years' service on his retirement as a Flight Lieutenant in 1958. Keen on sport – he played hockey, cricket, squash and tennis in the RAF – he is now more active as a 'follower', particularly of soccer and athletics. Dickie and his wife live at Eynsford in Kent and have a son and daughter, both married.

learning all about

The Council's Central Training Section has continued over the year to organise induction courses for new recruits. The courses are held at establishments, in turn, and in April ROE will be the venue for the first time: a group of people lucky enough to have joined us at the right moment will be spending two days in Edinburgh just before Easter, finding out about SRC. ROE reports that by then, although it may not have all melted, the snow should at least have stopped falling.

Another training 'first' in April will be the holding of an experimental one-week middle management course, which part of the CSD college at Sunningdale has been hired to accommodate. Course members will include five people from the other Research Councils as part of a current investigation into the feasibility of collaboration between the Councils in middle and senior management training.

John Walsh
Training Officer

newsfront

social research

Andrew Shonfield, Chairman of the Social Science Research Council, gave a short talk to SRC Headquarters staff at State House on 23 October.

His chief aim was to explain to natural scientists the methodological difficulties of the social sciences and to outline the most effective contribution which social scientists could make. He said that the raw material of the social sciences was social life, which offered very limited possibility of experimentation that could be controlled and repeated at will.

There were three major techniques available to social scientists; analysis of historical data, the use of survey methods, and simulation techniques. None of these approached the methods of the other sciences for precision of measurement; and judgement necessarily played a considerable part in social science activities.

The social sciences had, however, had some real successes to its credit – e.g. in prediction of short-term movements of national income, although even here there were significant margins of error which affected the conduct of public policy. The basic difficulties inherent in forecasting were illustrated by the performance of the public opinion surveys at the general election, where the majority of polls had failed to take account of people's views on certain key issues.

The talk was followed by questions from the SRC audience. A number of issues were raised, in particular the SSRC's policies for selecting research projects for support. Jeremy Mitchell, the SSRC's Secretary, replied that until quite recently the Council had played a largely responsive role, waiting for applications to come in from universities which were then judged on individual merit. It was now becoming more active in stimulating research in particular fields, and three new SSRC research units – in Race Relations, Industrial Relations and Survey methods – had been established early in 1970.

The success of the Knutsford Plains Rally each October owes a lot to Leslie Naylor from Daresbury Laboratory. He leads the results team who keep track of the rally as it covers 200 miles from Welshpool to Llangollen by picking up result cards from the control points and computing the result in the quickest possible time. Members of the team – David Hughes, Colin Horrabin, John Lowe, Alan White, Ron Gallop, who all come from the Laboratory – pride themselves on their speed and accuracy. In 1968 they helped to gain the rally, which is run by the Knutsford Motor Club, a second place in the Rally of the Year Championship.

They start two hours before the drivers, at 8 p.m. on Saturday evening, when they synchronise the 75 watches used at the course control points. From then on it's non stop through the small hours until the finish on Sunday morning.

picture shows Leslie Naylor (centre) with Alan White (at back) and Ron Gallop, checking and setting the 75 watches.

Photo by courtesy of the Knutsford Guardian.

to the tune of . . .

A musical evening held in December at Herstmonceux Castle raised £150 for the Sussex Churches Campaign. The Choir of Chichester Cathedral sang anthems and motets followed by carols both traditional and modern. They were directed by the Organist and Master of Choristers, John Birch, who also performed a movement from a Bach concerto and movements from the *Scaramouche* suite by Milhaud, set for two pianos. The second pianist was the assistant organist, Michael Davey. (The two pianos being the ones which are featured in the SRC film *'Insight'*).

Fred Hatton (l) and Brian Mellor

civil service

Another of the pioneers of the Rutherford Laboratory has retired (See Quest, *October 1970, newsfront). Fred Hatton joined AERE on June 21, 1948, to work in one of the stores and in 1961 he transferred to the Rutherford Laboratory as one of the three storemen in the only store at the new Laboratory. Later when it was expanded he moved into the newly built central building, to help organise a main store.*

A presentation was made by Brian Mellor, Head of the General Administration Group, who said that the Laboratory was judged to a large degree by the service it gives to outside people working there, including university members, and Fred in his job had certainly made a big contribution to this service. He also read out a letter from Sir Brian Flowers, the Chairman of SRC, which expressed thanks and appreciation of Fred's service.

We join the Laboratory in wishing Fred Hatton all the best for the future.

retirement from space

The retirement of Mr. A. G. Wilson, Senior Scientific Assistant, last year lost the space section of the Radio and Space Research Station an expert. Known most recently for his work on the design and construction of experimental rocket payloads – he received the MBE in 1966 – Arch Wilson's work at RSRS dated back more than forty years. During that time he was given charge of the workshops and made valuable contributions to the instrumentation of the pioneer radar installations. In 1955 he left for a few years for a spell in industry but returned to apply his talents to Space Experimentation. We join RSRS in sending him good wishes for the future.

QUEST

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QUEST

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Vol. 4 No. 2

April 1971

contents

Cover picture shows the Daresbury Nuclear Physics Laboratory whose Director appears in 'profile' in this issue. The plan on facing page shows the layout of the buildings.
Not yet in the photograph but indicated on the plan is the site of the new Synchrotron Radiation Facility which is described on page 1.

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new synchrotron radiation facility

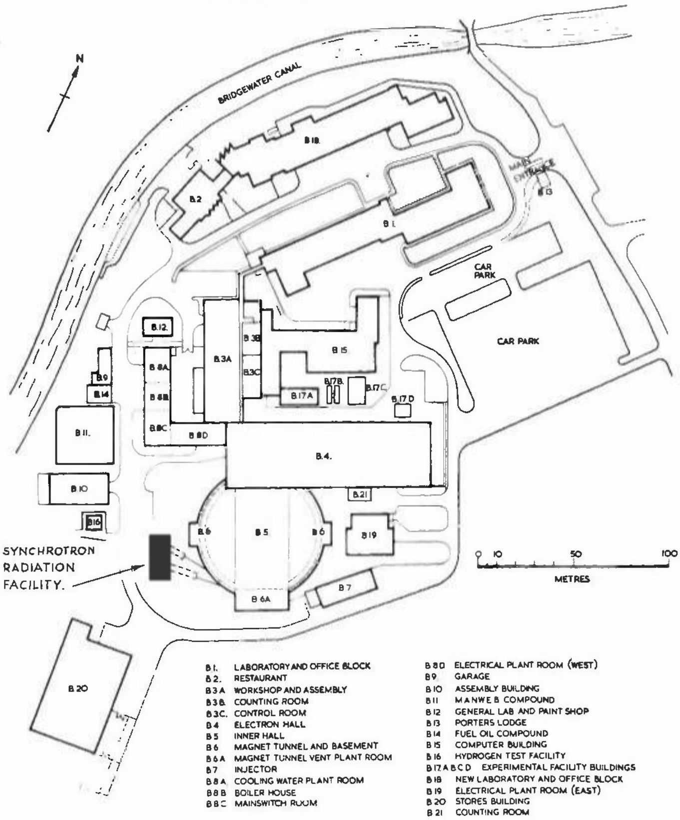
The properties of radiation emitted when electrons are accelerated at high energies are such that they represent a unique light source which can be very valuable for spectroscopic research.

In order to make use of such a source, the Science Research Council has allocated £360,000 over five years to set up and run a Synchrotron Radiation Facility associated with the 5 GeV electron synchrotron (Nina) at the Daresbury Nuclear Physics Laboratory. The new Facility which is expected to be completed and operational in mid-1972 will provide scientists from universities and other research laboratories with a service available nationally.

At the present time research is being carried out with a number of electron synchrotrons throughout the world using the ultra-violet light radiated from the electron orbit. In the UK studies have been made during recent years which have confirmed the potential value for future spectroscopic work of the synchrotron light from the Daresbury accelerator.

Professor Alick Ashmore, Director of the Daresbury Nuclear Physics Laboratory, whose 'Profile' appears on page 2.

DARESBURY LABORATORY
SITE PLAN



The national Facility which the Council is now setting up, will allow several independent experiments to be undertaken simultaneously. It has also been designed, so that, once established, it will operate without interfering with the main users of the synchrotron. Time on the Facility will be allocated by a panel of scientists, expert in the field.

Already much interest has been expressed by university departments who are planning experiments.

New information on topics ranging from the study of inner electrons of isolated atoms to the study of biological specimens may be expected and additional research activities in the fields of physical chemistry or X-ray crystallography undertaken. In this way, a great deal of exciting scientific activity will be pursued based on the vast amount of electromagnetic radiation emitted from electron synchrotrons – energy which would otherwise simply be wasted.

Dr. Geoffrey Marr and Dr. Ian Munroe published an article about the Facility in *New Scientist* Feb. 4, 1971. Dr. Munroe is user coordinator of the Facility at Daresbury and a Lecturer in Physics at Manchester University. Dr. Marr is a Reader in Physics at Reading University.

profile

Professor Alick Ashmore

Director of the Daresbury Nuclear Physics Laboratory

Nuclear Physics is a twentieth century science which has grown enormously since Rutherford, using very simple apparatus, first observed a nuclear reaction in 1919. Rutherford—Chadwick—Liverpool—Rutherford Laboratory—Daresbury—CERN are all names in the chain which links nuclear physicists both nationally and internationally in close associaton. The remarkable results achieved at Liverpool in the late 1950's on Chadwick's Synchrocyclotron gave the incentive that led to the building of the 5 GeV electron synchrotron at Daresbury to provide a powerful facility for the northern universities. Chadwick was associated with the Daresbury project by the Laboratory's first Director Professor Merrison.

So it was appropriate to choose as the next Director Professor Alick Ashmore, a Liverpool PhD and Lecturer who had been part of the research team which produced the results of the 50's and had earlier worked on the original small cyclotron at Liverpool. On the new accelerator the first spin correlation measurements were made on the nucleon-nucleon interaction. Interesting work was carried out on muon catalysed fusion – inducing fusion reactions between hydrogen and deuterium nuclei by absorbing negative muons into atomic orbits to form muonic molecules. Because of the small orbit of the muons the two nuclei are brought close enough to fuse. Although the rate of fusion was insufficient to form the basis for economic power generation, there was interest in this possibility and he wrote some articles for engineering journals and was consulted by the Atomic Energy Authority. Some results of his work at Liverpool were published in the Proceedings of the Physical Society in his papers on 'The γ-rays from muon catalysed fusion of Hydrogen and Deuterium' (1958), 'Spin-Correlation measurements in p-p scattering at 382 and 320 MeV' (1961). He gained a PhD in 1958 and became a Fellow of the Institute of Physics in the following year.

Professor Ashmore originally graduated in Physics at Kings College London (also Professor Merrison's College), in 1941, then spent the next few years on war effort as an Experimental Officer at the Radar Research and Development Establishment, Malvern, developing radio proximity fuses and aerials for radar equipment based on Watson-Watt's pre-war work. Watson-Watt had taken out patents on his methods of following aircraft by radio wave reflections as early as 1935 and given Great Britain a world lead. This was kept up by the research teams at Malvern which included such well known names as Cockcroft, Dee, Lovell, Pippard, Runcorn and Farley. The level of the work was therefore very high and it was an excellent introduction to applied science.

Afterwards though, like many of the others, he preferred to return to academic life. Being about to get married he applied for a salaried appointment as an assistant lecturer in Physics at the University of Liverpool where he stayed for twelve years, until 1959, as a lecturer and senior lecturer. He has taught most subjects in physics although his main interests lie in high energy physics and in the education of physicists. His wife too teaches physics and mathematics, in schools, though only part-time as there are five children in the family, not one of whom has so far chosen to specialise in physics. Two are at university reading biology – a son (20) at East Anglia and a daughter (19) at York. His next daughter is in the sixth form at Lymm Grammar School and also there are twins of 15, a boy and a girl.

For the first few years at Liverpool he was heavily involved in teaching and only slowly built up a research programme on the small cyclotron. The building of the new accelerator provided a golden opportunity to do more research. By 1959 he was thinking about moving on to work on the proton accelerator at Rutherford Laboratory, under Dr. Pickavance, or the 28 GeV alternating gradient synchrotron at CERN, when an appointment as Reader in Experimental Physics came up at Queen Mary College London. He got the post along with the chance to start his own nuclear physics group, and the opportunity to work at both the Rutherford and CERN laboratories and, later, in the USA. The group has grown and now has a professor, a reader, three lecturers, three research fellows, supporting staff and students. He continued his Liverpool work on the nucleon-nucleon interaction on the proton linear accelerator and later on the 7 GeV proton synchrotron 'Nimrod' (operating from 1963) at Rutherford Laboratory. In 1965–6 he was a Visiting Physicist at the Brookhaven National Laboratory, USA, which has a proton synchrotron similar to the one at CERN. Publications include papers on total cross sections for high-energy protons at CERN (Physical Review Letters 1960), wide-angle pion, kaon and antiproton scattering at Brookhaven (Physical Review 1969) and 'measurements of A and R parameters in p-p scattering' at Rutherford Laboratory (Nuclear Physics 1965). He was appointed Professor of Nuclear Physics at Queen Mary College in 1964 and Head of the Physics Department in 1968. Meanwhile he also became a member of the SRC Nuclear Physics Board, the Nuclear Physics Laboratories Committee and the Film Analysis Grants Committee. So when invited to become Director of the Daresbury Laboratory he knew quite a lot about the organisation of nuclear physics under SRC as well as having firsthand experience of research at the 'receiving end'.

As Director at Daresbury he is chairman of the Selection Committee which sees that the Laboratory's experimental programme is well launched on good lines. He also maintains informal contact with all the physics that is going on and is getting to know more about the facets of the Laboratory outside his own field, such as accelerator and applied physics, computing and electronics. He does not yet foresee having enough time to take part in a high energy experiment on the synchrotron, because this requires a certain amount of time spent on it, below which, he says, you are not much of an asset to the team.

He has a particular interest in the Theory Group, run by Professor Donnachie and he regularly attends the Friday 'coffee mornings' for high energy experimentalists and theorists which are lively generators of ideas and enthusiasm. Maintaining good contact with the user universities is very important to the Laboratory. Since his arrival last year he has contributed by giving lectures at Liverpool, where he is a Visiting Professor, to the Physical Society at Aberystwyth and to the Midland Branch of the Institute of Physics in Birmingham. It is his intention to continue and extend these contacts with the universities.

To relax he enjoys camping holidays with his family in Europe and at present they are working on the house they have bought at Lymm to add improvements planned by his wife.

The Laboratory itself has a family atmosphere. Being a specialised laboratory everyone on the staff of 500 brings their special skills, as pure or applied physicists, engineers, craftsmen or technicians and so on, towards a common end. It also benefits from the outside experience of the visiting research teams. At universities, for instance, there is usually a wide range of physics subjects and interaction between them and with other disciplines. The Laboratory has been well planned and set up and has a good spirit and the new Director intends that it should continue that way.

£1M A YEAR FOR ATOMS MOLECULES AND PLASMAS ++ BEST DATA YET FROM SKYLARK SPACE
PROBE IN SOLAR ULTRA-VIOLET SPECTRUM ++ SYMPOSIUM ON ELECTRON AND PHOTO INTERACT
++ £59,000 HARDWARE FOR MULTI ACCESS COMPUTER SYSTEM ++ BRITISH EXPERIMENT IN ORI
ING SOLAR OBSERVATORY OSO-G ++ FIRST LUNAR SAMPLES FOR BRITAIN ARRIVE AT SRC ++
[illegible] MAJOR SRC GI
FOR CONTROL ENGINEERING RESEARCH ++ ANGLO-AUSTRALIAN TELESCOPE CONSIDERABLE CONTI
BUTION TOWARDS SCIENTIFIC DISCOVERY ++ RSRS PARTICIPATES IN UK4 SATELLITE TO MEA:
INTENSITIES OF ELECTROMAGNETIC RADIATION ++ DEVELOPMENT IN ANALYSIS OF BUBBLE CHA
BER PHOTOGRAPHS BY SWEEPNIK AIDED BY SRC GRANT OF £40,473 ++ SUCCESSFUL LAUNCH OI

council commentary

december

As recorded in the last edition of *Quest*, at the end of last year Mrs. Margaret Thatcher the Secretary of State for Education and Science announced in Parliament the decision that the UK would participate in the revised proposal to build the 300 GeV accelerator near the existing CERN site at Geneva. The decision was made on the recommendation of the SRC and at the December meeting Council members were particularly pleased to hear that UK participation was possible. All other members of CERN, with the exception of Greece and Denmark who have not yet decided, have since agreed to contribute so the project can at last go ahead.

Also at the December meeting, the Council was told of the Working Party set up by the Council for Scientific Policy to consider the arrangements for the support of civil research in the UK. Further information about this Working Party was given in the SRC Circular 5/71 of 27 January 1971.

One of the main items on the Agenda for the December Council meeting was that of student training awards for 1971. Council decided to seek authority to make 3,850 awards, an increase of about 120 over last year. The additional awards will mainly be for research and advanced course studentships in engineering and for the special scheme of broader-based training being financed jointly by SRC and the Social Science Research Council. This scheme gives postgraduate students the opportunity to undertake research which crosses the borders between science and social science.

Several large and important grants were approved by Council including the 1971 consolidated grant for Sir Bernard Lovell's programme of radio astronomy and a supplementary grant for repairs and modifications to the 250 ft. radio telescope at Jodrell Bank. The detailed design phase of a joint US/UK programme for a small astronomical satellite was approved, as were grants totalling up to £71,000 to Oxford and Heriot Watt Universities for handling and analysis of data from their experiment to be flown in the US Nimbus-E Satellite. Council approved a grant of up to £125,000 to Professor T. Weis-Fogh at Cambridge for work aimed at the development and application of methods for the preservation of soft highly hydrated biological tissues and an award of up to £115,000 for the purchase of a multi-access computer for analysis of data from a wide range of experiments using the 3 MeV Dynamitron linear accelerator provided earlier by SRC for the joint use of Birmingham and Aston Universities. Council also approved the 1971 grants for the main University Nuclear Physics teams for continuation of their film analysis and nuclear structure research.

january

Council agreed that the SRC Forward Look should be prepared on the basis of an 11% growth over the three years up to 1974-5 with a somewhat higher growth rate for the following two years. The detailed Forward Look will be presented to Council in April when the growth rates for each of the four Boards will be decided.

Arising from this preliminary discussion of the Forward Look and in particular of the forecasts of computing facilities for the coming five years for the Atlas Laboratory and other SRC Establishments, Council asked for a full review of the likely requirements and of the best way of meeting these needs.

Of increasing importance for research in several branches of science is the provision of high flux neutron beams and the largest item to be considered for possible inclusion in the Forward Look will be the High Flux Beam Reactor (HFBR). The HFBR has been included in plans for a long time as a joint project with AEA, but is now being considered solely as an SRC proposal and, as at present envisaged, could cost about £20 million. The project was last considered by Council in May 1970 when it was decided to prepare a costed programme of the work necessary to complete a design study and a detailed specification. Dr. Leo Hobbis of the Rutherford Laboratory, who is the project leader, presented the results of his study to Council in January. Council accepted his report but deferred a decision on the project until the April meeting, when it could be considered in relation to the other proposals in the Forward Look. In the meantime, further study of some aspects of neutron beam research will be made; for example, the possibility of European collaboration and the plans of other bodies for work in this area.

Amongst the grants approved in January was an award of up to £31,000 supplementing an earlier award of £97,000 to Professor A. M. Uttley at Sussex University for continuation of his research in pattern recognition, based on adaptive electronic networks. Council recommended continuation of the UK-5 satellite project at an estimated cost of just over £3 million. The UK-5 is the most sophisticated scientific satellite to be built by the UK and will carry an American experiment. Council also approved expenditure of up to £61,500 on two magnetic tape deck clusters for the ICL 1906A computer at the Atlas Computer Laboratory.

february

The Secretary of State for Education and Science, Mrs. Margaret Thatcher, accepted Council's invitation to attend the February meeting. In the discussion of the Council's programme, Mrs. Thatcher stressed the special role of the SRC in supporting fundamental research. She also showed particular interest in the balance between postgraduate training and research activities and in the reasons for supporting research in the applied sciences.

In preparation for the Forward Look in April, Council was to review the programme of its four Boards and the main item on the Agenda for the February meeting was a discussion of the policies and programmes of the Science and Engineering Boards. The Science Board's presentation to Council makes it clear that the principal motive for most of the work which the Board supports is the drive to achieve a deeper understanding of man and his surroundings. Much of this fundamental knowledge is essential for the development of new technologies which if widely used can be of benefit, but the chief criterion for selecting what shall be given support must always be the likelihood that the imagination, skill and drive of the individual will lead to this deeper understanding. The Board's review of its training policy similarly lays stress on the importance of postgraduate education that will develop the intellectual ability and personality of the student through undertaking challenging work in science.

The review of the Engineering Board's programme outlined the progress made since the Board's inception in 1969 in determining the criteria for support in engineering and in concentrating effort into viable groups. In addition the Board is paying particular attention to postgraduate training which at present influences students to take up careers in research whereas there is need for a greater proportion of the most able students in such areas as design, production, project management and technical marketing.

at the universities

interactive graphics

A grant was made to continue and extend earlier work supported by SRC in the application of advanced computer techniques to design problems in electrical and electronic engineering. The Department of Computer Science at Edinburgh University receives £314,986 for a four year programme for 'Interactive Graphics applied to Electronic Design'.

Much of the work is fundamental in character but many aspects are of interest to industry (close co-operation is maintained) and should lead eventually to the discovery of novel design techniques and new methods of problem solving as well as advances in the efficiency of man-machine interactions.

The grant provides for a PDP-10 computer made by the Digital Equipment Company. The configuration provided will allow simultaneous access by eight users. Used in conjunction with the existing PDP-7 system, which contains a cathode ray tube, it will be possible to exploit the PDP-10's rapidity and accuracy combined with the experience and insight of a human designer. This approach has already proved promising in the design of printed circuit wiring boards. Other applications include the analysis and display of the flow of power in electricity distribution networks and the design of electronic filters for particularly exacting requirements.

boost for electrochemistry

A working party was set up in 1968 to examine the field of electrochemistry and to determine areas in which further research would be most likely to give benefit to industry. It was felt that many industrial processes then based on a rather empirical approach would benefit by research aimed at establishing them on a firm scientific basis.

Applications for support were invited and four grants have just been announced to the Universities of Bristol, City of London, Newcastle and Southampton.

Dr. R. Parsons of Bristol is to receive £26,239 over 3 years for research on electrocatalysis and the mechanism of electrode reactions.

Professor D. J. Alner, City of London, gets £13,575 for research in electrodeposition and related phenomena, electrocatalysis and electrode structures.

Professors J. M. Coulson and H. R. Thirsk and Dr. A. K. Corington of Newcastle will receive £58,039 for research in electrolytic process engineering, electrochemical plating of noble metals, electrochemical kinetics of certain transition metals, and effect of non-aqueous organic solvents on gas electrodes.

Professor M. Fleishman of Southampton receives £48,567 for research on electrode processes, electrosynthesis and reflectance spectroscopy of electrode surfaces.

chemical analysis

'Chemistry – a review of the policies and activities of the Chemistry Committee' was published in February. It included a survey of the current state of research in chemistry, short accounts of some of the work carried out with the help of SRC funds, discussion on current trends and the views of the Committee on the likely pattern for future support.

The various forms of training available to chemists were reviewed and, from an analysis of recent employment statistics, the Committee estimated the number of PhDs likely to be required in the various sectors five years from now and looked at the appropriateness of available training methods. The Chemistry PhD output rose by 35% between 1967 and 1969 but the Committee expects it will now flatten off and remain around a total of 850 for the next few years.

This is significantly greater than the number required for research and teaching in Chemistry but the Committee believes that the training is suitable for a wide range of careers and that about a quarter of Chemistry PhDs will work outside the research and development field. They are looking for a somewhat broader training for the majority who will work in R and D and a much broader training, built around a core of Chemistry, for those who will take up other types of employment.

The report is being widely circulated throughout the Scientific community as well as to Chemists under the SRC's practice of making its policies widely known and inviting comments before final decisions are made.

the first superheavy?

Early in February evidence was produced for the possible existence of a superheavy element with atomic number 112. The heaviest naturally occurring element is uranium (atomic number 92) and the previous heaviest artificial element was hahnium (atomic number 105).

A Rutherford Laboratory team led by Dr. C. F. Batty in conjunction with researchers from the chemistry department of Manchester University and the Universities Research Reactor, have been working for some time on an idea suggested by Dr. A. Marinov (a member of the Rutherford Laboratory team on leave from the Hebrew University, Jerusalem), that the super heavy elements might be produced by bombarding tungsten targets with fast protons. The collision of a fast proton with the tungsten atom may produce very energetic tungsten nuclei which if they collide with the other tungsten atoms may possibly produce super heavy nuclei.

Accordingly, tungsten targets that had been used in the 28GeV CERN accelerator were obtained and since it had been predicted that element 112 would have similar chemical properties to mercury, chemical samples were prepared using mercury as a carrier. Measurements made of the alpha particle energies, the spontaneous fission and the estimated upper limit half-life of 500 years are all in good agreement with the values expected for element 112.

The team is working to confirm the existence of this new element and at the same time to search for others which may have been produced in the tungsten targets. A full report of this work was published in *Nature* on 12 February (229, 464 : 1971) a Science Report in *The Times* on 12 February and in *New Scientist* on 18 February.

high current affairs

The Rutherford Laboratory has been engaged for several years in preparatory studies of a high field bubble chamber. This chamber incorporates a number of advanced ideas, not the least being a 70 kilogauss super conducting magnet. In order to assess the performance of the conductor developed for this project a super conducting magnet known as Racoon II has been constructed and tested. Operating fully immersed in liquid helium Racoon II was energised with currents up to 14,800 amps and reached a peak magnetic field of 66 kG. This is believed to be the highest current at which a superconducting coil has yet operated. The peak current density achieved is ten to twenty up on conventional water cooled magnets wound with copper conductors. Racoon II uses about 100 metres of stabilised superconducting strip wound into six double pancake coils each of about 25 turns. The conductor consists of 361 niobium-titanium filaments each 0.3mm in diameter. The filaments are embedded in a copper matrix of cross-section 25mm by 6mm and twisted about the longitudinal axis of the conductor with a pitch of 50cm.

The second stage of the test programme is aimed at proving that the superconducting strip will also carry its design current of 7,500 amps in a magnetic field of 84 kG. For this test Racoon II will be mounted within the bore of a 50 kG water cooled magnet at the Royal Radar Establishment at Malvern. When both coils are energised simultaneously it is expected that peak fields in excess of 84 kG will be generated.

nutcracker no. 3 — grants

The Astronomical Analysis Committee has long treasured a blithe disregard for the demands of selectivity and concentration. At its last meeting it was faced with the following applications:

University of Llanfyllin: £10,000, £5,000, £3,000, £3,000, £2,000, £1,000.

East Barking Technical College: £8,000, £7,000, £4,000, £2,000, £2,000.

Louseburn University of Technology: £10,000, £6,000 £6,000, £3,000, £1,000, £1,000, £1,000.

Wessex Free University Commune: £9,000, £5,000, £4,000, £2,000.

In a spirit of absolute fairness, the Committee rejected six applications, chosen at random in such a way that no institution had more than two rejected, and awarded each of the remainder three-quarters of the sum requested. In this way they allocated £54,000, without any institution receiving less than half its total sum requested. Furthermore their final totals followed the same order as their total sums applied for. The two £5,000 applications, being from Committee members, naturally received awards. How much did each institution receive?

Your local correspondent holds the answer this time. Find his/her name on the list inside the front cover.

telecom '71

SRC has a stand in the British Pavilion at the Second Symposium on Space and Radio Communications which is being run by the International Telecommunications Union (ITU) in Geneva from June 17 to 27. The other stand will be produced by the Post Office. SRC's stand will include a general idea of the Science Research Council's work and its interests in radio astronomy and space science. Jodrell Bank and the proposed new 5KM Cambridge telescope will be featured under radio astronomy, space science will include a display from the Mullard Space Science Laboratory and, if available, a prototype of their extreme ultraviolet polychromator, the flight model of which is now in orbit in OSO–6. The Radio and Space Research Station will feature their work on radio wave propagation research. The stand is designed and produced by the Central Office of Information under the sponsorship of the Department of Trade and Industry.

The United Kingdom celebrates the centenary of its membership of the ITU this year. The ITU was founded as the International Telegraphic Union in 1865 by 20 European countries following negotiations for a uniform international telegraph system. The United Kingdom was not invited to the negotiations because the operation of our wire telegraph systems (at that time the only telecommunications service) was still in the hands of private companies, including the railways. Later when these were taken over by the Government, following the Telegraph Act of 1868, and the United Kingdom was able to accept and apply the regulations and other provisions of the International Telegraph Convention we became a member of the ITU on Febraury 24, 1871. During those 100 years, telecommunications have evolved into all the highly developed techniques of telegraph, telex, telephone, radio and television which can transmit information rapidly all over the earth and into outer space.

la recherche scientifique

John Walsh

I believe that people who are in favour of Britain's entry into the Common Market are, approximately, those who *like* Europe; and further, I think that what they like about it are its differences from Britain. It is ironical (and a pity) that if we do go into the EEC, these very differences will be eroded by economic and ultimately political union. For the moment, though, the differences exist, and last year I spent two periods with SRC's sister organisation in France–le Centre National de la Recherche Scientifique (CNRS) – trying to spot any differences between us that might stand in the way of formal collaboration in research.

There is already considerable Franco-British co-operation in scientific research at the informal level between individuals, at the national level in organisations such as CERN, and at an intermediate level between numbers of laboratories and groups of research workers. Examples of the last type are the Council's recent decisions to investigate participating in the work of the Franco-German von Laue-Langevin Institute and the CNRS high magnetic field laboratory at Grenoble. If for no other reason than that some types of research are so expensive, it seems certain that European (including British) co-operation in this area must continue to grow, whether or not we join 'the six'.

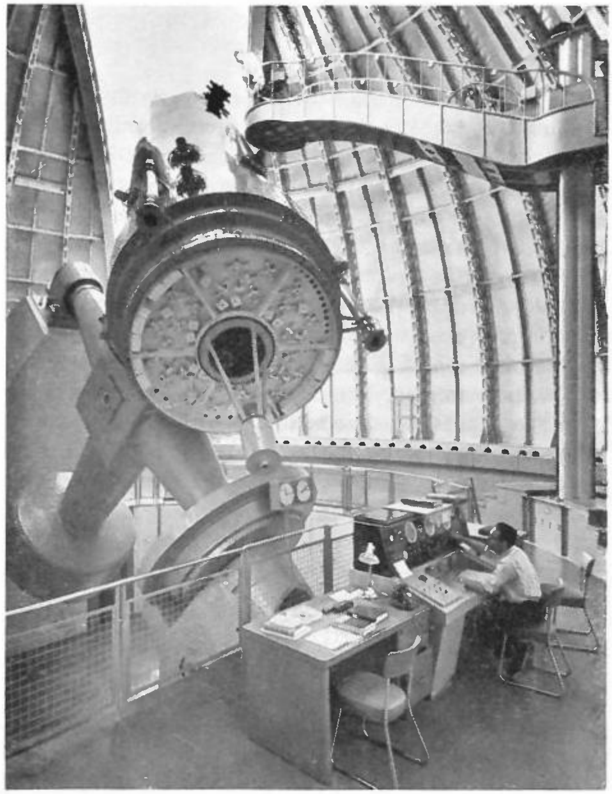
The differences between SRC and CNRS are, on the face of it, extensive. In terms of scientific disciplines covered, CNRS equates to SRC, SSRC and NERC, and supports also some areas such as literature and history that in Britain seem to get along without a Research Council watching over them. An important exception is that CNRS has no equivalent to our Engineering Board and its Committees. This gap stems from the traditional separation, in French education, of the pure and applied sciences, and probably makes the commercial exploitation of research results even more difficult than it usually is.

The next most striking difference is of physical size: there are about 125 laboratories and study centres throughout France that belong to CNRS. There are about 16,000 permanent CNRS employees, who include some 6,300 research scientists. Some laboratories are grouped into CNRS 'campuses', and I visited the groups at Marseille and Gif-sur-Yvette. Each of these groups is large enough to have its own administrative and central services function, and these may form the basis for a regionalised administration that it is hoped to introduce over the next few years as an antidote to some of the problems arising because of the large scale of CNRS activities.

Anyone familiar with the 'management style' of large European firms would not find anything surprising about the way CNRS is organised and run. The set-up approximates to what Max Weber called a 'rational-legal bureaucracy'. What this means is that there are clear rules governing how most things should be done. The result is what seems to the British eye a fairly cumbersome machine, as is evidenced by the pejorative connotation that 'bureaucracy' has assumed in English. This sort of system tends to have a lot of paperwork associated with it: the members of SRC Committees who complain about the weight of papers they have to read before meetings have little to grumble about on a comparative basis – CNRS sends out its papers in special returnable boxes because they are too heavy to expect people to carry with them back to Paris! But the big advantage of the formalised system of working is that the decision-making process is clearly laid down and known about. Problems are expected to be soluble, and there is none of that wooliness in the reception of a new idea that, in Britain, can smother it at birth.

There are two very important qualifications of this description of how CNRS is run. The first is that with 'number-crunching' facilities on tap, formalised working systems are ideal: they are ready-made for the computer, which will make short work of the tasks they generate. Second, CNRS has, since the 'events' of May 1968 (when the pressures for social changes erupted throughout France), introduced a democratisation of its procedures; for example, half the membership of its Committees is elected by research workers and University teachers, and there are Laboratory Councils in all establishments. I saw examples of both these aspects in the Committee elections of autumn, 1970. The total electorate was 44,000, electing 370 people from a list many times that size, to 34 different committees. The rules to govern the elections and to ensure their fairness resulted in a task of nightmare size and complexity, bearing in mind that it is an ancillary and only occasional operation. But the rules were easily transcribed into a program, and the CNRS central computer quickly finished what would probably not have been completed yet if done manually.

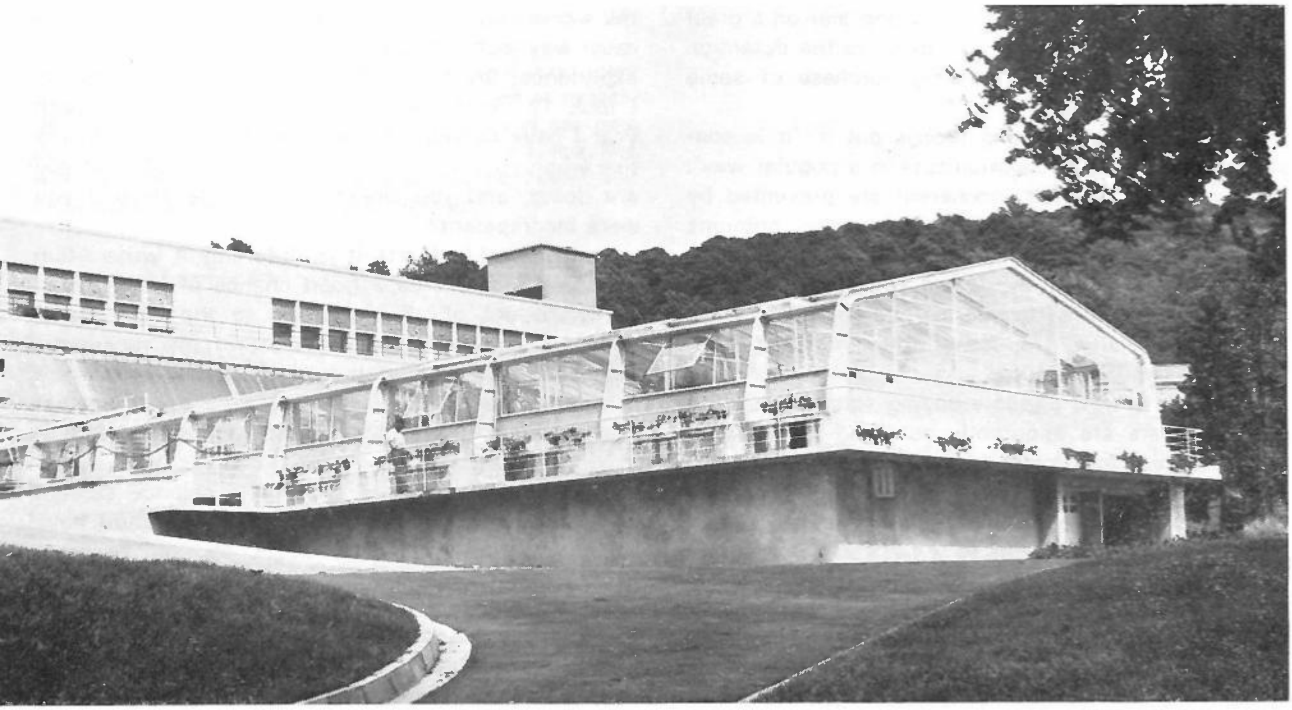
Within these overall differences of method and context between CNRS and SRC there were numerous smaller ones. For instance, as well as its own establishments, CNRS supports a large number of 'associated' laboratories. But I concluded that there were no great differences in principle or in practice that would hinder our collaboration. Indeed, the problems that each organisation sees facing it – like the need for the selective use of scarce funds – were remarkably similar.



The 193cm Telescope at the CNRS Observatory at Haute-Provence. Original techniques have been developed at the Observatory and used in the study of galactic rotation and interstellar hydrogen clouds.

My visits to France have been reciprocated by the visit here in January of Mr. J. F. Zahn of CNRS. During his stay, he saw something of the work of London Office, RGO, Rutherford, Atlas and a University, and I think that he, too, would have been as struck by the similarities between us as by our differences. The twin visits have provided an interesting comparative study of organisations that reflect a microcosm of national differences. But since I don't think that any colossal difficulties will arise in our future co-operation with CNRS, we can afford to say 'vive la différence'!

John Walsh is Head of the Training Section at London Office.



The super-greenhouse at the CNRS Phytrotron Laboratory at Gif-sur-Yvette, near Paris. Here, the germination and growth of plants are studied in an environment that can be altered to suit the research. It is possible to simulate any climatic condition by varying sunlight dosage, temperature, humidity, luminosity and even wind force. The problem of soil variability is overcome by growing the plants in glass fibre automatically 'watered' with a nutrient solution. The photographs are reproduced by courtesy of CNRS.

tongue tied scientists

Does the influence of the mass media affect even our choice of career? The following article is written by the senior science master of Sherrardswood School, Welwyn, and is reproduced from the Times Educational Supplement by kind permission.

Tony Rook

Something must be wrong with science. If all was well, we would not read reports and articles which tell us that too few teachers are teaching better and better science to fewer and fewer pupils. The reasons for the so-called swing away from science are complex.

In many cases the decision to 'drop' physical sciences is made by 14-year-olds, whose motives are difficult to analyse. New syllabuses, teaching methods and examination requirements are suggested and tried; perhaps it would be better if someone were to attempt an analysis, if only as a sort of Aunt Sally, of the various pressures working on the pupil.

The most obvious difference between the 'arts' and the 'sciences' lies in the field of public relations. Any educated person could, for example, write a play for television. The qualifications to become a disc jockey or a pop star are not of the same sort as those required to become a scientist.

If we examine the output of the BBC, bearing in mind that we live in a technological age, in which most of us are, in some way or another, involved with the progress of science, we discover an infinitesimal fraction concerned with science, scientists, or the excitement and mental stimulation of research. *Tomorrow's World* stands alone, yet its compere is not a qualified scientist, and the team producing the programme cannot distinguish between heat and temperature. There is no peak programme concerned directly with science.

Why is this? Partly because television is looked upon as one of 'the arts'. Anyone involved with the arts is supremely confident of his own importance. When he runs out of material he will be quite capable of inventing a programme where he and his cronies get together in a self-congratulatory clique. If you are in mass communications, you don't just provide the information. The opinion of a pop star on a great moral issue is second only as news to the detention of a reporter or the impending purchase of some second-rate newspaper.

In science, as Desmond Morris put it, 'it is considered bad form to communicate in a popular way'. Scientists who are not incoherent are prevented by their group taboos from communicating their opinions directly to the public, and at best may condescend to being interviewed by James Burke. A friend of mine was blackballed from a learned society because he was a journalist. This is not a new attitude; H. G. Wells had similar trouble.

At an early age, pupils studying science discover that scientists are apparently ashamed to admit to their own actions. Instead, they write in 'the third person obscure'. What pupil can take pride in his work if he has to write an account ending 'it was found that' when he wants to write 'I just discovered . . .'? I once referred a paper on particle size analysis which contained the statement: 'The second experiment was performed using a different sample of the powder . . .'

I phoned the author and asked him why he did not explain this. He told me: 'The lab. assistant dropped the whole bloody lot on the floor, but I can't think how to explain that in the right sort of language!' Until scientists are prepared to communicate with one another in ordinary English, and with the rest of the world enthusiastically, they cannot compete with the arts men.

Another fault of science lies in its chromium plated image. After a dip into scientific journalism it is difficult to imagine that anyone could do worthwhile work without half a million dollars worth of hardware and a computer terminal in his living room. The exhibit which depressed my pupils most at a recent Physical Society exhibition, where everything was measured in £ x 10^n consisted of banks of photocells and an on-line computer discovering how goldfish moved in a tank.

What has become of the educated Victorians who seem to be scattered among my forebears and those of my friends – the people from whom we inherited the microscope, telescope and box of minerals which seem to have become part of the furniture? Who now publishes their sort of books: *Evenings at the Microscope*, *Scientific Recreations*, and so on? Books may be better produced nowadays, but they produce a glossy vicarious look at computers, space rockets, and atom smashers. Science is not fun for the individual any more, it is big business for the corporations.

With the chromium plated image we have the computerised reward. Top management, The Establishment, are not scientists, and scientist-managers are getting rarer. Since the boss cannot understand the worker he cannot assess his value, and takes the easy way out. He pays him for qualifications and experience. My salary depends upon an examination I took 12 years ago, plus a small reward for each year I have survived since then. Where is the incentive when your employer cannot understand what you are doing, and you would be paid the same if you were incompetent?

In the world of arts it is different. A writer, film star, pop star stands a good chance of being given a reward out of all proportion to the work done, which is completely independent of the recipient's past academic history. It is ironical that people are driven to the creative arts, not as a revolt against the materialistic world, but in an attempt to exploit it.

As a teacher I would say that a science student should have the following abilities: he should have excellent powers of observation, be able to write clear concise English, be able to draw well, be able to think logically, and be able to learn a new vocabulary; he must also have dexterity in handling apparatus, and should ideally have basic skills in metalwork and woodwork. In addition, he must be a mathematician.

I am sure it is possible to do well in an arts course with only a few of these accomplishments and as students see it, at the end the arts course would more likely lead to reward for his ability. So if he has any opinion of his ability, why should he choose science?

After suggesting a partial diagnosis, I suppose I should suggest some treatment. Broadening the examination requirements does not seem really fair on the pupil, and to keep changing the syllabuses merely adds to the work being done by overloaded science teachers. We should start by trying to make science appear as attractive as it undoubtedly is to the enthusiast. Scientists must communicate with one another in English, and with the rest of the community with enthusiasm. We should infiltrate the BBC, and the mass media. And we should find some way in which people can be fairly rewarded for their ability.

Seen among a list of pop groups on a poster for the Lyceum Easter Festival :

Van de Graaff Generator

Still, as the film mogul said, 'All publicity is good . . . bad publicity is good too.'

Following observations made earlier this year at the Old Bailey, relating to section 2 of the Official Secrets Act – or the Obscene Publications Act (whichever it was) – we now feel free to publish a revealing document of tremendous import, which we deny was given to us at any time during a party (or 'committee') or a working lunch. Nor will we reveal that our source was Yvonne Taylor and Peter Casey of the Nuclear Physics Division.

confidential

glossary of terms

For the sole use of members of SRC boards, panels, committees, etc. etc.

applications

Necessary	*Desirable*
Desirable	*We still have some money to spend*
Useful	*The manufacturer has offered me 10% off*
Clearly preferable equipment	*It matches my laboratory decor*

referees

Not of SVF (Senior Visiting Fellow) status	*I've never heard of him*
Already in progress elsewhere	*I propose to steal the idea*
Appears a sound case	*I know nothing about it*
An excellent case	*He used to be my research student*
An absolutely impregnable case	*I've been asked to referee my own application*

boards and committees

Insufficient timeliness and promise	*Second-rate routine data collection*
Competition for funds was severe	*Your project was no good*
The application lacked scientific merit	*The Committee laughed*
Suitable for students	*We've run out of postdoctoral manpower*
The Board's bid	*The largest number that won't make the Council laugh*
Estimates	*Guesses*
Forward Look	*Wishful thinking*
The report was accepted without discussion	*No one had read the report*
Major centre	*The professor is on the Committee*
Minor centre	*The professor deserves to be on the Committee*
Satellite centre	*Equipment obsolete, but won't lie down*
An important new project	*An expensive extravagance*
A stimulating new development	*An expensive extravagance that probably won't work*
The Board believes	*The Board's Chairman believes*
Members of the Board believe	*All the members except the Chairman believe*
Some members of the Board believe	*Two members believe*
Dr. Jones believes	*Dr. Jones is in a minority of one, and won't keep quiet*

the office

Concentration	*To him that hath shall be given*
Administrative difficulties	*We lost the papers*
Subsistence allowance	*Inadequate*
Suitable for promotion	*Embarrassingly clever*
(K)night line	*The thoughts of Chairman Brian (see little red book)*
Little red book	*Little-read book*

what's in the nest

A report following an ornithological survey of recognised hibitats

northern fantail

(supportus mancunae)

This well known bird is a distinctive off-shoot of the general species of Supportus, with local sub-specie mutations. Their normal habitat is in the north-west counties of England, but isolated groups are to be found in most counties. Is a great traveller and has been seen and recognised in Asia and the New World as well as in Southern England. Its distinguishing plumage differs from area to area but the two main sub-species are easily recognised by their red and white crests and throats and pale blue crests with throat markings to match. The males greatly outnumber the females, who incidentally carry the same markings. It has been known for the sub-species to mate but when this happens there is often discord in the nest occasioned by inherited prejudices.

When not employed in foraging for food or providing for their young they are usually to be found in large numbers surrounding smaller groups of like species engaged in ritualistic combat. They are very vocal in support of their own sub-specie, and although no general recognition call can be identified, a three part call resembling 'sendimoff' is prevalent in most areas.

This form of ritual combat is usually at its peak between August and April but it has been recorded that small outbursts occur at other times of the year (*eg* beginning of July).

They have a strong aversion to their southern counterparts, who are only distinguishable by their head and throat markings, and tend to get restive if their prowess in combat is questioned. After defeat or victory they are not vindictive and one usually finds them at the local watering hole jostling in a friendly manner with those who only a few hours earlier would have been prepared to draw blood in defence of their kind.

sussex white sporter

(fagiani philcoxii)

This bird, named after a very well known ornithologist in the area, is a native of the Sussex marshes. It is not thought to stray far from the local breeding grounds. Has no distinguishing winter plumage but in summer a white covering emerges. When travelling tends to move in flocks of twelve. During the summer months this specie usually spends most of its time on nearby village greens intimidating potential rivals with short runs and flailing appendages.

An interesting point about this bird is its great aversion to water. At the merest hint of rain it always seeks shelter. It cannot be considered a songbird, but at regular intervals utters raucus sounds which are rarely understood except by the most veteran watchers. When rivals show stubborn defiance the white sporter is liable to get angry and the intimidatory runs become faster and more violent. When resistance is overcome they soon recover their composure and are content to let the rival leave the area unmolested.

Very few females exist of this specie, but the male has been known to pair off with any unattached female of other species when the opportunity arises.

common wanderer

(sectus auditii)

Very rarely seen alone and usually travels in flocks of four or five. Although having a main nesting area they are to be found occasionally in all regions. These migratory journeys can, and do, occur at any time of the year but are of short duration only. Females of the specie are, like the Fagiani Philcoxii *(above)*, very rare. Their habits are very unpredictable but in general they are to be found poking their beaks into the most unlikely places. Natives in the migratory areas do not relish these sporadic invasions but normally accept them as inevitable. No distinguishing plumage and tend to blend inconspicuously with natives in all areas. Are thought to have a suspicious nature.

northern watcher

(patrius caledonae)

This bird is only found in the southern part of Scotland, making very infrequent forays into England. It is basically of nocturnal habits and prefers clear moonlight nights for observing distant objects. Plumage is sometimes considered drab when compared to some of the English birds but the bulky nature of their plumage, evolved because of extreme climatic conditions, gives a very unusual silhouette when outlined against the sky. Birds of similar habits are known to exist in Southern England and South Africa but only occasionally do the species intermingle.

Anonymous Hyde

Q column by 'observer'

ps

Now the postal strike is over we give a very warm thank you to everyone who kept the communications systems going, particularly to those who bore the brunt of it – like office services, registries, messengers, drivers, voluntary carrier pigeons, the telephone girls who kept London Office on the line and the staff who manned the 'answering service' rota. The overall effect seems to be an increase in the use of corn plasters and visits to the cobbler, but several inches lost around some circumferences. Pathfinding has improved and full marks go to the Rutherford and Atlas drivers who rushed things round the Thames Valley on the service organised by the Secretary of Atlas, Mr. C. Roberts, covering our own establishments, the UKAEA's and various universities, not to mention all the single deliveries dropped off on the way. Establishments north and south looked after other main centres and the crisis found most people ready, literally, to go out of their way to deliver important letters, pensions and everything necessary to keep SRC going at the speed of the twentieth century.

Just imagine how it would have been in January 1771, asking a horseman to carry a letter from London Office to Daresbury and not knowing if he would ever arrive. In 1871, our Aberdeen correspondent says, Queen Victoria could arrive there from London (on her way to Balmoral) *in less than twelve hours* by the new railway. In 1971 the service had improved by an hour and a half, if you picked the right train, and the motor car had been invented for getting to places where the track had been taken away again but on the other hand you could transmit a message instantaneously by telex or telephone, not to mention radio, and one chap did it very expensively by television. In 2071 will people just think the message and let the cybernetic system decide where to send it or, even, whether it should be sent at all. Will they even know how to write?

'no quertyuiop today'

One thing we were always sure about was that agency typists had jam on it when it came to knowing how to live in freedom and yet still afford the holidays abroad sort of status symbols which are the only real proof of success in life – or so the ads try to convince us. Then came the postal strike (remember it?) and the popularity rating of letter writing dropped sharply, giving place to those essential office routines of chatting to all and sundry on the telephone (the 'my time is money' image – there were queues for lines all over the country), filing away all the letters sent, received and discarded over the past twelve months (some people saw the tops of their desks for the first time) and making tea (they also found the kettle).

The pace became rather calm in some quarters not too close to a night line. Messages sent by hand took a little longer and if they were to go any distance they had to wait until some unsuspecting professor arrived for a committee and found he was expected 'if he would'nt mind' to take five large parcels all the way back to Liverpool, or Manchester, or Edinburgh, or vice versa.

Without letters the urgent demand for agencies to supply a shorthand typist 'now/within half an hour' disappeared altogether in some firms – although not in SRC offices where they are all regarded as amenities – and for the first time since the typewriter and the woman to use it was invented, typists were seen at the labour exchange. (Apology for not remembering the fancy new name, it was always 'down the labour' to its best supporters).

The brighter side is that some of those bright young dolly birds might have to go to Margate this year instead of Majorca. That should make it look a bit more like the posters.

lexicological

When we heard that the Government were to ask manufacturers to put warnings against smoking on *advertisements*, it sounded like a contradiction in terms to one who had come to believe that 'to advertise' meant to persuade people to buy things and the shoddier the goods the 'better' the advertising required. So we looked it up in the Concise one and found, as all dons know, that the verb means to notify, inform or, indeed, *to warn.* We are left in no doubt that the phrase was the work of a civil servant coining a 'nice' one for his Minister (in the Oxford sense) – those chaps can indeed be very subtle.

time off : 1

legal London

A. G. Wilson

State House is in the centre of legal London. From its upper-floor front windows may be seen Lincoln's Inn and, beyond, the back of the Law Courts in the Strand; while from the windows at the east end is visible the equally noble Gray's Inn. The other two Inns of Court, which have the exclusive right of calling persons to the English Bar, are Inner Temple and Middle Temple, but a short walk away between Fleet Street and the river.

As a Londoner the courts of law have long fascinated me and it seems strange that so few of my fellows ever bother to investigate the opportunities for interest and entertainment they so readily provide. Some may feel that it isn't quite the done thing to seek entertainment in the courts, since in many instances a court action means distress to somebody, but for many years a columnist in the Evening News carried a large public with his 'Courts day by day' which was never unkind but always very funny.

The Law Courts in the Strand deal with civil actions and appeals, but they have one criminal court, that of Criminal Appeal, which is the only one to have a dock for a prisoner. Members of the staff who take an early lunch might look in at one of the courts there as they seldom rise for lunch before one o'clock. Entry is gained up the spiral staircase, either side of the main entrance. The Cause List in the glass cases on the walls outside the building will explain what is on and where, and if the Lord Chief Justice is sitting in his court his should be preferred. These courts have all the traditional formalities – robes, wigs and gowns – which are not seen in the lower courts or the Police Courts. The Old Bailey, about ten minutes away in Newgate Street, is the country's great criminal court and in the past has dealt with most of the notorious murderers of the present century. This may be visited if one is prepared to queue up before the court opens.

Over a period of more than thirty years I have visited many of the courts, using up the odd day's leave by hearing most of the crimes in the calendar. The Police Courts, which have a full-time salaried magistrate, are having more and more to cope with motoring offences, but they tend to deal with these in the afternoons so the morning is the time to go. A chance visit to Marylebone Police Court during the war gave me my most amusing experience.

One evening a gentleman registered at a quiet and select hotel in Paddington. He enquired why the young man at the reception desk was not in the Forces and was informed that he had been discharged on medical grounds. 'Then how would you like to be my aide'? asked the gentleman, adding 'I am Sir Thomas Lawrence. The reports of my death were put out by the Secret Service to cloak my activities underground in Russia and I have now returned for active duty. I am going to the palace tomorrow to receive the KBE' T. E. Lawrence (of Arabia) had been killed, I believe, in 1935 by crashing his motor cycle.

In the course of a few days the gentleman had borrowed a morning suit from one of the hotel guests in which to go to the palace, had shown all the guests a decoration which he said was the KBE that the King had given to him, issued the receptionist with a document on buff paper appointing him aide-de-camp and proclaiming him Captain, obtained a Captain's uniform and a Major-General's uniform for each of them respectively from a military outfitters and opened bank accounts for them both at a bank in Piccadilly.

The receptionist lost no time in giving up his job and assuming his new uniform and duties, but it was not apparent what the latter were. Whilst so occupied he appears to have been pulled up by the police and as proof of identity produced the letter given him by Sir Thomas. This started off the chain of enquiries that led to the case I was watching, at which the doubtful Sir Thomas was charged among other things with falsely wearing the uniform and badges of a Major-General and decorations. The magistrate, Laurence Dunne (who was later knighted and became Chief Metropolitan Magistrate at Bow Street), found much amusement as an officer from World War One in pointing out that the hotch-potch of decorations on the uniform were out of order and some inappropriate. The man seemed to have been apprehended before he could get fully launched, as the offences were not voluminous, but he was sent to the Sessions for trial and got, I believe, eighteen months.

I had been something of a fan of T. E. Lawrence and had read most of the literature then extant by or about him. It puzzled me that this small man, with a large head and good crop of hair, could be impersonated, with some success, by a large fat man with a bald head – for such was the bogus warrior's appearance.

The author works in LO Administration Division

time off : 2

London transport

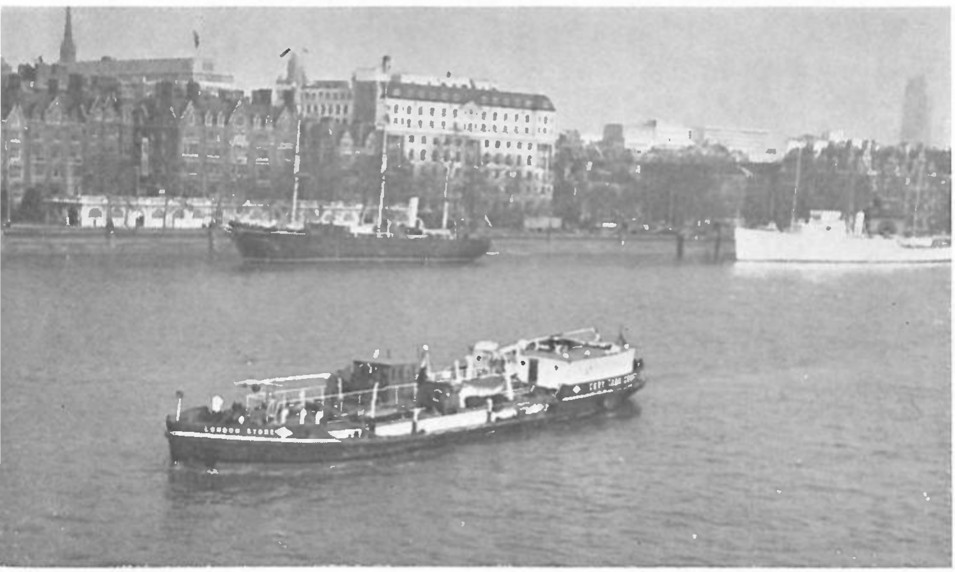
One advantage of working in London Office is that London is a focal point for all modes of transport and if, like me, you are a transport enthusiast, you can find quite a lot to interest you. Take a camera on your explorations and you will find subjects such as the two vessels illustrated in these photographs.

The picture above of a tug taking an empty lighter downstream is a familiar sight on 'London River', as the Thames is known to sailors all over the world. The tug, 'Fenland', is a 38-ton, 400 bhp motor vessel built in 1929, at a time when tugs were generally steam-powered. This early example of the now almost universal motor-tug has served her owners for 42 years and must be considered an excellent investment.

The picture below shows 'London Stone', a self-propelled barge of some 100 tons owned by the Cory organisation, well known as oil distributors. 'London Stone' and others of her kind are dual-purpose vessels that not only serve as barges themselves but can also be used to tow one or more dumb (engine-less) lighters.

In the background is Captain Scott's 'Discovery' which has been berthed at Victoria Embankment for fifteen years, and now serves as a training ship for the RNVR. The vessel is open to the public at times, but at the time of writing the grand old lady of the sea is undergoing a refit because she is suffering from, of all things, dry rot! This is more of a problem than might be supposed since the timber hull, built to resist the pressure of the ice in the Antarctic, is 2ft 2in thick in most places. The bowsprit and rigging are also being renewed.

There is plenty more of interest in London. The Clapham Transport Museum, whose fate is at present in the balance, deserves an article to itself, and the railways are not without interest even though steam has been displaced by 'inferior' forms of power. However, my major interest is in buses and coaches, and I hope sometime to be able to tell you a little about this hobby and to describe the 22-year-old coach I have saved from the scrapyard.



a land of clear water

Dennis Fogerty

This unusual view of the Ayasofia Mosque or 'Church of the Holy Wisdom' was photographed from a vantage point on the Sultan Ahmet or 'Blue Mosque' looking towards Seraglio Point and the Bosphorous. Erected in AD 537 by the Emperor Justinian on the site of Constantine's earlier church, it was turned into a mosque in 1453 when the city fell to the Turks. Under the Turkish Republic it is now a museum and many of the original Christian decorations have been uncovered after 500 years under plaster and paint. The large middle dome rests on two half domes and is considered to be an amazing architectural feat. Photo by courtesy of the Turkish Tourist Office.

Turkey with her magnificent past glories of an Imperial heritage, is full of historic treasures covering the ruins of twelve successive civilisations. Even tourists who spend only a few weeks there can see traces of more than twenty centuries of history.

In this same land which bears the marks of the past, now live a smiling hospitable people – the Turks. Although they have to fight hard to make a living, it is difficult to find a friendlier people, and a visitor is made very welcome.

Turkey offers the holidaymaker a complete change from the cares and routine of everyday life. From May to September most parts have a perfect climate – with temperatures rarely falling below the seventies (F, that is, or twenties (C) if you insist) – providing ideal conditions in which the visitor can relax on sandy beaches or enjoy the peace and solitude of mountains and lakes.

Besides these attractions, the cost of living is extremely low. For 10p (2½ Turkish lira) one can buy a kilo (2 lb.) of grapes, apples, pears, peaches, or oranges. In the larger towns lunch or dinner costs from 20p – 30p and a single room with bath costs between 50p – 80p per night. Luxury hotel rates are of course more expensive but the rates are much lower than in most European countries.

I suppose that I could claim to be a pioneer in overland travel by car to Turkey. I have returned there every year since 1965 and my annual camping expeditions have become a regular habit. Last year, just for the fun of it, I hired a mini-bus and introduced a party of new visitors, one of whom was Ken Somerville of ROE. This venture was called 'Topkapi Safari' and it proved to be a success well worth repeating this season, and this time there are four expeditions and more drivers. A heavy strong vehicle with a good turn of speed is required for the long overland journey and to stand up to the rough conditions found in some remote regions. My choice is the long wheel base transit-bus. It can carry a group of 15 passengers, easily, deep into the interior of Anatolia and beyond.

'Topkapi Safari' expeditions are suited for the young and adventurous who wish to share new places and faces with mixed group informality and freedom. The upper age limit is flexible, providing the participant is fit and healthy and willing to join in and have a go at *anything*. For instance passengers help load and unload the vehicle and participate in every way – there is no one else to do it. Definitely no spoon feeding!

The overland journey through Europe passes through six countries – France, Belgium, Germany, Austria, Yugoslavia and Bulgaria, on the busy communication trunk roads linking Europe with Asia. This is an historic route used by Roman legions, the barbaric tribes, the Slavs, the Crusades and, in the reverse direction, the Ottoman Turks.

The journey of nearly 2,000 miles is completed in four days. We travel fast stopping for meals and fuel only, at regular intervals. At night we do stop for sleep at suitable way-side spots but we use the minimum of tents and do not change into sleeping attire. At first light we are away again, halting for breakfast later in the morning. It is a hard and fast journey but this way we reach our destination – Istanbul – on the fourth day. The last 100 miles seem interminable because by this time we are travel weary and a bit dirty.

In Turkey at last! The Sun is shining, the people smiling and everything looks so different. Ox carts, horses and donkeys, everything at the slower pace of the East.

At Istanbul we want some luxury and feel we have earned the good long rest of four days. We stay at the BP Kartaltepe Mocamp, one of the most modern sites in Europe with constant hot and cold water, beautiful tiled showers and toilet rooms, cooking, laundering and ironing facilities, snack bar and restaurant, souvenir stand, exchange bureau and swimming pool. There are free swimming facilities at the BP's private beach 3 kilometres away, and nearby some of Istanbul's finest golden beaches, on the sea of Marmara.

The city itself is absolutely fabulous. For two thousand years, in its glorious situation astride the Bosphorous, this great city has been the capital of the empires which have formed the bridge between Europe and Asia. Istanbul – or Constantinople as it was – already counted her population in millions while London was still a village on the Thames. It is alive with history – with castles, palaces, churches and mosques. There is a bewildering variety of life, from the maze of alleyways around the old market, which look as if they have not changed very much in a thousand years, to the smart residential districts of Beyoglu with its modern hotels and apartment houses which equal anything in Paris.

The bazaar district of the old city is a fascinating wilderness of tiny shops in which it is possible to buy objects excavated from the sites of ancient Greek and Roman ruins. There are manuscripts and icons from the old churches of Byzantium, Persian miniatures, Ottoman brassware, carpets and rugs from all over the orient – an unending variety of fascinating and beautiful objects which the discriminating purchaser can often secure for very small sums of money.

All too soon we must tear ourselves away from Istanbul. On the longer three-week trips we cross the Bosphorus into Asia and then on to the Aegean or Mediterranean sea coasts. Turkey has a comprehensive road system, the main roads are generally good, and once outside Istanbul the traffic is light. Our travel policy is now reversed and we often stop for visits to the many places of interest and, of course, for refreshment. In the Mediterranean region apart from the natural beauty there are Greek, Roman, Arab, Crusader and Ottoman remains to explore. In the Aegean region there are more Hellenic ruins than in Greece itself, also Roman and Byzantine influences.

During the Summer these regions are very hot and arid and it is necessary to replenish body fluid frequently. Turkey is noted for its wonderful natural water which is often drawn from deep wayside wells. It is of excellent quality, ice cold, clear and sparkling. Some wary visitors from Europe insist on treating all Turkish water with pills or tablets. This is unnecessary but if it makes you feel better do so by all means. One of the sad things about leaving Turkey is the prospect of returning to our cloudy processed water, often tasting of chlorine.

Turkish bread is good and cheap made from stone-ground natural grain with no adulteration. Together with cheese, fruit and sour milk it is the staple diet of the peasants. Meat is an expensive luxury enjoyed about once a week. At the tourist exchange rate Turkish meat is cheaper than in the UK but tends to be tough due to the arid conditions. Turkish cooking has its own special quality and characteristics and is certainly different – most visitors enjoy some particular dishes. In country districts it is the usual thing for customers to be invited into the kitchen to make their own choice. Very often the whole family will parade at the exit to say 'güle güle' ('go smiling') because they feel honoured to have Europeans as patrons.

The Turkish people are of the Islamic faith. They have a long tradition of tolerance toward the Christian (People of the Book) and Jewish religions, originating from the days of the mighty Ottoman Empire which contained a kaleidoscope of many nations and religions living, for the most part, in peaceful harmony and enjoying a common citizenship from the Atlantic to the Indian Oceans. Nowadays in all parts of Turkey it is possible to enter the Mosques and other sacred places provided that one is decently dressed and behaves with restraint.

The memory of Ataturk is strongly venerated everywhere. After the first world war the country was occupied by military forces from Britain, France, Russia, Italy and Greece and the Turkish homeland was reduced to a small territory in central Anatolia. By diplomacy and war, Ataturk drove out all the invaders and managed to unite the whole of Anatolia and Thrace under the flag of the Turkish Republic, then commenced a programme of reconstruction and modernisation that continues to this day.

In recent years Turkey has pursued a policy of self reliance and sacrifice, importing very little except essential raw materials, and making great strides toward industrialisation. The hardworking Turks expect an improvement in their lot, because of this, within the next decade. Turkey is an associate member of the Common Market and will become a full member in a few years, she is also a loyal member of NATO and the most powerful military nation in the Near East. The fighting qualities of the common Turkish soldier are well known and it is true that the tough Turkish peasant can endure incredible hardship and will fight to the death.

Turkish gold, silver and jewellery is of very high quality and of superior workmanship, but considerably cheaper, than in Europe. Other good buys for visitors are brass and copper ware – the usual stuff made for tourists, but it is *Turkish* – remember nothing is imported. Leather too is mostly of good quality, very soft and smooth and wears well. A full length maxi-coat, made to measure, can be bought for £12-£14. Men's car coats or short jackets, very nicely tailored to measure, £10-£12.

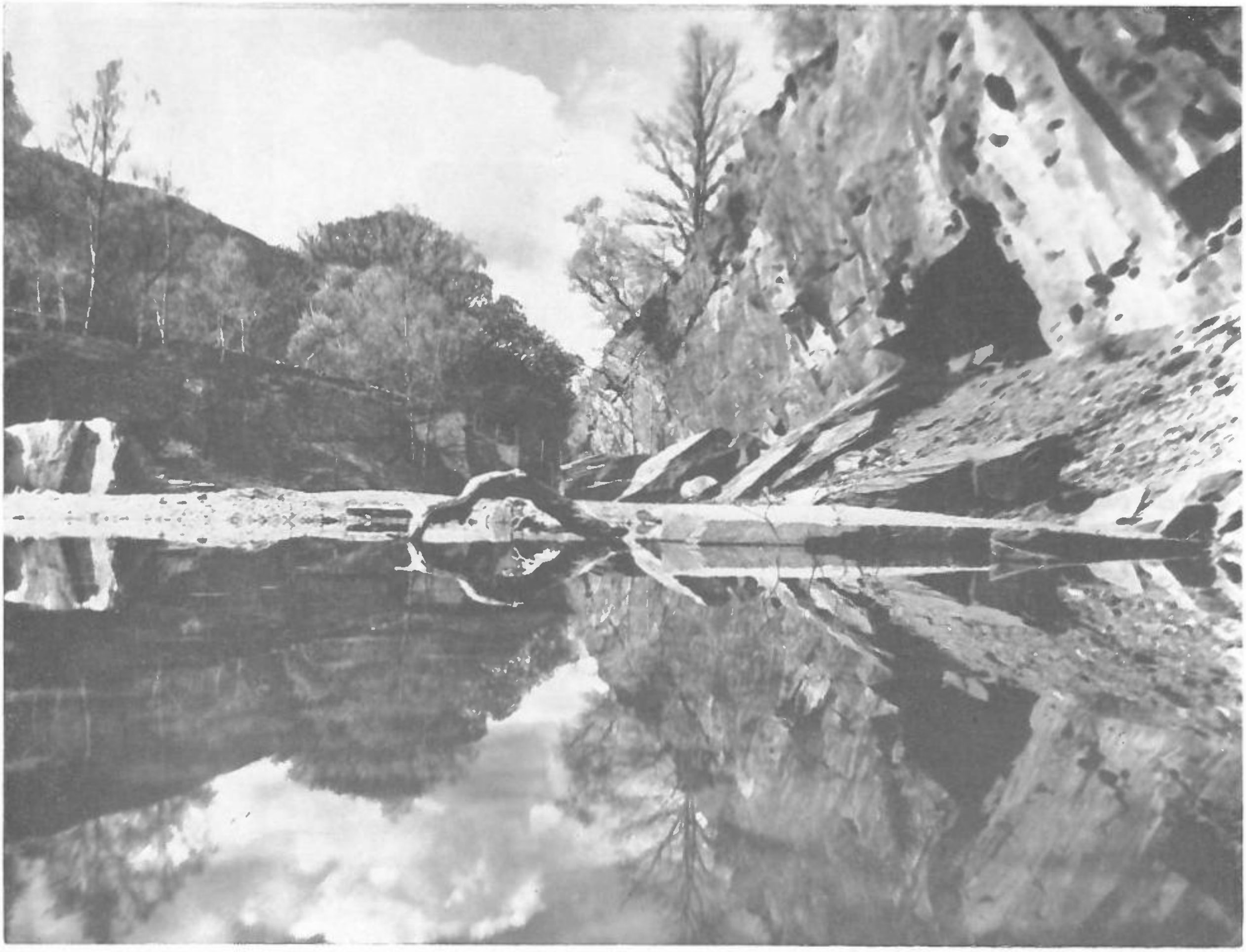
A last few words for visitors. Don't expect too much. There is dirt, dust, flies – all the usual inconveniences of a hot and dry summer climate. The Turks will not put on a special display for you, you will see terrible poverty, children and adults dressed in rags and patched up clothes but they are happy and contented and, as yet, bear no animosity towards the better off visitors. In spite of all this, there is a certain charm about the place that gets under one's skin. I suppose I am just hooked on Turkey, and if anyone reading this wishes to see the *REAL* Turkey, come with me, on 'Topkapi Safari', 1971.*

These are the holidays for 1971:

To/1	*Sea of Marmara Tour: June 4-20*	
	Istanbul-Gallipoli	*16 days*
To/2	*Aegean Sea Tour: July 2-25*	
	Istanbul-Bursa-Kusadasi-Ephasus-Pergamum-Troy-Gallipoli	*23 days*
To/3	*Mediterranean Sea Tour: August 6-30*	
	Istanbul-Ankara-Silifke-Alanya-Istanbul	*24 days*
To/4	*Aegean Sea Tour: September 3-26*	
	Istanbul-Bursa-Kusadasi-Ephasus-Pergamum-Troy-Gallipoli	*23 days*

All holidays include use of cooking and camping equipment with comprehensive health and baggage, personal accident and cancellation insurance, also international camping carnet cover, and all camping fees and ferries are taken care of.

**Bookings can be arranged through the exclusive agents 'TRAILFINDERS' 48 Earls Court Road, London, W8 6EJ. Tel. 01-937-4569. Further information can be obtained from Dennis Fogerty 'TOPKAPI SAFARI', 99 Elmshurst Crescent, East Finchley, London. N.2. Tel. 01-883-0915. Dennis works in the Internal Audit section of Finance Division at London office.*



The Old Slate Quarry, Borrowdale

time off : 4

Peter Culba

This year why not try the English Lake District for a holiday? Forget the old joke about the 'Lakes' having a six day week with no **Sun**day, because while it can and does rain quite a lot – having the wettest habitation in England – the sun does shine and if you choose the right time of year, with a bit of luck you will find it.

Generally the driest part of the year is the period May to the middle of July, May being the driest but rather on the chilly side, so for a first visit I would suggest late June or early July. September and October can be pleasant, but you have more chance of rain and hours of daylight are on the short side.

If you contemplate doing some walking, choose Keswick or Ambleside as your centre, whilst Windermere is a useful centre if you are interested in yachting. (Bathing may be had almost ad lib, except on Thirlmere where it is strictly forbidden).

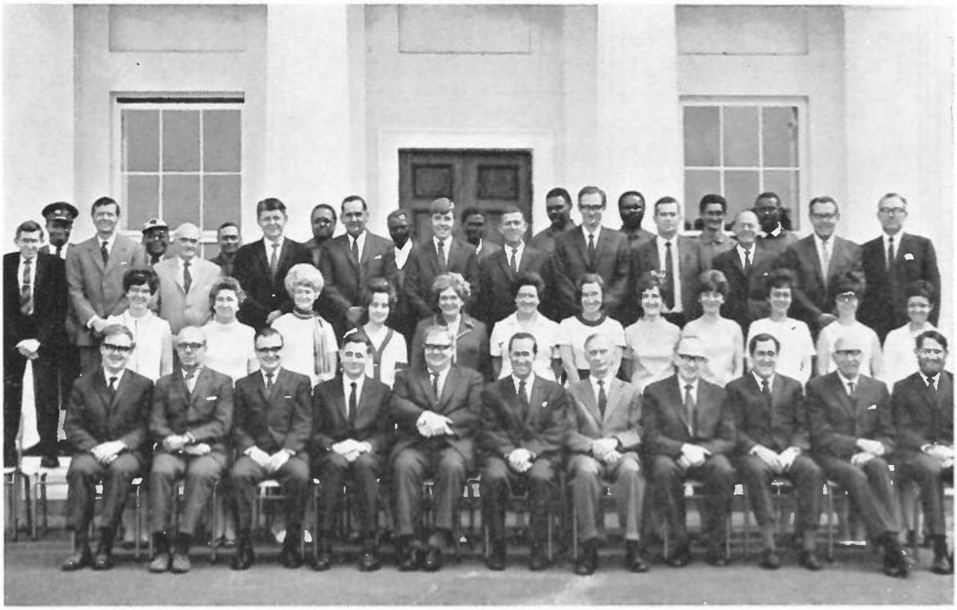
Strong footwear is advisable for general use in visiting well known viewpoints, and commando soled (or nailed) shoes or boots are essential if you intend climbing any of the many peaks over 2,000 ft. as is an Ordnance Survey 1" map, compass, and the knowledge of how to use them. Extras, in the way of clothing and food *ie* sweaters and chocolate, should be taken if venturing on the higher peaks as the temperature can be much lower than in the valleys and you may need the chocolate to provide the extra energy to keep warm. Drink is usually no problem as the water in the mountain streams above say 1,000 feet is quite safe to drink.

If you are not the walking type you will still enjoy a trip to the district. There are boat trips, swimming, golf, and of course the superb scenery, and the many waterfalls of which perhaps the best is Aira Force (120 foot fall) – car park nearby or by bus from Keswick.

I shall be only too pleased to help anyone who is thinking of going, with information on accommodation etc, if they get in touch with me.

Peter Culba works in the Contracts Section at London Office. He processes his own photographs like the one above.

newsfront



at the cape

This photograph of the Observatory staff was taken to commemorate the 150th anniversary. (See Quest article in Oct '70 issue) From left to right they are:
front row: J D Laing, P R Cook, A Shortland, P M Corben, J Churms, G A Harding (The Officer-in-Charge), A W J Cousins, W. G Grimwood, P W Stimpson, T W Russo, T G Hawarden
second row: S F Parker, H Rigby, C Strydom, A J Goedhals, D E Johnson, M C Coetzee, R M Banfield, A A Neethling, J E le Roux, Y Z R Thomas, B Brown, C A Byrnes
third row: W G Pearson, R W Etherton, L C Browne, M A Edwards, A T Rose, B S Carter, D J Ribgy, G M Harvey, D S Malan, W A Rasmussen, A E Cordwell, O G F H Fiamingo
top row: A Congwane, L Makobs, H G Haupt, P E Zikalala, G Mgayiya (deceased), N Matiwane, J Blom, N C Thompson, P P Okkers, A Mngoma.
photo by Colin Edwards, Cape Town

congratulations

to Dr N. Lipman of the Rutherford Laboratory who has become a Visiting Professor of the University of Sussex.

and to Professor Fred Hoyle FRS who has been appointed as the next President of the Royal Astronomical Society, to succeed Professor Sir Bernard Lovell. Professor Hoyle, Plumian Professor of Astronomy and Experimental Philosophy at Cambridge University and Director of the Institute of Theoretical Astronomy, is a Member and Royal Society Assessor of the Science Research Council, a member of the Astronomy Space and Radio Board and Chairman of the Astronomy Policy and Grants Committee. He is also Vice-President of the Royal Society, a Foreign Associate of the National Academy of Sciences and Professor of Astronomy at the Royal Institution.

★

Professor Sir Brian Flowers FRS was the Physicist on the panel of judges on the final 'Young Scientist of the Year' programme on BBC 1 television. With him were Professor George Porter FRS, Director of the Royal Institution and Fullerian Professor of Chemistry, who received the Nobel Prize for Chemistry in 1967, and Dr. John Carthy, Zoologist, the Director of the Institute of Field Studies.

The young competitors appeared in preliminary rounds over the previous few weeks. The project of the winning team, from Sittingbourne (Kent) Girls' Grammar School, related to genetics and eye colour. The other two finalist teams had carried out studies on moss ecology and on electronic traffic stimulation.

★

Visitors to the Rutherford and Harwell Laboratories who have admired the surrounding grounds will be interested to know that the Superintendent Mr. A. E. Burge MBE received the Silver Gift Medal of the Royal Horticultural Society for services to the AERE Horticultural Society over the past 20 years. The medal is only awarded in cases of real merit and those who have enjoyed the benefit of the beautiful surroundings he has created (under very difficult conditions) feel that it is a just tribute. Mr. Burge retired from AERE in December but not, of course, from gardening. Before joining Harwell 20 years ago he had been in charge of St. James Park, having worked for 32 years in the London Parks, and had also been responsible for laying out the Roosevelt Memorial Gardens after the war.

Doug House, ACL

new to Quest

To replace Bill Napier, ROE, and Fred Lunnon, ACL, who have left the Editorial Board, we are pleased to welcome Jim Campbell, ROE, and Doug House, ACL. We also express our thanks to the retiring members for their support.

Doug House has been Deputy Head of Operations at ACL since 1964. Before this he served with the Royal Naval Scientific Service since leaving school, first coming into computer work in 1956 as an engineer until he joined SRC and changed to operations. Previously he had worked at the Royal Naval Physiological Laboratory in underwater blast and applied physiology and had taken part in some experiments as a 'guinea pig'. His main spare time interests lie in sport, particularly cricket and golf – his handicap is 12 !

Jim Campbell is a Senior Scientific Officer engaged in space research at ROE.

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pro sano corpore

(or, for the less latin types, 'how to achieve a sane corpse')

Sports day 1971. June 30 is the provisional date for the event. (Details will be published nearer the time). It will be held at Chiswick as before and will include all the events of last year – bowls, cricket (there will be 2 pitches this time), netball, six-a-side football and tennis (men's and mixed doubles). The Sports and Social Association hope that all establishments will be well represented both by teams and spectators, remembering that this is as much a social occasion as a competition.

[Our crystal gazer can't foretell anything of real meteorological value but does forecast a rise in pressure around the ladies' netball matches in proportion to the prevalence of 'hot pants'. Ed.]

Cricket. A team to represent SRC has been entered for the Curtis-Bennett cricket competition, the all-civil service tournament. Spectators are welcome if you can spare a day's leave. Watch notice boards for details and dates of matches.

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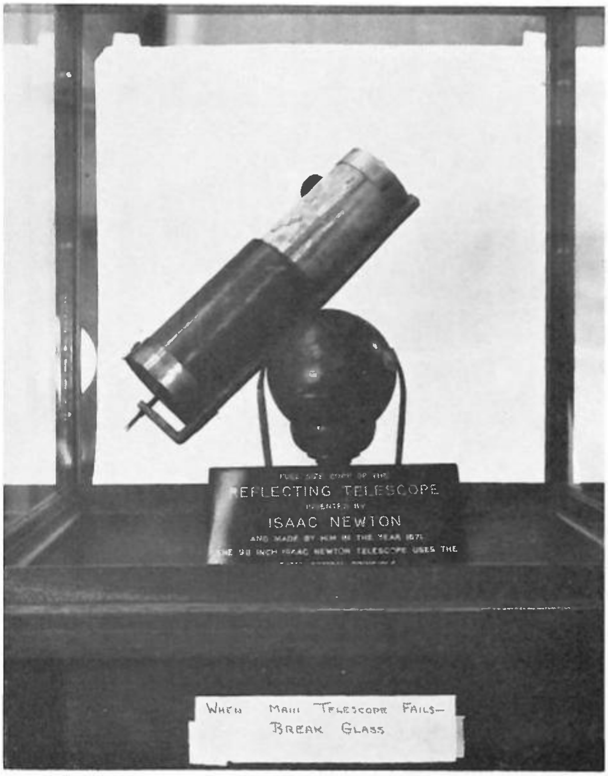
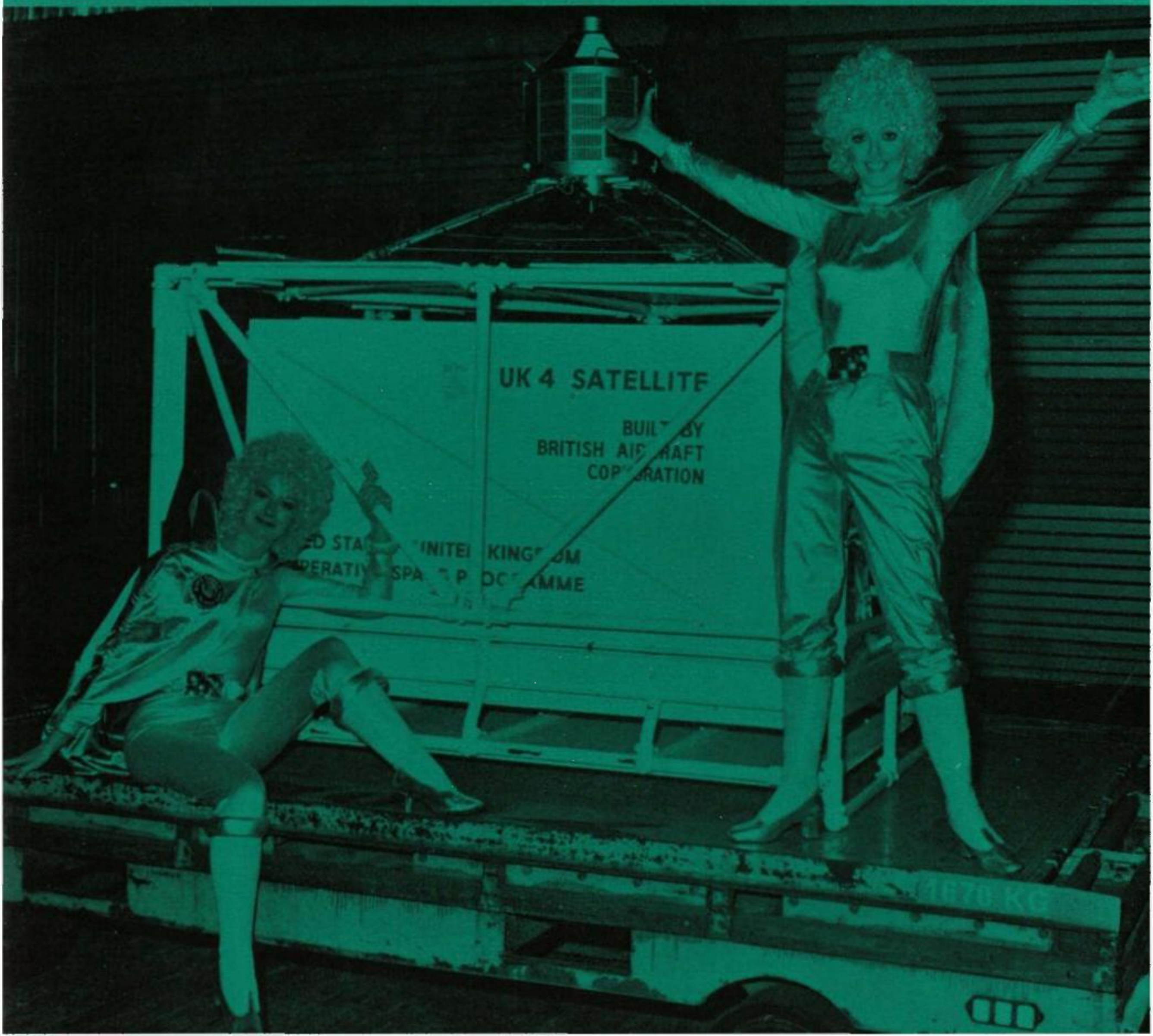
exact image

Since the inauguration of the Isaac Newton telescope by the Queen in 1967, there have been many visitors to the public gallery. Throughout the year the public are allowed to view the large 98in reflecting telescope from an especially constructed area at the observational level some 48 feet above the ground. Among the exhibits on view is a copy of the replica of the first reflecting telescope made by Sir Isaac Newton in the 17th Century – the replica itself was presented to the Queen by the Astronomer Royal at the inauguration ceremony. Both the replica and its copy were made by members of the RGO engineering workshop.

Visitors are unable to see the notice that has been attached by some joker to the far side of the showcase (see photograph) but the standard of maintenance provided by the Observatory's engineering and electronic workshops is so high that there has been no need to resort to such drastic measures.



QUEST



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QUEST

House Journal of the

Science Research Council

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Vol. 4 No. 4

October 1971

contents

'And now for something completely different . . .'

Cover picture shows the UK 4 package and a half scale model on the way to the United States for the NASA launching. The part RSRS play in the UK–US project was told in Quest July 1971 p. 8. The project scientist Robert Dalziel says he did not in fact provide the two assistants in the picture. We think BOAC may be responsible, they provided the freight service and the photo.

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new director for RGO

Professor E. Margaret Burbidge, FRS

Professor Margaret Burbidge, FRS is to become the new Director of the Royal Greenwich Observatory. She has been Professor of Astronomy at the University of California, San Diego, since 1965, and is expected to join the Observatory in the summer of 1972. Professor Burbidge will succeed Sir Richard Woolley, OBE, FRS, the present Astronomer Royal who retires at the end of 1971.

In recent years Professor Burbidge has made important studies of the quasi-stellar objects, known as quasars, in collaboration with her husband, Professor Geoffrey Burbidge, FRS, who is Professor of Physics at the same university. They were married in 1948 and have made many significant contributions to astronomy, working together. SRC is now considering arrangements which will enable their collaboration to continue in this country. Both are British subjects and graduates of University College London. They have one daughter.

From 1948 to 1951 Mrs. Burbidge was Assistant and Acting Director of the University of London Observatory followed by several research posts in the United States until her present appointment at the University of California. She was elected a Fellow of the Royal Society in 1964. Travel and music are her main recreations, and at one time she played in an amateur string orchestra. Her father Stanley John Peachey was a Lecturer in Chemistry and a Research Chemist.

Publications include 'Quasi-Stellar Objects' (Margaret and Geoffrey Burbidge) and many contributions to scientific journals, mostly in the United States.

An account of the Observatory's work as it has been moulded under the direction of Sir Richard since 1955 follows on page 2. Between the date of his leaving and the new Director's arrival, Dr. A. Hunter the Deputy Director will act as Director of the Observatory.

Sir Richard Woolley
OBE FRS

Photo Universal Pictorial Press, London.

At the end of the year Sir Richard Woolley retires from the ancient position of Astronomer Royal to undertake the direction of an entirely new venture – the South African Astronomical Observatory.

In sending our good wishes to Sir Richard in the new undertaking we also remember his work over the past sixteen years as Astronomer Royal. This has been largely spent in leading the Royal Greenwich Observatory to its present day position as a centre for optical astronomy and astrophysical research.

Sir Richard was appointed to the post of Astronomer Royal at the beginning of 1956 on the retirement of Sir Harold Spencer Jones. He is the eleventh holder of the office; his predecessors are remarkably few considering that there has been an Astronomer Royal for the past 296 years.

It was decided many years ago to move the Royal Greenwich Observatory from its original location in Greenwich Park to somewhere else in Britain with skies more suitable for astronomical observation. However the actual move was delayed by the Second World War and its aftermath. By 1956, although nearly all of the staff were working at Herstmonceux, most of the telescopes had not yet been placed on the new site. One of the present Astronomer Royal's first major tasks was to arrange for the erection of the equatorial telescopes and to initiate various observing programmes with them.

At Greenwich most of the work of the Observatory had been related to the determination of the positions and motions of the heavenly bodies and to the provision of an accurate time service. Although most of the old interests have been continued, there has been a great broadening of the outlook of the Observatory in recent years. There has been a considerable change of emphasis and various branches of astrophysics now play an important role. Some of the older types of work have received added impetus from the presence of the new interests in the observatory.

The study of distant galaxies and quasars is very important and often produces spectacular results. However only a relatively small fraction of the observational astronomers in the world work on these objects partly because most of the problems in this field require a large telescope situated in a good location. The work of the Royal Greenwich Observatory in recent years has been concerned mainly with the properties of individual stars or groups of stars and with the structure and evolution of our Galaxy. In this case there are many important observations which can be made successfully even in a poor climate. Many of the programmes initiated by Sir Richard are ones designed to study the motions of different types of star in our Galaxy using various techniques. (Velocities in the direction of the line of sight can be found spectroscopically using the Doppler effect. Proper motions in the plane perpendicular to the line of sight can be determined by observing with a transit circle or by comparing photographs of the same part of the sky at different epochs.) Considerable attention has also been paid to obtaining the colours and magnitudes of stars in star clusters; such information is the observational basis for much of the theory of stellar evolution. Much work is being done at Herstmonceux on various types of variable star, particularly those of RR Lyrae type. These latter stars provide useful information on both the early history and the distance scale of our Galaxy.

Most of the telescopes now at Herstmonceux were originally at Greenwich. A very important exception is the 98-inch Isaac Newton Telescope which became operational in 1967. This instrument is for the use of astronomers from both the Royal Observatories and the universities. A considerable amount of the work of the Royal Greenwich Observatory during the past sixteen years has been the analysis of observational material obtained with telescopes situated in better climates than that of Britain. Sir Richard is himself a keen observer; in recent years he has observed in South Africa, California and Egypt in addition to his night time work at Herstmonceux.

It is important that observational astronomers should relate their work to that of the theoreticians and vice versa. In addition to theoretical work being done at Herstmonceux, there are now close links between the Royal Greenwich Observatory and the Astronomy Centre in the University of Sussex. Sir Richard is a Visiting Professor of Astronomy in the University. Collaboration between astronomers in different institutions in Britain is also encouraged by the annual conferences at Herstmonceux which were initiated by the Astronomer Royal in 1957. Another innovation was a summer vacation course for undergraduates. These have been very successful and many of the students who have attended these courses have subsequently chosen astronomy as a career.

In addition to directing the work of the Royal Greenwich Observatory and that of the Royal Observatory in Cape Town, the Astronomer Royal has been closely involved with other aspects of British astronomy such as the plans for the erection of the Anglo-Australian 150-inch telescope. In spite of all these commitments, Sir Richard has found time to continue with his own research interests. He was awarded the Gold Medal of the Royal Astronomical Society in 1971; this was for his contributions to observational and theoretical astrophysics particularly in the field of stellar dynamics.

£1M A YEAR FOR ATOMS MOLECULES AND PLASMAS ◆◆ BEST DATA YET FROM SKYLARK SPACE
PROBE IN SOLAR ULTRA-VIOLET SPECTRUM ◆◆ SYMPOSIUM ON ELECTRON AND PHOTO INTERACT
◆◆ £59,000 HARDWARE FOR MULTI ACCESS COMPUTER SYSTEM ◆◆ BRITISH EXPERIMENT IN ORI
ING SOLAR OBSERVATORY [illegible]-G ◆◆ FIRST LUNAR SAMPLES FOR BRITAIN ARRIVE AT SRC ◆◆
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council commentary

FOR CONTROL ENGINEERING RESEARCH ◆◆ ANGLO-AUSTRALIAN TELESCOPE CONSIDERABLE CONTI
BUTION TOWARDS SCIENTIFIC DISCOVERY ◆◆ RSRS PARTICIPATES IN UK4 SATELLITE TO MEA
INTENSITIES OF ELECTROMAGNETIC RADIATION ◆◆ DEVELOPMENT IN ANALYSIS OF BUBBLE CH
BER PHOTOGRAPHS BY SWEEPNIK AIDED BY SRC GRANT OF £40,473 ◆◆ SUCCESSFUL LAUNCH OI

june

Each year the Council visits one of its Establishments and this year the June meeting was at the Radio and Space Research Station at Slough. Council was shown round the Station and had the opportunity of discussing the work with Dr. Saxton and his staff. A visit was also arranged to the 25 metre steerable aerial at Chilbolton.

The main subject discussed at the June meeting was future participation in the European space programme. SRC is only directly concerned with the scientific aspects of the European space activities and the purpose of the discussion was to advise on the scientific satellite and sounding rocket parts of proposals put forward by the Chairman of the ESRO Council. Advice on UK participation in the application and launcher programmes comes from DTI and from other potential users of application satellites.

The proposals for the future of the European space science programme envisaged a reduction in the level of the scientific satellite programme below that of recent years and Council considered the likely return to the UK of such a programme both in relation to the domestic space science activities and to the bilateral UK/US collaboration. The cost of the European programme is high and, with the small number of scientific experiments likely to be flown, doubts were expressed whether such a programme could form a scientifically viable and cost effective part of the UK space effort.

At the July meeting, Professor Sheppard and Mr. Hosie were able to report on the outcome of the ESRO Council meeting when the proposals for the future were considered. Final decisions both on the science and applications programmes have been deferred until later in the year but a detailed draft plan has been drawn up on the basis of the views expressed. Participating countries are now considering these proposals further in readiness for the next ESRO meeting in November.

At the June meeting, Council also finalised the draft of its Annual Report for the year ending 31 March 1971. The Report was submitted to the Secretary of State and was published on 29 September.

july

At an earlier Council meeting Sir Ewart Jones pointed out that one of the most valuable research resources, that of time, could not be provided through the existing SRC research grant scheme. He suggested that the advance of science would be significantly helped if Council gave research grants to enable a few outstanding individuals to devote their whole time to research by freeing them from administrative work and all but a small amount of teaching. At the July meeting Council recommended introduction of a scheme, on an experimental basis, whereby research workers could have their salary paid by SRC for a period normally between 3 and 5 years. Views on the scheme will be invited from the Vice Chancellors' Committee, th UGC and the other Research Councils before Government approval is sought.

In the Autumn of 1969, the ASR Board appointed a Panel to consider the present programme of the Radio and Space Research Station and to make proposals for the future. The Panel has now completed its work and its report was presented to Council by Dr. Eastwood. He drew attention to the valuable role that the Station has played in providing basic information about radio wave propagation and explained how this should be continued in future years. Particular interest is now centred on short wave propagation where tropospheric influences are paramount. He also outlined the space activities of the Station and the part at present played in support of University space groups. The Council accepted the recommendation of the Panel that the effort on ionospheric radio propagation should be reduced and that the Station should become more active in space science. In this connection RSRS is to be the future home of the Space Research Management Unit, at present located in London Office. Council went on to endorse participation by RSRS in the Italian satellite project, SIRIO. The Station's interest will be to study variations in transmissions from the satellite at short wavelengths. A network of six 12 GHz receiving stations will be constructed to determine the correlation of fading patterns caused by rain and other atmospheric effects.

Amongst the grants approved by Council in July was an award of up to £101,000 to Oxford University to enable Dr. J. T. Houghton to build an experiment to be flown in the NASA satellite Nimbus F. Dr. Houghton and Professor S. D. Smith (Heriot Watt University) have had considerable success with their selective chopper radiometer experiment, launched in Nimbus D, which records temperatures up to about 40 km measuring infra-red emission from CO_2 in the atmosphere. A second experiment is under preparation for Nimbus E which will include new wavelengths in the infra-red. The proposal made by Dr. Houghton for Nimbus F is a new technique using a pressure-modulated radiometer which will extend the temperature soundings up to 80km from the earth's surface.

In recent months the Engineering Board has been looking into the possibility of setting up major University centres in transport research and Council approved grants totalling up to £680,000 for five such centres — at Leeds, where the emphasis will be on transport planning, Newcastle — transport operations, Liverpool — marine transport and Cranfield and Loughborough — transport technology. Government approval for these awards is now being sought. The main interest is in design and formulation of transport systems which will be viable in the economic and social context and an important aspect of the support being given will be the number of young people trained in this new field.

In the Science Board area, the major grant made at the July meeting was up to £88,500 to Sheffield University for work on the reactions of gaseous ions. The research, which is to be carried out by Dr. K. B. Jennings, involves construction of a specialised mass spectrometer. The main objectives are to develop the preliminary work, initiated at Sheffield and Cambridge, on the study of energetics and mechanisms of uni-molecular fragmentations, to investigate the kinetics of metastable transitions and to study the transitional energy dependence of ion-molecule reactions.

Mr. J. F. Hosie, OBE, has been appointed Chairman of the ESRO Administrative and Finance Committee. Mr. Hosie is the Director of Astronomy, Space and Radio (ASR) at London Office and has been one of the UK representatives on the ESRO Council since the organisation was established in 1964. Before the SRC was set up Mr. Hosie was in the office of the Minister for Science, later the Department of Education and Science. Earlier in his career he served in the Indian Civil Service and in the Ministry of Defence before being lent to the War office – in the Quartermaster General and Finance Division. A general account of the many space activities looked after by ASR appeared in *Quest* Vol. 1 no. 1 p. 9.

ESRO, the European Space Research Organisation, was formed to provide for, and to promote, collaboration among European States in space research and technology exclusively for peaceful purposes. Besides the United Kingdom, the member states include Belgium, Denmark, France, the Federal Republic of Germany, Italy, the Netherlands, Spain, Sweden and Switzerland. Austria, Norway and Ireland have observer status.

The Organisation launches sounding rockets, develops satellites, provides certain services such as data acquisition and handling and conducts some applied research. For its rocket launchings the organisation uses its own rocket launching site (ESRange) at Kiruna Sweden, north of the Arctic Circle in Northern Lappland, and also the Italian national range at Salto di Quirra, Sardinia and, more recently, the Woomera range in Australia. The rockets chiefly used are the British *Skylark* and the French *Centaure.* Smaller rockets such as the *Skua* launched for meteorological surveys are not included in the ESRO programme but are used in national campaigns. The latitude of Sardinia (39.6°N) makes it suitable for mid-latitude atmospheric and ionospheric studies and in summer, when the sun is high, it is used for solar studies.

Mr. J. F. Hosie, OBE

ESRange is very close to the centre of the auroral zone, which passes just north of it along the coast of Norway. Many experiments are launched to study the aurora and in particular to relate the brightness of an aurora with the incoming flux of high energy particles. An equally important activity lies in studies of the ionosphere and its relation with magnetic fields. Several rockets have been launched to investigate noctilucent clouds during the northern hemisphere summer when they are seen at high latitudes. The recent use of the Woomera range has been for launching stabilised rockets when recovery of payload is desired.

More ambitious have been the ESRO satellites Iris, HEOS–1, Aurorae and Boreas which were launched by NASA (the US National Aeronautic and Space Administration) in 1968–9. More experiments are being prepared for HEOS–A2, TD–1, ESRO IV for launch in 1971–2 and, still at an early planning stage, COS B, a γ-ray satellite, and GEOS, a geostationary satellite for study of the magnetosphere.

The European Space Technology Centre (ESTEC) at Noordwijk, Netherlands is operated by ESRO for the study and development of spacecraft and payloads for sounding rockets and for applied research work on space technology. At Darmstadt in the Federal Republic of Germany, there is a Space Operations Centre (ESOC) which looks after the provision of rocket launching facilities, the control in orbit and tracking of satellites, and data collection and processing.

The Space Research Institute (ESRIN) at Frascati, Italy, carries out laboratory and theoretical research in the basic physical and chemical aspects of space phenomena.

ESRO experiments come from space research teams at the universities research institutes of the Member States who develop experiments, prepare payloads and process data, generally in their own laboratories. In this country there are some 12–15 university groups engaged on scientific space research of which the largest is the Mullard Space Science Laboratory at University College London (a description of the MSSL's work appeared in *Quest* Vol. 1 No. 3 page 2). SRC establishments are also involved, particularly the Radio and Space Research Station, which also operates three tracking stations, the Astrophysics Research Unit at Culham and the Royal Observatory, Edinburgh.

The experiments proposed by the universities and research groups are assessed by one of ESRO's six scientific *ad hoc* groups and, if recommended, are combined into the payloads for selected rockets or satellites. At the same time ESRO carries out a technical feasibility study and estimates the cost. The Launching Programmes Advisory Committee (LPAC) then makes a selection on scientific grounds of the payloads that can be accommodated within the framework of the budget.

The Administrative and Finance Committee (AFC) is responsible, under the ESRO Convention, for advising the ESRO Council on all administrative and financial matters. In particular it screens the Secretariat's proposals for annual budgets and future level of resources, considers all questions of international co-operation and decides all contract matters above the level to which the Director General has delegated authority.

In the years since ESRO came into being in 1964, most of the Member States have become more interested in space applications, and their wish to switch resources from scientific space research led to difficulties. At the ESRO Council meeting in July 1971 the scientific programme was reviewed and it was decided that after 1973 the sounding rocket programme would be discontinued and the scientific satellite programme restricted, while ESRO could expand its activities into other areas of space technology. Although the rocket work described in this account will not long be continued as part of the ESRO programme, the facilities will no doubt continue to be used for national research programmes.

the cavendish laboratory in the thirties

Joy Clarke

A scientific visitor from abroad coming to the Cavendish in the early thirties, to explore that Mecca for physicists from all over the world, would have experienced the surprise of his life when directed to the Laboratory down a back street in the middle of Cambridge. He would have walked down Free School Lane, a narrow passage behind Corpus Christi College, and he could well have imagined that he had come to the Victorian Free School itself – a sombre brick building, entered by a dark archway, and bordered by a concrete path. The labs and lecture rooms were primitive and inconvenient and in the courtyard were a number of temporary buildings. These housed various specialised projects such as Cockcroft and Walton's High Voltage Laboratory, the Crystallography Department, and, in 1934, Kapitza's Mond Laboratory for work on powerful magnetic fields at very low temperatures. The Mond was by contrast a very modern building with a round white brick turret decorated in low relief with a seven foot sculpture of a *crocodile* by Eric Gill – which I will come back to later.

The spirit of the Cavendish in those days was not in its brick and mortar, but in the scientific men who inhabited its dark passages and labs. At their head was Sir Ernest Rutherford, OM, PRS – in fact it could be said that Rutherford *was* the Cavendish. He had in 1919, inherited a great tradition from Sir J. J. Thomson OM, FRS under whose reign, someone commented, there was more physics to the square centimetre in the Cavendish than anywhere else in the world – partly due to the fact that facilities for ten or twelve researchers in 1903 had to make do for twenty-five in 1918. In the thirties Rutherford was at the peak of his influence on atomic physics and so international was the reputation of his team – his 'young men' as he called them – that to be accepted for research was to join an élite who have since made their mark in most of the Universities of the world.

Laboratory facilities in those days were very limited, and the major discoveries were made with equipment that seems laughable by modern standards. Cockcroft has said that the tradition of the Cavendish was to look very carefully before spending £50 on equipment and never to spend more than £100. But in the early thirties Cockcroft and Walton were allowed the unheard-of sum of £500 for apparatus for their High Voltage lab, and in 1932 announced their sensational breakthrough in artificial transmutation. Almost at the same time Chadwick

The Cavendish Laboratory

The Mond Crocodile

published an equally momentous paper on the discovery of the neutron. The staid Cavendish buildings were inundated with newspaper reporters who produced sensational headlines in the Press on Atom Splitting, little knowing how near the truth they were when they spoke of the end of the world being possible.

At the same time other researches, less eye-catching, but all bearing on the same problems were being done, with Rutherford at the head of his team. He co-ordinated their efforts with unflagging enthusiasm and had an instinctive skill in selecting both the men and the researches they were to pursue.

What of Rutherford the man? He was one of the truly great men of his era, large in frame, big in ideas, jovial, extrovert, and with the genius of seeing straight to the core of a problem. At home, his early background on his father's small farm in New Zealand gave him a liking for outdoor pursuits. He was a keen if somewhat erratic golfer, and played with a famous circle of Trinity Fellows, often five of them in a three-ball match, and the story is that their unevenness in skill was balanced by allowing the weaker party to say 'Boo!' loudly and suddenly on a certain number of occasions when the better players were making a stroke!

One of his greatest pleasures was his country cottage retreat at Upper Chute near Andover. Here he was the real countryman: he and Lady Rutherford created from field and woodland a garden which was a constant joy to both, where Lord Rutherford was able to use his abundant energy in chopping down trees and reducing them to firewood with axe and cross-cut saw. They were very hospitable and enjoyed entertaining guests for simple week-ends. Lord Rutherford had a great gift with children and would kneel down on the floor to be on the same level as a small grandchild to discuss toys or some other childish matter – this was typical of his approach to people.

In the Cavendish, Rutherford cultivated a similar informality, though inspiring a certain awe with his booming voice and direct talk. It was above all a happy place, with an atmosphere of infectious enthusiasm which radiated down to the humblest lab boy. Every member of his staff was a person to Rutherford and he was approachable by all. His humanity was above race, politics and language and he believed implicitly in the internationality of science: he was directly instrumental in helping the displaced scientists from Nazi or other régimes to find positions in universities in the United Kingdom and elsewhere, and the Cavendish always contained a large percentage of men from abroad.

A case in point was Rutherford's backing of Kapitza, who originally came from Petrograd Polytechnical Institute, and for whom he moved heaven and earth to get valuable laboratory equipment sent out to Russia when Kapitza (who had been there on a visit) was compelled by Stalin to stay in the USSR. His laboratory remains, decorated by Kapitza's wish, with the crocodile mentioned earlier. The story was that in Russia the crocodile is admired as a creature who never turns back; this, and the name of the Russian humorous magazine 'Krokodil' (a kind of 'Punch') made Kapitza affectionately symbolize the Great Man himself in this way. What more suitable decoration could there be to grace his splendid new Mond Laboratory than Eric Gill's rampant crocodile which still stands to remind the visitor to the Cavendish that its most eminent professor had a sense of humour which he could share with one of his brilliant 'young men'.

The old nucleus of the Cavendish Laboratory still remains in Free School Lane: modern laboratories have grown up alongside, but it is still possible to see the building in which so much was initiated by Rutherford to change the face of the world, and to provide the possibility of peaceful uses of atomic energy for the service of mankind.

l to r Dr. E. S. Walton, Lord Rutherford and J. D. Cockcroft at the Cavendish Laboratory in May 1932.
Central Press Photo.

BIOGRAPHICAL NOTES

The article on the Cavendish Laboratory was contributed to mark the centenary of the birth on 30 August 1871 of Ernest Rutherford, later to become President of the Royal Society, first Baron Rutherford of Nelson and the holder of many other honours conferred in recognition of his discoveries in nuclear physics.

The writer Mrs. Joy Clarke (née Stebbing) was private secretary to Lord Rutherford for six years in the early thirties during her employment at the Cavendish Laboratory, having started off as secretary to Dr. Cockcroft and Professor Kapitza. Mrs. Clarke left the Laboratory on her marriage and it was her brother Mr. John Stebbing, employed at UKAEA Culham, who asked if she would contribute her article to 'Quest'.

Rutherford became Director of the Cavendish Laboratory in 1919 as successor to Sir J. J. Thomson, OM FRS who had laid the foundations for the work that made the Laboratory famous. Between 1895 and Thomson's retirement the Cavendish had produced three Nobel prize winners, twenty-two Fellows of the Royal Society and more than fifty university professors of physics.

From 1895–98 Rutherford had worked under Thomson and they produced together a paper on conductivity produced in air by the (then) newly discovered x-rays. From 1898–1907 Rutherford was MacDonald Professor of Physics at McGill University, Montreal and from 1907–19 he was Langworthy Professor and Director of the Physics Laboratories at Manchester University (the post held by Sir Brian Flowers, FRS since 1961).

Rutherford became a Fellow of the Royal Society in 1903 (at 32), President from 1925–30, received the Nobel prize for Chemistry in 1908, was knighted in 1914, awarded the Order of Merit in 1921 and was raised to the peerage in 1931, as first Baron Rutherford of Nelson (after his birthplace in New Zealand).

Like Thomson, Rutherford was a most successful team leader. Assisted by H. Geiger and E. Marsden he formed his nuclear theory of the atom. In his later years at the Cavendish (he died in 1937) the most important discoveries were made by his co-workers. Among them were James Chadwick (who discovered the neutron) and John Cockcroft who worked first with P. Kapitza and later with E. T. S. Walton, with whom he achieved the artificial splitting of the nucleus, created the Cockcroft-Walton type particle accelerator and gained the Nobel prize for Physics in 1951.

Cockcroft afterwards became a leading figure in the UKAEA and in the use of atomic power and Chadwick set up the nuclear physics research centre at the University of Liverpool. Kapitza was Director of the Mond Laboratory from 1930–34. Back in Russia he became Director of the Institute of Physics Problems, USSR Academy of Sciences and this year he spoke about Rutherford at the History of Science Congress held in Moscow. A special session was devoted to the centenary of Rutherford's birth.

council members

Two new Council members have been appointed from October 1 1971. They are:

Professor H. Elliott	Professor of Physics at Imperial College of Science and Technology, London
Professor R. Mason	Professor of Chemistry, School of Molecular Sciences, University of Sussex

The retiring members were Professor Sir Ronald Nyholm, FRS and Professor P. A. Sheppard, CBE, FRS.

Except for the Chairman and Secretary, who hold full-time appointments, the members of the Council are appointed on a part-time basis, usually for a term of three to four years. The names and full time appointments of the existing Council members are:

Professor Sir Brian Flowers, FRS	Chairman Science Research Council
Dr. A. H. Chilver	Vice Chancellor, Cranfield Institute of Technology
Dr. D. S. Davies	General Manager Research and Development, ICI Ltd.
Dr. E. Eastwood, CBE, FRS	Director of Research, GEC Ltd.
Professor H. Ford, FRS	Head of Mechanical Engineering Department, Imperial College of Science and Technology. Group Technical Director, Davy-Ashmore Ltd. *(For other appointments see Quest October 1969 p. 6)*
Professor J. C. Gunn	Cargill Professor of Natural Philosophy, University of Glasgow.
Professor F. Hoyle, FRS	Plumian Professor of Astronomy and Experimental Philosophy and Director of the Institute of Theoretical Astronomy, University of Cambridge. Also Vice President of the Royal Society and President of the Royal Astronomical Society *(For other appointments see Quest April 1971 p. 20)*
Professor H. L. Kornberg, FRS	Professor of Biochemistry, University of Leicester *(For other appointments see Quest October 1969 p. 6)*
Professor P. T. Matthews, FRS	Professor of Theoretical Physics and Head of the Physics Department, Imperial College of Science and Technology.
Dr. J. W. Menter, FRS	Director, Research and Development, Tube Investments Ltd.
Professor E. W. J. Mitchell	Professor of Physical Properties of Materials, University of Reading
D. L. Nicolson	Chairman, BTR Leyland Industries Ltd.
Dr. E. J. Richards, OBE	Vice-Chancellor, Loughborough University of Technology
Professor M. M. Swann, FRS	Principal and Vice-Chancellor, University of Edinburgh
Dr. W. L. Francis, CBE	Secretary, Science Research Council

sports day 1971

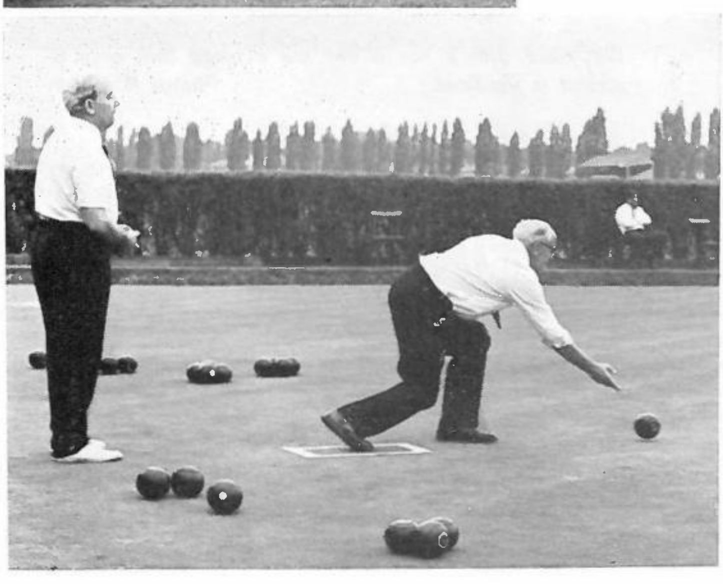
Photos by Peter Hicks (PH) RSRS and Quest.

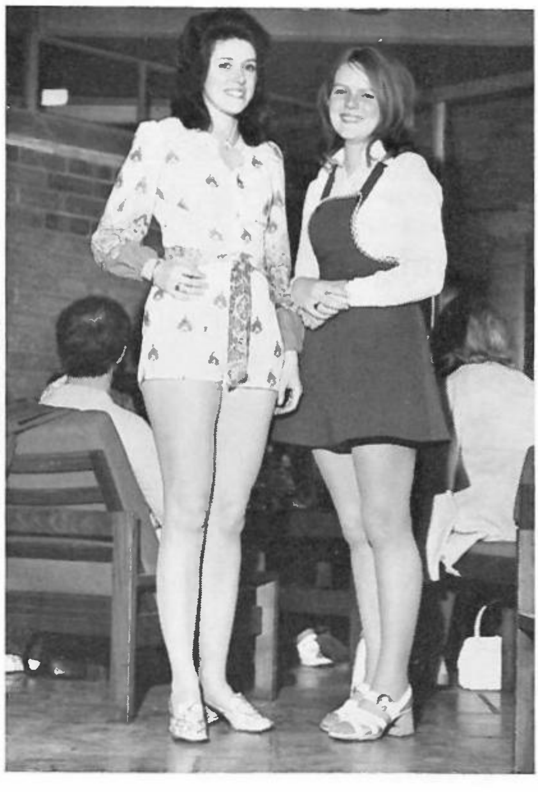
Sports Day 1971 was better than ever. More people came and more stayed longer so the SRC Sports Association who organised it must feel well rewarded for their efforts. Dr. F. Horner, RSRS, is Chairman of the Sports Association, W. Nicholson, RGO, is Vice-Chairman, H. Cook, LO, is Treasurer and Yvonne Taylor, LO, is Secretary.
With members from all establishments they arranged a very full day. Bowls, chess, cricket, football, netball and tennis were all fitted in. The players gave of their best and then threw themselves into full swing again for a party that ended only when the last coaches had to leave at 11 p.m.

the chess players

Top Eric Bramley, RSRS, the winner of the chess competition who is also Bucks County Champion.
Above left Brian Ferry, DNPL, who played a large part in providing clocks and chessmen so that all the games in each round could be played at the same time.

Lady Flowers kindly came along to present the prizes and pictures above show that it was a happy occasion.
Above left Dorothy Hobden and Dr. G. A. Wilkins, RGO, receive the Mixed Doubles Tennis Cup. The Men's Doubles was won by A. Roberts and A. Gordon-Smith of RSRS.
Above right, the winners of the Bowls Team Shield – Bill Rouse, Dicky Blunt, Eddie Gray and Ron Hogan from RHEL. The Pairs Cup was won by Cyril Richardson and Roy Price, also of RHEL, who beat the DNPL pair by 4 shots.
Left, two moments in the bowls tournament.
Below right, two for the party. *Photos P. Hicks*





Cosmos for the Cup

It appears that there is no truth in the rumour that one of the Observatories fielded a side of six white dwarfs. However, the day being very hot, many of the football teams were seen to contain a number of red giants.

netball

Above the Atlas Netball team who won all their games and the cup.
l to r (back row) Judy Wilson, Nora Rowland, Elizabeth Ellaway, Julie Bryant and Gill Weedon.
(front row) Anna Thompson, Ann Walter, Lorna Claringbold and Judy Herring.

Above Rutherford 'C' Six-a-side Football team who beat Edinburgh Observatory in the final to retain the cup they won last year. Bissell, Shand and Taylor scored the goals.
l to r (back row) John Whittaker, Leslie Patton, Nigel Henderson, Jim Taylor, John Carr and Gordon Howard.
(front row) John Mackerness, Jeff Bissell and Gavin Shand.
We make that 9 not 6 but are assured that only 6 played in the final. *Photos P. Hicks*

football

the cricketers

HOWZAT!

Above an Atlas batsman caught out by Mike John RSRS (wicket keeper) with John Halley (r) fielding. Photo P. Hicks

Below the Rutherford Cricket Team who won the Cup.
l to r (back row) Ray Smith, Mike Watson, Roger Wolfenden, Steve Hancock, Tudor Morgan and Dave Price.
(front row) Brian Goodenough, Martin Donald, Peter Craske (with the cup), Bob Blowfield and Harry Jarvis. Photo PH.

Above spectators at an exciting moment in the cricket final between RHEL and RGO.
In foreground, l to r, Ray Edmonds (former Sports Assoc, Chairman, now seconded to DES), Mrs. Edmonds, and Mrs. Saxton (wife of Dr. Saxton, RSRS).
Behind them, waiting to bat, Brian Goodenough and (in cap) Ray Smith of RHEL whose team beat RGO by 7 runs to win the cup.
In the semi-finals RGO beat DNPL, who won the cup last year, and RHEL beat RSRS. Quest photo.

special merit

Four of the Council's research staff have this year gained special merit promotion in recognition of outstanding individual work. They were among thirty throughout Government and public service establishments who were selected by a special panel set up to review scientists who are engaged on research of very high calibre. The promotions are at Deputy Chief Scientific Officer level, equivalent to university professor or reader. They allow the scientist to continue his research without necessarily imposing the extra administrative responsibilities normally associated with the grade.

Dr. A. H. Gabriel, Astrophysics Research Unit
Fundamental contributions to the atomic physics of multiple ionised species and their application to astrophysics is Dr. Gabriel's special achievement and of particular note are his researches into Helium-like systems. These have included the measurement of electron impact cross-sections from the ground level, the classification of groups of satellite lines as inner shell transitions in the Lithium-like state produced by dielectronic recombination of the Helium-like state and the classification of strong lines in the solar x-ray spectrum as the single photon forbidden transition from the meta-stable level and the application of this to the only means of determining electron density in active regions.

Dr. Gabriel is at present a Group Leader with responsibility on the scientific side for the ARU solar programme. The programme is based on the study of the ultraviolet solar spectrum by means of experiments launched in rockets (from Woomera and other ranges). He is also continuing his studies of the Spectra from Laboratory plasmas and is an Honorary Lecturer of the Physics Department of University College London, where he gives courses to post-graduate students on Plasma Spectroscopy.

Dr. B. E. J. Pagel, Royal Greenwich Observatory
Dr. Pagel is distinguished for his work on the abundance of elements in stellar atmospheres. He was a Research Fellow of Sidney Sussex College, Cambridge, and joined the Royal Greenwich Observatory in 1956. He has remained on the staff ever since, but spent six months at Sacramento Peak Observatory, New Mexico in 1960 and nine months at the Mount Stromlo Observatory in Canberra, Australia, in 1963. During most of this time Dr. Pagel has devoted himself to the analysis of stellar spectra – in the last few years these have been taken with the Isaac Newton Telescopes. He has also been an active supporter of the Astronomy Department of the University of Sussex since it opened in the 1960's and is a Visiting Professor. He is married with three children and lives at Ringmer, Sussex.

Dr. P. F. Smith, Rutherford High Energy Laboratory
Dr. Smith heads a research team engaged on the development of super-conducting magnets. His contributions in recent years to the theory of twisted filamentary superconductors and their subsequent experimental verification have resulted in the development of superconducting composities which for the first time are completely stable in operation and also have a low heat dissipation under pulsed operation *(as reported in Quest July 1971 p. 12)*

These new materials have revolutionised the construction of superconducting magnets suitable for high energy proton synchrotrons. Earlier on Dr. Smith was responsible for the first feasibility studies of superconducting synchrotrons, and for devising a new type of synchrotron power supply using superconducting energy storage.

Although the work recognised in his special promotion relates to a specific area of technology, this is a means to an end – the primary objective being to advance ways of exploring fundamental physics. Dr. Smith's interests are directed towards any new ideas which may help to remove present practical or theoretical limitations in this field of research.

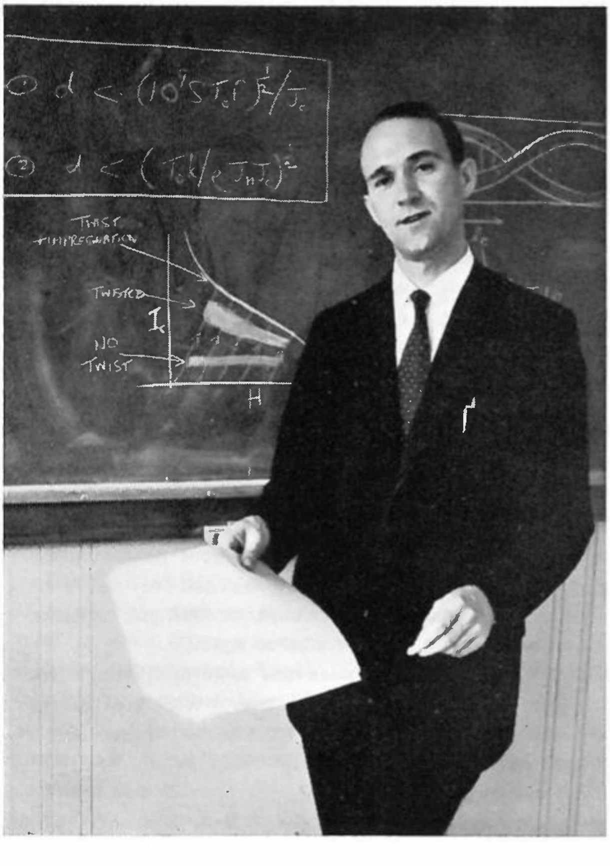
Dr. Smith is 37, married with two daughters and his leisure activities include elementary particle theory, fencing and music (he was at one time musical director for an amateur dramatic society in Oxford). He joined the 'Accelerator Division' of AERE Harwell which has since grown into the Rutherford Laboratory, in 1955.

Mr. N. M. King, Rutherford High Energy Laboratory
Mr. King is a high energy accelerator theorist, currently engaged in the design of a 1000 GeV proton accelerator based on the new superconducting magnet technology. This is conceived as a possible development of the 300 GeV accelerator which has just been approved by CERN Member States. He is the convenor of a small design working group drawn from the three European Laboratories – Karlsruhe, Saclay and Rutherford – who are jointly studying the problems of superconducting synchrotrons.

Marshall King, Rutherford High Energy Laboratory.

Dr. A. H. Gabriel (ARU).

Dr. P. F. Smith, RHEL, Rutherford High Energy Laboratory.



Professor Bernard Pagel (RGO).

Photo by E. A. Meyer, Lewes, Sussex.

Q column by 'observer'

Sports of all sorts in the last few months. The pictures that passed the Censor are in the centre pages, the rest are now on tour to all establishments (or available we suppose from the usual sources). Copies may be found at Peter Hicks's (RSRS Photographer) or Quest office.

Quest Quarterly Quote

'. . . the 8 Miladies on-line have been operating in the TC Division since 1971. A total output of at least 500,000 measured events is expected.'

CERN Scientific Policy Committee paper.

Happy ones we hope.

All rounders

Congratulations to the Rutherford Laboratory Rounders Team who became champions of their league without conceding a match. They attribute their success to dexterity, agility, holding on to the ball and a good sense of direction – you have to play to understand the subtleties! Where else can you chase a girl round the field legitimately. Congratulations also to the team captain Tony Stevens who bowled a maiden over in each match – and caught a fella by mistake (we hope).

The Christmas Card competition (see opposite page) prompted one of the committee secretaries to send in the following letter. The name of the alleged student is withheld following an official request from the special branch (grants?) committee at Tintagel House who are pursuing their enquiries among associate members of the NUS.

Dear Mr. X

I felt that I must write personally to apologise for the fact that you did not receive a Christmas card from us last year. The fact of the matter is that I had not seen your file before I used it to find out your current address, and I became so engrossed in the correspondence which you have had with the Council that I quite forgot why I had obtained the file in the first place.

The first exchange of letters which caught my attention was the one in which we queried whether Miss A or Miss B was in fact your common-law wife and, if so, whether the relevant liaison had begun during a period in which you had supported yourself by your own earnings. The question of whether the earnings should properly have been attributed to you or to one or both of the ladies was a fascinating point, as was the question of whether time spent as a 'trusty' in a mail-bag shop could qualify as a period of responsible employment in industry. Again, the total number of children of which you claimed paternity was quite outside our normal experience. Your arguments concerning your enforced absences from the University were, I feel, very well put, though I am sure my colleagues were correct in their decision that since you were receiving board and lodging at public expense during these periods your award should be abated. Your contention that the benefits received should be regarded as prizes (i.e. resulting from past achievements and having no direct relationship to future work) undoubtedly caused some consternation here for a while, though. I can understand how it was that from time to time you became a little exasperated at what you felt was our rigid interpretation of regulations but I feel that our general flexibility was demonstrated by our willingness to pay your field work expenses in connexion with your botanical studies in Mexico. Perhaps this is a convenient point at which to deal with your recent query and to say that the sum which the United States authorities have sought from you cannot be regarded as a legitimate cost for SRC to bear. If I may anticipate your next enquiry, we shall be pleased to put your award in abeyance until you can take up your studies again.

In case the opportunity does not occur again, may I wish you 'Merry Christmas' for the next three years?

Yours etc.

Competition result

Competitors were asked to design a Birthday card or Christmas card for SRC-supported students and to supply good reasons that could be offered as an explanation, in keeping with the high tradition of SRC, for having forgotten Christmas.

The results which appear here have been referred to the appropriate Grants and Awards Sub-committee (Chairman S. Nicholas) with our recommendations. A report can reasonably be expected within five to ten years.

HAPPY NEW YEAR DEAR STUDENT

It is regretted that it was not possible to wish you the compliments of the Christmas season. This was due to the fact that the Chairman and Members of the Committee, and such supporting office staff as could be spared from their duties, had chartered a Boeing 707 and gone to Morocco.

May I take this opportunity to say that our funds are rather low, as I am sure that you would like to show your appreciation of our generous support over the last year by a small donation. For instance, did you know that just £550 from every student would bring in a handsome addition to our meagre salaries.

Merry

Christmas

INSIDE:

1. The Council intends that its greetings shall be received by the person whose name appears on the accompanying envelope (hereafter called the Student).
2. The Student will provide the facilities normally required for the achievement of the situation described in the greeting, e.g. accommodation, heat, light, food, alcohol, etc. These are not precisely defined since they may vary with the circumstances of the student.
3. The Council will have no responsibility financial or otherwise for expenditure or liabilities arising from the Students attempt to achieve or his successful described in the greeting.

~~to~~ you

fr(SRC)m us

Here's a card 'spec'ly for you

(A standard form's with it too)

Just complete and send to us

Thus avoid delay and fuss

(a multi-purpose standard personal goodwill card by ϕ).

We're sorry you didn't get your Christmas card, but . . .

The decision to move all the Council's closing dates to October 1 produced an unexpected burden of work in the pre-Christmas period.

The ASR Board argued that the whole exercise was a waste of money, and also queried the accuracy of the astronomical event depicted on the cards.

The O & M Unit calculated that it would be cheaper to send one card to each university with a circulation list attached. Those receiving the card before June 25 should take it as applying to the previous Christmas; those receiving it later to the next one.

The recent pay award which raised a CO's starting salary above the SSO's maximum has caused a certain amount of friction over who should address the envelopes, but it is expected that this problem will be resolved in time for next Christmas.

The punched card system at NPL of which details of students are recorded was declared an ancient monument and immediately demolished by a speculative builder.

The question of whether the card should read 'Happy Christmas' or 'Merry Xmas' was referred to the IDC. The final compromise solution (Happy/Merry/Christmas/Xmas – delete as appropriate) was unfortunately not reached until mid-March.

'F' Division favoured the use of 'Xmas' since it would be cheaper to print, but 'E' Division objected that this would leave too much wasteful white space on the card and argued that 'Christmas' would give better value for money overall. the argument is still proceeding.

The design of the card was produced in good time by Mr. St.n W.ts.n. When he received no adverse comments on it, however, he lost confidence in the result and refused to let it be used.

hotel bomb plot
CRISIS HITS
TOURISTS
HOLIDAY HOTEL
CRASHES
BRITONS PLUNGE
take to the boats

Have you noticed that every year there are more dreadful experiences lying in wait for the unwary traveller who sets off with the idea that a charter to Majorca is no greater risk than taking the Piccadilly to Holborn. Up till now we had dismissed the lot as stories to spin out the silly season, on the level of the one that got away.

Perhaps we are wrong. It may be the stay-at-homes who say it's easy. Perhaps those who go really are the first to scale the rising towers of concrete, to sleep where no one has been able to lie down before, and venture on the seas in ships where human hand forbears to turn the wheel when all-seeing radar is on the bridge.

that boat

Roger Count

We wanted a holiday that we would never forget. Looking through the brochures my wife and I were completely seduced by the bountiful descriptions of heaven on earth. Eventually we decided on a cruise. Who wouldn't after reading:

'Jet away to a glistening white ship: slip away through the sparkling seas of the Adriatic, the Aegean and the Mediterranean; explore Greece and her Islands; see Jugoslavia, Cyprus, the Lebanon and Israel.

'Isn't 1971 your year for this kind of holiday? A holiday of sunshine and bracing salt breezes; of balmy nights at sea; of fascinating days exploring ashore; plus ****'s care on an air-conditioned cruise ship. Join the holidaymaking élite and cruise through azure seas, following ancient trade routes to living history. Enjoy the glamour of shipboard life on starry nights as your floating hotel glides on to the centuries old wonder of tomorrow's port of call. Perhaps it'll be the Island of Rhodes. Perhaps the jet-set life of Beirut; possibly Athens by night. Strike out from Haifa to see Bethlehem or Nazareth; gaze at the Acropolis or Olympia.

AND – do it all on the same holiday with no fuss, no unpacking, no wearying overland journeys. Wherever you go your air-conditioned hotel goes too, waiting at the quay to welcome you aboard as you return, aglow with the magic of an unforgettable day, looking forward to a night of fun at sea as you sail away into the sunset. Ready for this kind of holiday? Of course you are. Who isn't?'

The brochure continues in a similar vein but from now on I would like to offer a translation for other would be members of the 'holidaymaking élite'.

Brochure: 'The cruise ship, TSS ————, is being specially prepared for ****'s 1971 cruising season. She will be fully air-conditioned, has an overall length of 495 feet and a maximum cruising speed of 19 knots.'

Translation: *The TSS 'Floating Just' is at present still not ready for ****'s 197? cruising season. She will be as stuffy as hell and will be too slow to get you where you are supposed to be going on time. (They were right about the length.)*

Brochure: 'Below decks the ship will have (*note the future tense*) an exciting discotheque, well-stocked duty free shop and hairdressing salon. A daily information sheet tells you all about the entertainment and things of interest happening on board.'

Translation: *On board you will have an exciting time trying to locate the non-existent discotheque and hairdressing salon. The duty free shop is so well stocked that you will not be able to get inside for the first three days. At breakfast a daily information sheet is issued telling you about the entertainment and things of interest happening on board; at dinner you will be given a supplement telling you why they didn't take place.*

Brochure: 'As a major plus feature ****'s have insisted that all cabins are air-conditioned and have private shower, WC and wash basin. Every cabin is delightfully decorated and will provide ample clothes space and a full length mirror.'

Translation: *The air-conditioning is not working properly, to ensure that you spend as much time as possible on deck and in the bars. As the ship will list to starboard for the first 4 days of the cruise, those on the port side will only be able to have a 5 minute shower to prevent* *the cabins flooding. Every cabin is decorated and includes a full-length mirror – for midgets!*

Brochure: 'Breakfast is continental but, if preferred, English breakfasts can be ordered for only 20p extra a day. Snacks will be available at the pool bar and in the lounges. In each of the ship's bars, the drinks will be served at duty free prices. The same applies to cigarettes.'

Translation: *An English breakfast costs 22½p a day extra. If the meals on board do not satisfy your appetite you will have to wait until you go ashore before you can get anything more to eat. Alcoholic beverages will be sold at a little above duty free prices but soft drinks will be very expensive. Cigarettes are cheap, but are cheaper at Dubrovnik airport.*

Brochure: 'There'll be a host of on board activities, day and night. Apart from free deck-chairs in which to turn a lazy brown as you watch the foaming wake, you will enjoy deck-tennis, shuffle board, quoits or a dip in the pool. The games room includes table tennis. Every night will feature dancing in the main lounge and in the atmospheric discotheque (*So that's where it was*) Naturally the Social Director will be arranging Fancy Dress Parties and Gala nights to complement the glamour of your first night's Captain's cocktail party.'

Translation: *There'll be a host of on board activities, day and night. Apart . . . . as you watch the undisturbed sea, you WILL enjoy deck-tennis, quoits, a dip in the empty pool, suitcase and passport hunting, finding which bar still has some ice, etc. There is as yet no games room but the table tennis table is to be found in the pool. Naturally, the Social Director . . . . to complement the glamour of your first night's sherry and a crisp with the captain.*

Brochure: 'Each cruise has been carefully planned to ensure you berth at the best possible time to take advantage of the fabulous excursions we have arranged.

Translation: *Because the ship is slower than we thought, you will nearly always arrive late at our chosen ports of call. Don't worry! Jerusalem is well worth a 3 hour coach journey at an average speed of 80 mph!*

In all fairness I must add that ****'s only mistake was to let the ship sail – and I'm glad they made that one. Afterwards they did everything in their power to minimise the inconveniences and, for most of the passengers, they succeeded. The brochure contained much more which was perfectly accurate and I would recommend this type of holiday to anybody. We will certainly not forget it – it was our honeymoon!

guestimates

Would that someone had the power
To enter into Treasury's bower
And from there extract those pathetic inmates
Who decide on the form of our Estimates

From humble guess after careful thought
Multitudinous figures develop and are wrought
Into schedules and folios of figures sublime
Which have little meaning, but waste hours of time

Beware your guesses in Forward Look
For in five years' time you'll be brought to book
To explain in close detail your ridiculous guess
Without any recourse to years or stress

Explain if you dare why your five-year guess
Is today different and not much the less,
Only eighteen months have since gone by
So you may not now claim differently

But this is nought to the comparisons made
Twixt figures today and the last decade
Should they differ by the nearest jot
The vultures swoop on this terrible blot

Each figure you impose on your original guess
Will be rigidly examined to excess
Your original guess will however remain
'Ne'er mind the ball – get on with the game'

Dare not to claim that rising prices
Now change the mode of your guessing vices
You should have known five years ago
Something the Government did not know

The true position must not be declared
To complicate Estimates already aired
Then finally you will get your due
To spend on items not needed – but 'grew'

And when you come to the annual reckoning
Be sure that the hangsman is not beckoning
For if you Outturn what you expect to spend
Any change from your Estimates – portends your end

The inevitable moral about pennies and pounds
Must still be going the Treasury rounds
One day they'll accept the unwelcome fact
That the reverse position would be more exact.

Philis Tine

Quote quiz

'The duties (of the job) are varied and interesting and will provide successful applicants with experience in administrative procedures and the supervision of junior staff which will be invaluable in the development of their future careers.'

A tricky one this – who said it and when?

answer on page 24

Classified Advertisements

Send entries to Editor of Quest SRC. London Office R1521 with your name, address and tel. ext.

GEORGE – please phone training section as soon as possible.

QUEST jokes explained. Confidential service, plain wrapper. BOX 130.

URGENT – would the subscriber to Box 119 pse collect his mail asap. It seems to have died.

Nutcracker No. 5 — logic

The two perfect logicians Tick and Tock were conversing on the telephone.

Tick: I'm trying to remember how old Tack's children are. I know Perkin's the eldest, and Rosemary is older than Sadie. I know Perkin's not 30 yet, and I'm sure I went to Quentin's eleventh birthday party. I even know that Perkin's age times Quentin's equals Rosemary's age times Sadie's. In fact I can remember Sadie's age, but I still can't solve the problem.

Tock: I know Quentin's age, but I can't complete the list either.

Tick: I still can't solve it.

Tock: Neither can I. Would it help if I told you Quentin's age?

Tick: Not necessarily.

Tock: In that case I now know all the ages.

How old are Tack's children?

Hint Write down all the possible combinations of ages. Which ones can be eliminated after each statement?

answer on page 24

Competition

From what we hear, SRC's reputation for original research owes a great deal to the university groups, visiting Research Fellows or odd students who co-operate in our experiments. Competitors are asked to compose a suitable acknowledgement in the form of a thankyou letter, a confidential report or an official complaint.

Please send in your entries by **November 19** to your local correspondent or to the Editor of *Quest* – address as below.

The victor ludorum this year
Kept his cool and played in top
gear
But admitted when pressed
He reported for QUEST
And had only come for the beer

PLAY THE GAME – **TELL ALL** ABOUT YOUR PLACE IN THE SRC TEAM

write it for Quest now

physical metaphysical or farcical

write it or draw it and send it to your local correspondent or to:

The Editor
'Quest'
London Office
(room 1521 ext 255)

SEND COPY by **November 19** for january Quest (featuring Space) and before **February 1** for the april issue (featuring Technology)

SEND NEWS, PICTURES and ODD ITEMS in at any time

training timetable

Brief descriptions and future dates of courses run by the Central Training Section, London Office, are given below. Managers who are considering attendance by their staff can get further information from local or central training officers.

Scheduled dates
(up to June 30, 1972)

Induction Course

for all new staff

The course gives information on the formation and organisation of SRC and its work in the various scientific fields; also on conditions of service and staff associations.

1971
September 27–October 1 at DNPL
December 6–10 at RHEL

1972
February 28–March 3 at RSRS
May 22–26 (place to be arranged)

Course A

for clerical officers with at least 3 years' experience in the grade. (Initially for LO staff only).

The course covers basic statistics, estimates and accounts, basic organisation and methods (O & M), communication and effective writing.

1972
March 20–24 at LO

Course I

for Scientific Officers, Experimental Officers, Assistant Experimental Officers, Executive Officers and equivalent grades, under age 28.

The course looks at the National organisation of research and development and policy, at organisation and methods (O & M), networking for projects, decision analysis, communications, work-team relationships and basic managerial responsibilities.

1971
November 15–19 at LO

Course II

for Senior Scientific Officers, Experimental Officers, Engineers Grade II, Executive Officers and equivalent grades over age 28.

The course explores delegation, motivation, leadership planning and forecasting techniques, staff reporting and interviewing.

1971
October 18–22 at LO

1972
April 17–21 at LO

Course IIa

a follow-up course to II (new experimental course).

The content of the course will be selected by its members.

1971
September 1–2 at Coseners House Abingdon – residential

Course III

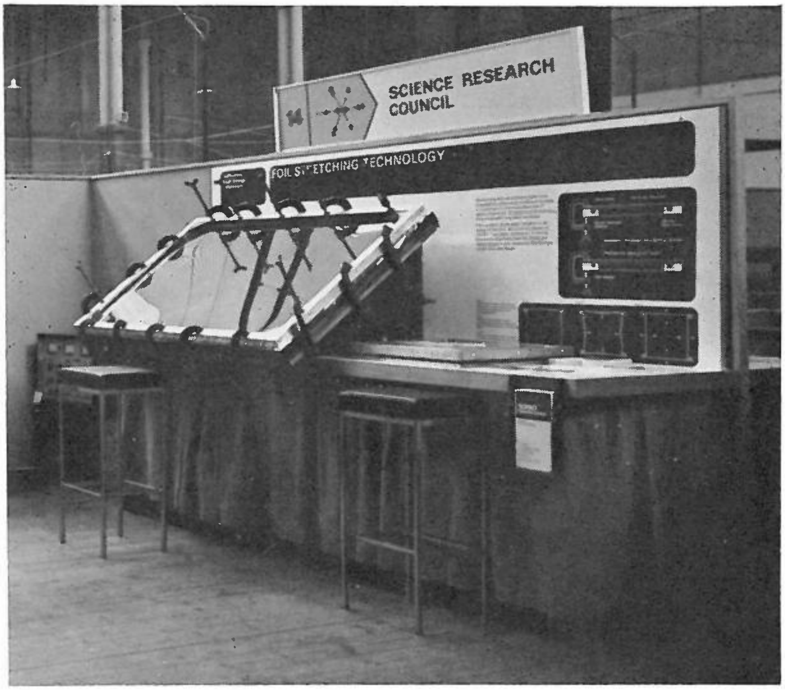
for Senior and Principal Scientific Officers, Senior Experimental Officers, Senior Executive Officers and equivalent grades.

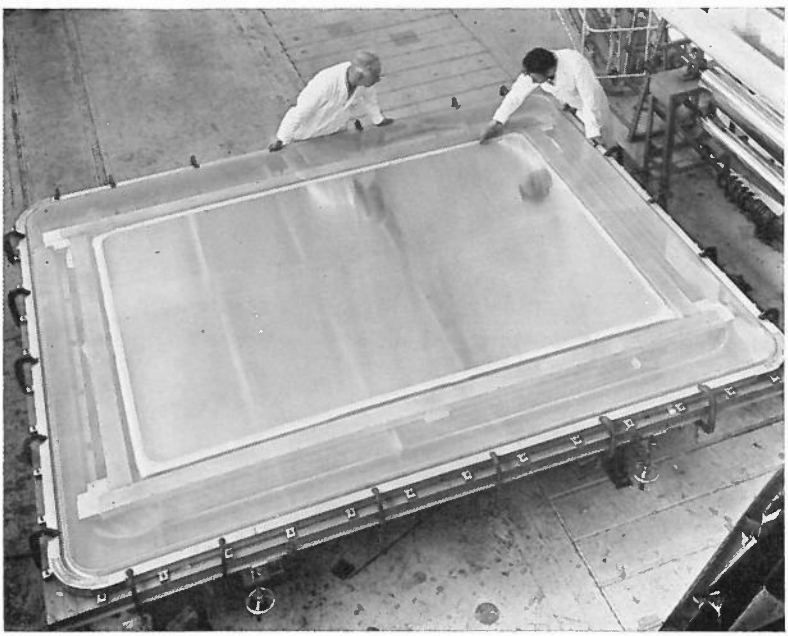
The course wil consider the analytical and sociological approaches to management.

1972
January 24–28
June 26–30
at Coseners House
Abingdon – residential

well stretched

Below, one of the five Rutherford Laboratory exhibits at the 1971 Physics Exhibition. The stands for the exhibits of the five Research Councils were designed and produced by the Central Office of Information on behalf of the Department of Education and Science. Other SRC establishments represented were the Radio and Space Research Station, Daresbury Laboratory and the Astrophysics Research Unit (the exhibits were named in *Quest*, January 1971 p5).





The picture shows the Rutherford Laboratory Foil Stretching Technique. By stretching foil over an inflated rubber tube set in a hollow frame, aluminium foil (0.0005 and 0.001 inches thick) and polyester film (0.001 to 0.005 inches thick) can be made wrinkle free at a pressure of up to 5 pounds per square inch and fitted to a frame in one simple operation. Pressure can be increased to 10–15 psi for very tight foils and the present maximum size of 12 by 8 feet is only limited by the size of foils available.

This relatively cheap but positive and controlled method has been developed at Rutherford Laboratory for the framed foils used as particle detectors in spark chambers. The method is more satisfactory than 'thermal stretching' which requires perfect temperature conditions and is in any case not suitable for polyester films which are very heat sensitive. It is also simpler and cheaper than the 'rising table' method which requires very accurate placing of the foil on the stretching

---

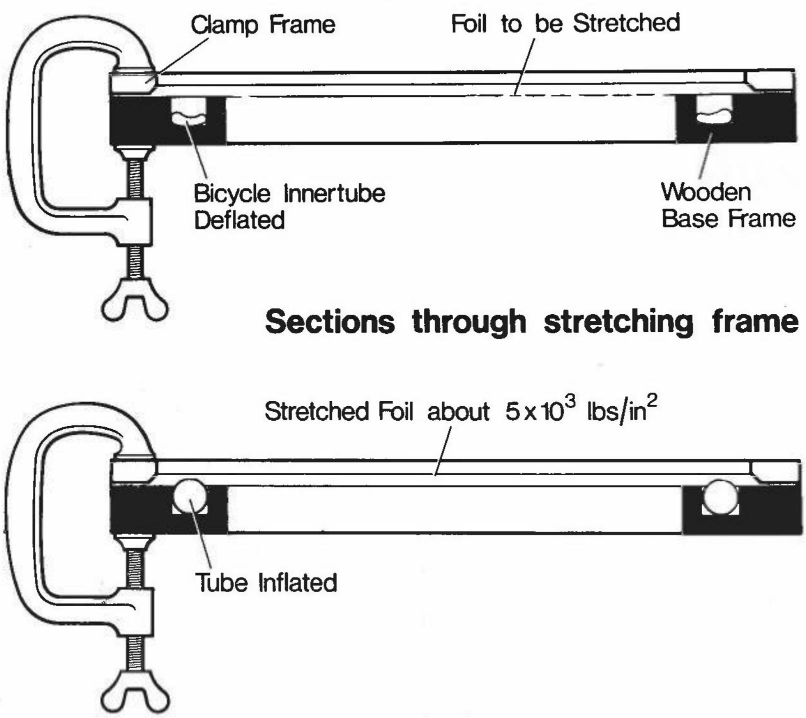
ICA exhibition — unlikely photography

Quest regrets to announce that the exhibition was not held on October 26 as expected (see July issue p. 13). ICA had to postpone it due to financial restrictions but their letter did not arrive until *Quest* was out.

ICA are keeping the material meanwhile and hope to arrange to hold the exhibition within six months of the original date. Anyone who wants to see it should keep in touch with Geoff Gardiner, RSRS, who should be the first to know the new date.

frame and very close tolerances from the machine, which is therefore expensive to construct.

In the new method, the rubber tube takes up discrepancies in the tightness of the foil, as it is inflated. It allows a choice of adhesives since they can be applied to the frame which can then be laid directly on to the foil and, providing the pressure of the tube in the stretching frame is kept constant, left to harden over many hours. The frame to be applied is prestressed to balance the tension in the foil (to avoid distortion) by a simple corner pivot and stressing bolt assembly and side clamps as demonstrated in the diagrams on right.



Sections through stretching frame

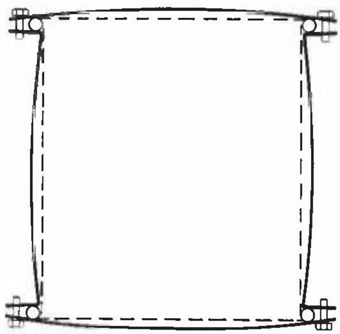


Fig. 1

The frame is distorted about the built-in pivot points at the corners by tightening the stressing bolts.

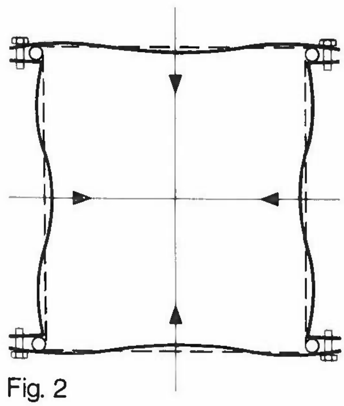


Fig. 2

Clamps are placed on the frames and opposite sides are pulled back as shown by the tie bars.

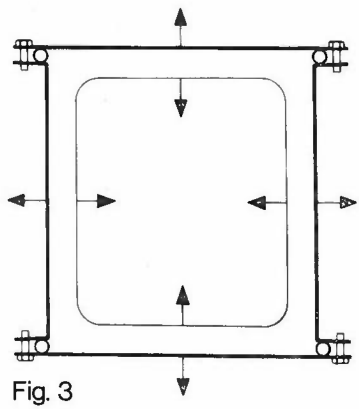


Fig. 3

The pre-stretched foil is stuck to the pre-stressed frame. The tension resulting from the frame members attempting to return to their normal state balances the tension in the stretched foil.

mark VA

A design for a new radio telescope with an aperture of 375 feet has been commissioned by the Science Research Council at a cost of some £250K. Two preliminary design studies begun in 1967 will now be carried a stage further and in a year's time tenders for construction of the major components will be considered.

The specification is for a telescope with a solid membrane across the aperture, to give accurate reception of wavelengths down to a few centimetres that can be operated by remote control from the Nuffield Radio Astronomy Laboratory of Manchester University, Jodrell Bank (Director Sir Bernard Lovell, FRS). The site proposed for the new telescope (the Mark V A) is Meifod in Montgomeryshire, Wales, so that together with the Jodrell Bank Mark I (250 foot) telescope (extensively modified and repaired under an SRC grant) it could form an interferometer with a base-line fifty miles long.

newsfront

welcome to atlas

families day

About 250 people attended an informal Families Day held in the Laboratory on Saturday 4 September. They had plenty to see – our new Computer Block, Atlas S 2 and SD 4020 operational on normal work, the PDP 15 being run up after its recent move, 1906A undergoing commissioning trials.

Demonstrations by AERE Fire Brigade of rescue from a car crash, and mouth to mouth resuscitation by Ricky Eaton of the Rutherford Laboratory Safety Section attracted many people, so did the SRC film 'Insight'. At the end of their tours everybody appreciated the refreshments prepared and served by Gillian Keats, Trude Trewin, Joan Markham and Synolda Butler.

Thank you Robbie and all the 'Adminers' for a very successful day.

animation

Animation at Atlas

On July 30, the Atlas Computer Laboratory held a one-day symposium on computer animation. The Laboratory's interest in the subject stems from the use of its SD 4020 microfilm recorder in the production of research and educational films. Probably the largest user is the Open University and John Richmond of the BBC gave an interesting talk showing how computer animation relates to the rest of the TV programme. He showed a number of excerpts from the Foundation course in Mathematics which has been screened this year.

Films were given by Jon Ogborn of the Nuffield Foundation's Science Teaching Project and Professor Judah Schwartz of the Massachusetts Institute of Technology. Professor Schwartz spent the summer at the Laboratory and showed a number of the films he had made to demonstrate electric fields of moving charges. These have an artistic beauty independent of the content of the film. This also applies to the work of Professor Roger Hockney of Reading University who stimulated the evolution of galaxies of 50,000 stars – on a severely contracted time scale!

The symposium was held in the Rutherford Laboratory Lecture Theatre from 10.30 am to 8.00 pm. It was attended by about 150 people and a repeat of the film portion drew over 100 people the following week. The Symposium received, on the whole, favourable press reviews. Here are two of them:

'It was also one of the best organised meetings that has been attended recently running very close to the scheduled timing and with a standard of presentation of a very high order – for once the visual aids were well handled, part of the proceedings and not a makeshift addendum to them. One might well add "Others please copy" . . .'

Film User Sept 1971.

'The subject of computer animation flared into prominence in the last fortnight when a one-day symposium was held by the Science Research Council at the Atlas Computer Laboratory in Didcot. This seems to be the spiritual home of the craft in Britain . . .'

Financial Times 10 August 1971.

answers

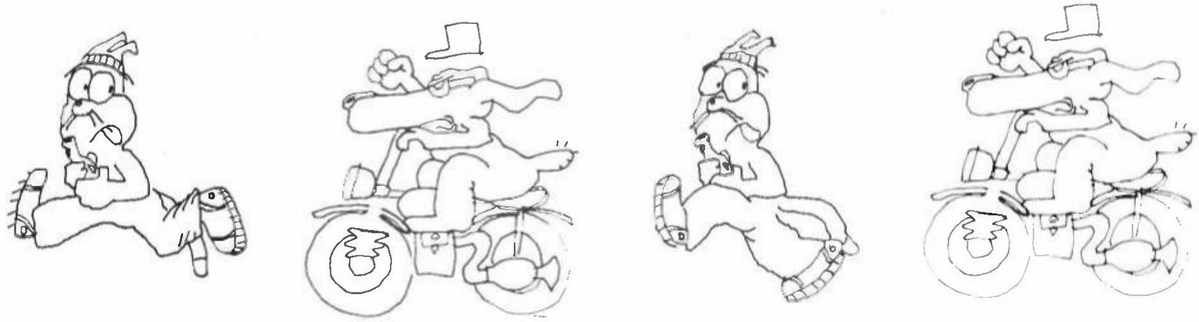
— see page 20 before you look at these.

Solution to 'logic'

Perkin is 28, Quentin 11, Rosemary 22, and Sadie 14.

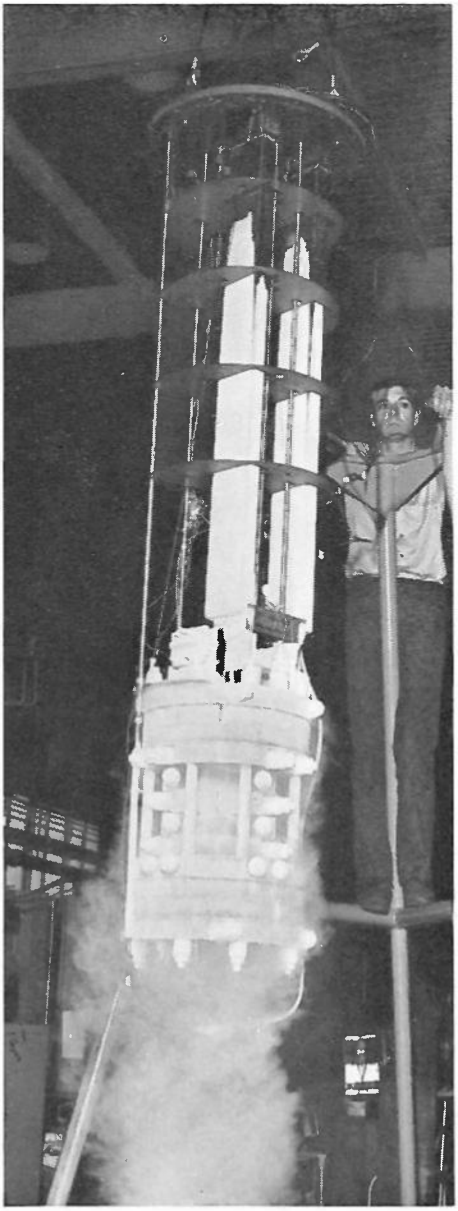
Answer to quote quiz

Extract from an SRC advertisement for Executive Officers for LO published early in 1966.



atlas aids BBC

In July the Atlas Laboratory was approached by the BBC's Tomorrow's World programme for help in producing a sequence on Computers and the Animation Industry. The aim was to show how a computer could be used to aid the professional animator in the design stage of his work. The Laboratory's facilities were used to show how a D-MAC pencil follower could be used to input the key frames in an animation sequence. Sample timing of the animation was done using the display on the Laboratory's PDP 15 and final pieces of film were produced using the SD 4020 microfilm recorder (see Quest Oct 1970 p. 6 for technical details). The operators certainly enjoyed seeing bloodhounds and cats coming out on the film in place of the more conventional scientific plots. The programme was televised in September.



milestone

picture shows the AC 3 magnet, still cold, being lifted out of its cryostat – low temperature enclosure – after the first test run. Up aloft is John Brown, a member of the experimental team.

Successful tests have been carried out at Rutherford Laboratory on the pulsed superconducting dipole magnet known as AC3. We believe this is the first pulsed dipole which has an aperture, field and operating current comparable to the requirements of a high energy superconducting synchrotron – such as the CERN 300 GeV machine converted to 1000 GeV or an uprated Nimrod. Developments along similar lines are well under way at most of the big accelerator Laboratories.

AC3 is capable of cyling continuously with rise times as short as 1–2 sec and is designed to produce a magnetic field of about 40 KG in a 10 cm bore, or (with an additional insert now under construction) about 45 KG in an 8cm bore. In the first tests AC3 was pulsed at about 90% of its 5400A critical current, with rise times down to 1 second. The measured ac loss was approximately 10 watts at a 4 sec cycle time – close to the predicted value for the conductor used. The magnet was quenched many times, without affecting its performance. Some 'training' was observed – a characteristic feature of the 'running in' period of a pulsed magnet – the maximum central field reached in this cooldown being 38KG (without the assistance of an iron shield which would increase the field by 20–40% in an actual synchrotron).

The successful testing of this latest magnet represents another significant milestone in demonstrating the feasibility of superconducting synchrotrons. Further dipole models AC4 and AC5, are planned for 1972-73. These will incorporate improved types of cable, iron shielding and higher winding precision.

The conductor for AC3 was made from a 1045 filament 0.4mm diameter composite supplied by IMI formed into a 90 strand transposed cable and subsequently compacted to a 5mm square section. The coil was of the 'sector geometry' type, wound in six concentric layers and fully impregnated with epoxy resin. Mats of copper wire, sandwiched between the winding layers, are used to conduct the ac heat out of the coil to the liquid helium.

QUEST

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QUEST

House Journal of the Science Research Council

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Editor

Vol. 5 No. 1
January 1972

contents

'Way up in the air in my beautiful balloon'

Cover picture: *a large helium filled balloon carrying scientific experiments which was flown in August 1971 from New Mexico. The launch is described in* **'Iter ad Astra'** *on page 7. The experiments included a solar spectrograph prepared by Queen's University, Belfast and the Astrophysics Research Unit, Culham.*

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QUEST

To begin our fifth year of publication this issue of *Quest* has a supplement on Space Research carried out in the Science Research Council. As nearly every establishment is mentioned it looks as if most of us get involved in one way or another. Thanks are due to the Astrophysics Research Unit in particular who provided much of the material.

The idea behind the supplement is to bring different aspects together. For the April issue we will be collecting news and pictures of the technology that supports the research programmes and in July the subject will be SRC's present and future projects in Europe. We look forward to receiving contributions from you – in the form of articles, illustrations and suggestions – on the special topics and others.

We sign off with a wish for a prosperous year to everyone in SRC and no less to those who seek our support.

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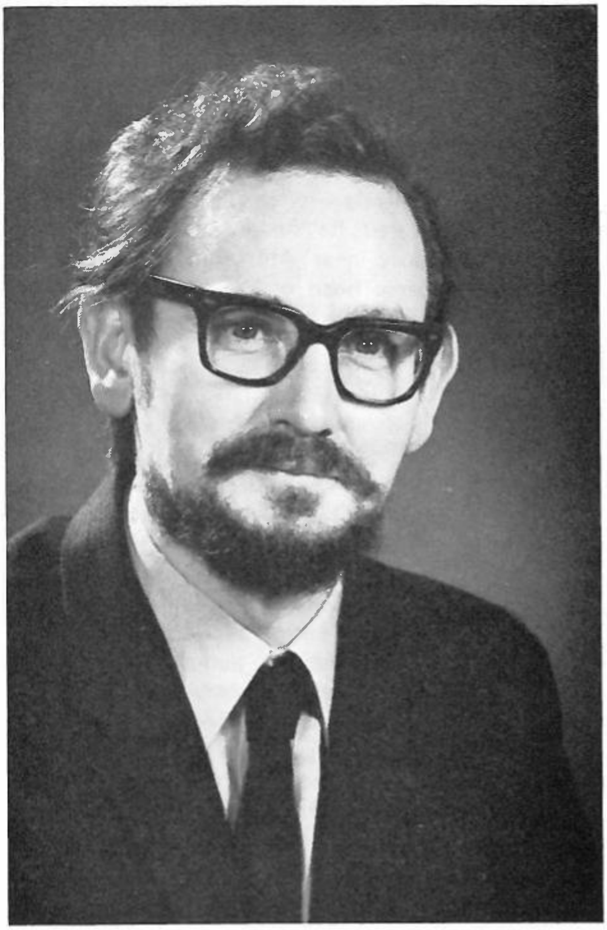
profile



Dr. Robert Wilson

Head of Astrophysics Research Unit

Since this issue of *Quest* is especially concerned with Space Science, it is appropriate to profile Dr. Wilson who heads the Astrophysics Research Unit of the Science Research Council. Although the ARU is the smallest and most recently formed of the SRC laboratories, it has already achieved an international reputation for its work in the field of space and laboratory astrophysics. Dr. Wilson's own scientific interests are directly reflected by this work which is aimed at understanding the physics of the sun and other stars and also the interstellar medium. This is done by using two complementary techniques: direct observations from space vehicles and laboratory measurements on high temperature ionised gas (plasma), which can simulate astrophysical conditions.

Coming originally from Northumberland, Bob Wilson graduated in physics at Newcastle University and then moved to Scotland to carry out post-graduate research work in astrophysics at the Royal Observatory, Edinburgh. Soon after his arrival in Edinburgh, a remarkable natural phenomenon occurred. One afternoon, the sun appeared to be coloured a deep blue and during that night a proverbial 'blue moon' was seen. Some rapid work with the ROE 36 inch Cassegrain telescope produced spectroscopic observations of the very unusual 'blue sun' phenomenon and these led to his first scientific publication. He showed that the blue colour of the sun was caused by selective scattering of the sunlight by small particles in the atmosphere; the particles had come from the smoke of forest fires burning in Canada several days before!

The research topic which occupied most of his time at the Royal Observatory concerned the nature of several diffuse absorption lines which are produced in stellar spectra by some component of the interstellar medium. This presented similar problems to the 'blue sun' investigation since both involve the theory of light scattering by small particles. While working at the ROE, he was awarded a PhD degree by the University of Edinburgh for astrophysics research and he also met his future wife, Eileen.

In 1957 he was granted leave to take a Canadian National Research Council Fellowship which gave him the chance to work at the Dominion Astrophysical Observatory in Victoria, near Vancouver in British Columbia, Canada. While at Victoria, he continued his research on the diffuse interstellar absorp-

profile continued

tion features and showed that they were probably caused by the small solid particles in interstellar space – the same interstellar dust that produces a red colouration in the light from distant stars.

When Dr. Wilson returned to England in 1959, his new appointment meant a change in his scientific interests. He joined the Controlled Thermonuclear Reactions Division at the Atomic Energy Research Establishment, Harwell, and was soon put in charge of the Spectroscopy Group. This group was mainly concerned with measuring the properties of the high temperature ionised gas which was produced in experimental devices used to study the problems of controlling thermonuclear fusion reactions. Although this work was in many ways different from his earlier astrophysical research, the techniques involved – measurement of physical conditions by spectroscopic analysis – were quite similar. In 1960 the UKAEA centred its fusion programme on the Culham Laboratory near Abingdon, Berkshire, and Dr. Wilson became head of the Spectroscopy Division.

the sun seen from a skylark

Having developed several methods for the measurement of very high temperature by studying extreme ultraviolet emission from hot plasma sources, Dr. Wilson and his colleagues became interested in the possibility of using similar techniques to study the high temperature atmosphere of the sun – the solar corona. Using the sun-stabilised *Skylark* rocket as a vehicle to carry spectroscopic instruments above the absorbing layers of the earth's atmosphere, the Culham group first recorded the extreme ultraviolet spectrum of the solar corona in 1964. Since that time, many more rocket payloads have been prepared. Flown at a rate of about two a year they have provided data for an active solar physics investigation.

The astrophysical nature of this work was not directly relevant to the UKAEA fusion programme but it was closely related to the work of the SRC Astronomy, Space and Radio Board. Consequently, the astrophysics research work was transferred from the UKAEA to the SRC and by 1969 most of the staff in the Culham Spectroscopy Division had been transferred to SRC to form the new Astrophysics Research Unit at Culham. As head of this new unit, Dr. Wilson has extended the original solar physics programme and it now includes further studies in ultraviolet astronomy and laboratory astrophysics.

In addition to his work in astrophysics research and in the management of the ARU, Dr. Wilson has played an active part in more general SRC management as a member of the Space Policy and Grants Committee and of the Astrophysics Policy and Grants Committee of the ASR Board. He was also the first chairman of the SRC Panel on Instrumentation for Large Optical Telescopes (PILOT) and a member of the committee set up by SRC to review the future programme of astronomy in the southern hemisphere.

studies in ultra-violet

Since 1964 Dr. Wilson has been concerned with several proposals for observatory-type satellites designed to make astronomical observations at ultraviolet wavelengths. He was responsible for the scientific aspects of two detailed design studies – the Large Astronomical Satellite (LAS) and the Ultraviolet Astronomical Satellite (UVAS) – which were carried out for ESRO, the European Space Research Organisation. The UVAS proposal was examined by NASA in the USA, and they suggested that the proposed UVAS concept could be developed as the main experiment for a new Small Astronomical Satellite designated SAS-D. A UK project team headed by Dr. Wilson is now working on the design of an ultraviolet detector system for SAS-D which has been planned as a collaborative USA-UK satellite experiment in which ESRO will probably be involved. Th UK team working on this experiment includes staff from ARU, RSRS and University College London.

Another ultraviolet satellite experiment, which was initiated by the Royal Observatory, Edinburgh in collaboration with l'Institut d'Astrophysique, Liège, will be launched in 1972 on the ESRO satellite TD 1. This experiment (S-68) has been prepared under the guidance of a SRC project management group which is led by Dr. Wilson and includes teams based at ROE and RHEL, with additional support from the Atlas Computer Laboratory and the ARU – surely a record for collaboration between SRC laboratories.

The ARU has developed active links with several universities and Dr. Wilson holds an honorary post as a Visiting Professor at University College, London. He is a Fellow of the Institute of Physics and a Fellow of the Royal Astronomical Society. He served on the Council of the RAS from 1965 to 1967. An active member of the International Astronomical Union he was elected President, from 1967-1970, of the IAU Commission 44 which is concerned with Space Astronomy.

The many activities outlined above take up a large part of Bob Wilson's life, but whenever possible he spends his leisure at his home in Abingdon with his wife and family – two sons and a daughter – and such leisure moments are all too few.

obituary

Professor Sir Ronald Nyholm FRS

Ron, who had helped us in DSIR or SRC for many years, died in a road accident on 4 December. It seems particularly hard to realise this has happened, because Ron's outstanding feature was life. A delightful, ebullient Australian, bursting with irreverent good humour, he must have given pleasure to everyone who knew him, for one reason or another.

He was certainly a good chemist, with 250 research papers and an FRS to his credit. He set high standards for himself and everyone else. One of his chief enthusiasms in life was chemistry, and it was quite clear that to him this was a subject of unending fascination, enjoyment, and excitement. He was a real leader as head of the Chemistry Department of University College London, where his tremendous urge to see it lively and growing, maintained the international repute which the Department had under his predecessor, Ingold.

But he had energy and enthusiasm for fields much wider than his own Department or College. He was always ready to help the new universities and the ex-CATS to build up their schools of research and teaching to high standards. Only a couple of days before, I met him at the Open University where, as their first external examiner in chemistry, he was excited by the success of this new venture – and incidentally he had three new funny stories.

He was a fervent DSIR/SRC fan, largely I think because he saw how the Research Councils could strengthen the unity of science, as well as helping the outstanding individuals, especially the up and coming ones. He once proposed that SRC should create some 'DSIR Memorial Fellowships' for outstanding young chemists.

And that of course gives the clue to Ron's success. The most important thing in the world to him, more so even than chemistry, were people; his own colleagues, who, like he, had 'arrived'; youngsters, whether able or not; and perhaps most of all, people who needed help. Ron enjoyed himself most of all when helping them or sharing their thoughts and ideas, and their fun. Ron is the sort of person who will always be alive in one's memory.

C Jolliffe

biographical note

Sir Ronald Nyholm FRS, FRIC was born at Broken Hill, New South Wales, in 1917. He went to Sydney University (BSc first class honours) then London (MSc-DSc) and for the rest of his life held appointments both here and at home. In the 1950's he became President of the Royal Society of New South Wales (1954) and a Corresponding Member of the Finnish Chemical Society, a Fellow of the Royal Society and a Fellow of the Royal Australian Chemical Institute. In the 1960's he became a Member of the Science Research Council, President of the Association for Science Education and a Trustee of the British Museum.

Sir Ronald's association with the University of London culminated in his appointment as Head of the Chemistry Department of University College, a post he held since 1963.

£1M A YEAR FOR ATOMS MOLECULES AND PLASMAS ++ BEST DATA YET FROM SKYLARK SPACE PROBE IN SOLAR ULTRA-VIOLET SPECTRUM ++ SYMPOSIUM ON ELECTRON AND PHOTO INTERACT ++ £59,000 HARDWARE FOR MULTI ACCESS COMPUTER SYSTEM ++ BRITISH EXPERIMENT IN ORI ING SOLAR OBSERVATORY ... ++ FIRST LUNAR SAMPLES FOR BRITAIN ARRIVE AT SRC ++

council commentary

FOR CONTROL ENGINEERING RESEARCH ++ ANGLO-AUSTRALIAN TELESCOPE CONSIDERABLE CONTI BUTION TOWARDS SCIENTIFIC DISCOVERY ++ RSRS PARTICIPATES IN UK4 SATELLITE TO MEA INTENSITIES OF ELECTROMAGNETIC RADIATION ++ DEVELOPMENT IN ANALYSIS OF BUBBLE CH BER PHOTOGRAPHS BY SWEEPNIK AIDED BY SRC GRANT OF £40,473 ++ SUCCESSFUL LAUNCH OI

september

As in previous years a weekend meeting was held at the end of September with representatives of the Boards and senior staff from the London Office. This year's meeting was in Edinburgh and participants stayed in Mylne's Court, a 17th century building in the Royal Mile, recently restored and now used as a hall of residence.

The Council discussed several aspects of postgraduate education and training at the Conference and in particular how support should be related to the numbers wishing to undertake postgraduate study and the likely opportunities for employment. This is important at a time when the opportunities for careers in research are decreasing, and there is a greater need for training for non-R and D type employment. As a result of the discussion, Boards have been asked to carry out detailed reviews of the need for postgraduate training in their areas and to advise Council on how these requirements can be met.

Council also discussed whether in future more time should be devoted to keeping under review the consequences of its policies and the activities it supports, both in the scientific and social context.

rewarding thoughts

october

In October the Council prepared the detailed estimates for 1972–73 for submission to the Department of Education and Science. These will be incorporated into the Estimates of Government Expenditure presented to Parliament in March 1972, and subsequently published. The Council's allocation for 1972–73 is close to that requested in the Forward Look submitted in April, but provisional allocations for the two later years are about £400k and £1.8m less than the Forward Look bid; these imply growth rates falling to 2% pa.

The expenditure approved at this meeting included £80,000 for purchase of a special magnet for the NINA electroproduction programme. The present electroproduction facility at the Daresbury Laboratory, which consists of two small solid-angle magnetic spectrometers, has enabled the Laboratory to make a significant contribution in this subject, and the new magnet will improve the data-collecting rate by almost two orders of magnitude. Amongst the grants approved for space experiments, was a supplementary award of £60,000 to University College London for preparation of three x-ray experiments to be flown in NASA satellites. Two of the experiments will be flown in the OSO–J satellite (OSO stands for Orbiting Solar Observatory) and will study point x-ray sources and the diffuse background emission, and one in HEAO–C (High Energy Astronomy Observatory) aimed at increasing angular resolution of x-ray sources.

The Council went on to discuss the staff structure in SRC and, in particular, the recent mergers of staff classes following the report of the Fulton Committee. With the agreement of the Staff Side and the appropriate staff associations, the Council has effected the same mergers as the Civil Service; the administrative executive and clerical classes have become the administration group, and the scientific officer, experimental and scientific assistant classes form the science group. The Council's policy is to continue to work towards a completely unified staff structure, but meanwhile to advance within the framework of the Civil Service arrangements.

november

The Council agreed the financial guidelines that should be given to Boards for preparation of the 1973–78 Forward Look; Boards are required to make their submissions to Council next April so that the Council-wide Forward Look can be submitted to the Department of Education and Science at the end of April. The guidelines given to the Boards, which vary according to the present policy and priorities, are in line with the provisional allocations for the Council for 1973–74 and 1974–75, and assume a 4% pa growth rate for later years.

At the Edinburgh Conference the Council agreed to keep the number of studentships for 1972 at the 1971 level of 3850 and this decision was confirmed at the November meeting. Within the total of 3850, the Council decided on the number of awards to be made for the special schemes (such as CAPS and ASSISTS) and the quotas to Boards. The balance between research and advanced course studentships and between science and engineering was kept the same as for last year.

The Council went on to review the 'Bring-back' Fellowship scheme, which was introduced originally to counteract the 'brain drain' to North America and to benefit British industry by attracting back scientists and engineers who had gained valuable experience of advanced American industries. It is now known that the 'brain-drain' was mainly in engineers whereas the Fellowship scheme has attracted mostly scientists and very few engineers. The flow of Fellows into industry and teaching has been disappointing and the increasing level of unemployment both in the UK and the US throws into question whether the scheme should be continued. The Council decided that the scheme in its present form should be abolished, but agreed that the SRC Higher Value Fellowship scheme should be expanded to ensure that outstanding scientists and engineers could gain experience overseas and bring this experience back to the UK.

We have told how £100 was awarded under the Rutherford Laboratory Suggestions Scheme for an idea which solved a problem and resulted in a financial saving *(Quest, October 1970)*.

For others keen to 'cash in' with their own original ideas, there is now a Suggestions Award Scheme for the whole of the Science Research Council *(see General Notice 58/71)*. The scheme will be run by local committees who will have powers to look at ideas in the light of the benefit to their establishment and to make awards of up to £100.

A central co-ordinating committee at London Office, chaired by the Establishment Officer, with members from local committees, will determine general policy. it will also review suggestions in the light of their possible value to other establishments or to the Council as a whole.

The scheme gives a right of appeal to anyone who has reason to believe that his idea has been turned down without proper consideration of all the relevant factors. He can also re-apply for an award if an idea of his has not been taken up or rewarded and is then adopted, unchanged, within three years from the date he first put it forward.

Whenever possible the awards will be related to the anticipated savings in gross man hours and materials costs only and will be related to 50% of the estimated value of the savings in the first year. Otherwise lump sums will be assessed on criteria which apply in the particular case. Awards will be paid in multiples of £5 and the minimum award will be £5 for ideas of minor but significant value. An award can be made even if the suggestion is not actually put into practice. Putting forward ideas which have merit but are not considered worthy of an award, may gain a mention in one's personal file.

Ideas invited

are those likely to:

promote greater safety and reduce health hazards;

increase efficiency and improve morale;

encourage economy in the use of time and materials;

develop or modify devices or techniques used in SRC or lead to the invention of new ones;

improve or simplify procedures (including office procedures and forms);

lead to new designs of, or improvements to existing tools, machines or equipment; modify or improve layout and use of buildings and services;

Suggestions made will be assessed on their practical value and need not be complex or technical in content to merit the highest awards. They may be related to one's own work but should not be such that one would have been expected to put forward or implement as a normal responsibility of the job.

We hope the Suggestion Awards Scheme will give people an incentive to look at work methods with a new eye and improve ways and means – even if they fail to come up with an award winning suggestion at once.

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SEND COPY by **February 26** for the April issue (featuring Technology) and before **May 1** for the July issue (featuring SRC in Europe)

two way match

How to match the vertical needs of the future with the horizontal activities of the present is the very difficult job of the Research Councils, the Chairman said when he addressed the press conference on the Science Research Council's sixth annual report, for 1970-71.

Mentioning the Dainton report, which was not yet published, he said that the current review of Government organisation of research and development was a matter of great importance. Science was organised in two ways – vertically and horizontally. By vertical organisation he meant the use of science to meet national or major objects such as, say, better health, transport or communications. By horizontal he meant the necessity to look at the whole range of science activity from astronomy to production engineering, from biology to meteorology in a horizontal way, subject by subject. He felt that the most difficult job was to match the horizontal to the vertical: to match academic science to the needs of the nation, bearing in mind that the prime object of academic science was to produce people with the right training and experience to meet vertical needs fifteen years later when they were at the peak of their ability.

In 1970-71, he said, the SRC had spent £51 million in support of basic research and education. About £9½ million was in the form of direct support to universities for research grants (for equipment and staff) and about £6 million was for postgraduate training awards and fellowships.

During the year SRC had accelerated its studies of the organisation of science in other European countries and its preparations for more national cooperation. This would become a major preoccupation for some years if we joined the Common Market.

Also present to address the conference and answer questions were the Chairmen of the four Boards: Professor Ford (Engineering), Dr. Eastwood (Astronomy, Space and Radio), Professor Gunn (Nuclear Physics) and Professor Kornberg (Science). Space activities were represented by Professor Sheppard, a Member of the Council, Chemistry by Professor Lewis of the Chemistry Committee and Physics by Professor Edwards, Chairman of the Physics Committee.

Why SRC is getting together with MRC was enlarged on by Professor Kornberg, taking his own subject, biochemistry, as an example. Professor Ford was asked to say more about the total technology concept. Professor Lewis talked about how one assessed the right numbers of studentships in the field of chemistry and Professor Edwards spoke about the special section of the Report on 'Research in Physics'.

more bytes

A bigger and better Computer just installed at the Rutherford Laboratory will be a great asset to the University and SRC groups who are the main users of the Laboratory's services.

The new computer, an IBM System/360 model 195, is six times as powerful as the model 75 which it replaces and cost about £3M. The Laboratory's Computer and Automation Division (under W. Walkinshaw) are particularly proud of the fact that they had it installed, accepted and working on-line in only fifteen days.

The central processor of the model 195 has a capacity of 2 megabytes, and is supported by a block multiplexor and a fast access fixed head file. Early this year the installation will be fitted with a disk store of 800 megabytes and high speed tape units. In 1973 it will be converted to a System/370 model 195.

Among the first users of the 195 will be the film analysis groups from Birmingham, Glasgow, Durham and Oxford and theoreticians from most of the university high energy physics groups. Atlas users have not yet been identified but are expected to come mostly from chemistry, plasma physics and astrophysics.

"We started in a small way with one hundred and fifty people and now we employ twenty."

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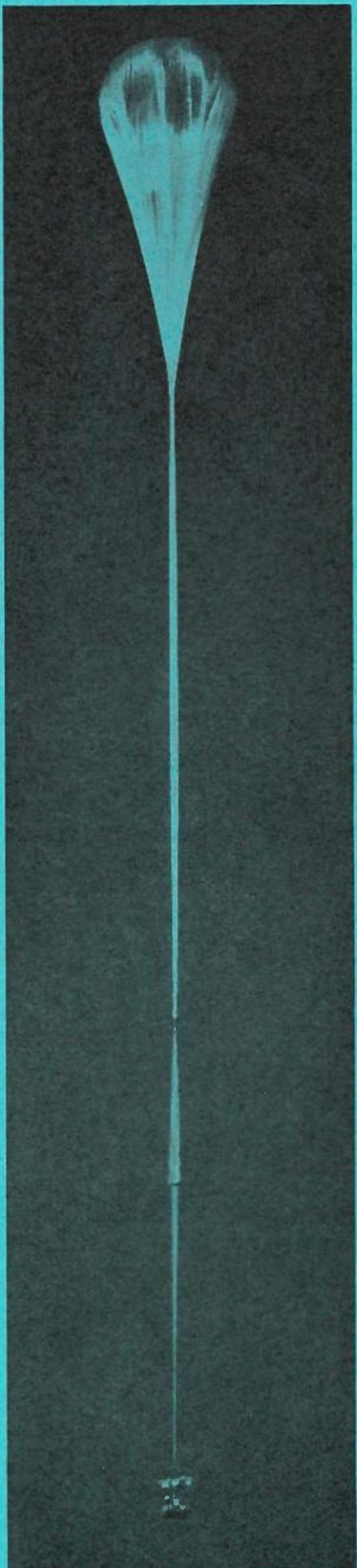


QUEST IN SPACE

Supplement on Space Research in the Science Research Council

1 iter ad astra

solar experiments launched by balloon in New Mexico

G. W. Ackland

'Iter ad astra' (Road to the Stars) is the motto emblazoned on the badge of the High Altitude Balloon Detachment of the United States Air Force stationed at the Holloman Air Force Base, located on the flat plain between the Organ and Sacramento Mountain ranges in New Mexico.

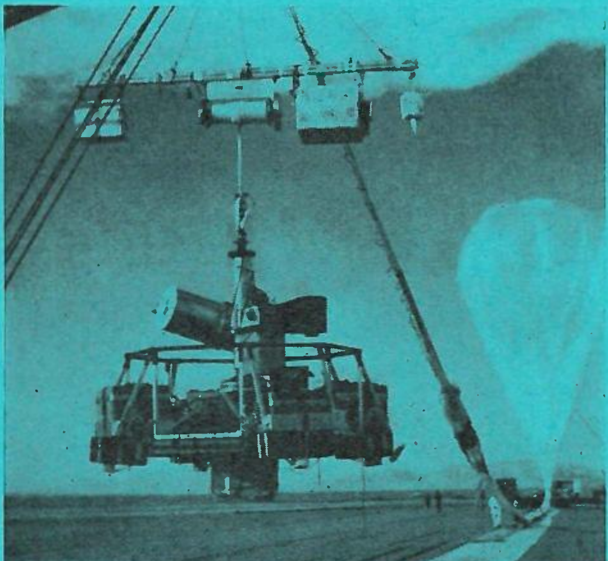
For the small group of men huddled on a dark, cold and windy runway on the aerodrome at half past four one morning early in August this year it was not thoughts of the stars that were of interest, although they were clearly visible, but rather the possibility of a long look at the Sun from nearly outside the Earth's atmosphere. For this was to be the culmination of nearly two year's co-operative effort by groups from the Physics Department of the Queen's University Belfast, from the Optical Physics Section of the United States Air Force Laboratory at Cambridge, Massachusetts, from the Meteorological Office at Bracknell and from the Astrophysics Research Unit of the Science Research Council.

It was hoped, by means of a large helium filled balloon, to carry a scientific package to a height of about twenty four miles and at the same time to point it – with great accuracy – at a particular part of the Sun's surface. By carrying the instruments above the atmospheric ozone layer it is possible to extend the observable ultra-violet solar spectrum to include the wavelength region near 2790Å. The objects of the experiments were threefold and apart from a brief statement of their scientific aims it is not intended, here, to go into any technical detail. Readers who want to know more may be interested in the full reports that will be published at a later date.

The main experiment was to record – by means of a high resolution spectrograph designed and built by the Astrophysics Research Unit and Queen's University – the profile of the Mg II doublet at 2795.5Å and 2802.7Å, with simultaneous spatial resolution across the solar disk of a few seconds of arc. The second experiment, using photometers designed by Air Force Cambridge, was to measure the distribution of minute particles of matter in the atmosphere, by measuring the sky radiation near the Sun. Finally, using apparatus supplied by the Meteorological Office, the third experiment was to measure the distribution of ozone at various heights.

In addition to the scientific apparatus, a considerable amount of ancilliary equipment was to be carried in a gondola suspended below the experimental package. This included telemetry transmitters to relay information and data to the ground control station, command receivers to enable the experiments and some of the balloon functions to be controlled remotely, tape recorders to receive some of the experimental data, batteries to supply the power, and so on. The total weight was just over half a ton. To lift this to a height of more than twenty miles a balloon with a volume of 10.6 million cubic feet was required. To hold this volume of gas, imagine a sheet of plastic (actually Mylar), only .0007in. thick – about a quarter of the thickness of a human hair – but large enough to cover completely three full sized football pitches – cut, shaped and welded together to form a sphere nearly three hundred feet in diameter and itself weighing nearly half a ton.

Now imagine aiming a rifle at an old fashioned penny a mile away. This is approximately the accuracy required to point the spectrograph at the Sun. To do it there are two aiming systems, one coarse and one fine, riding piggy back on each other. The coarse system, provided by the balloon pointing equipment, can only aim at the equivalent of a six foot high man a mile away (about five minutes of arc). This accuracy is sufficient for the Meteorological Office sensor and also for the USAF photometers and they can be bolted directly to the pointer shaft. The finer pointing (about five seconds of arc), required by the spectrograph, is achieved by means of a servo controlled mirror system. These units were originally developed by the Astrophysics Research Unit for use in payloads carried on the *Skylark* sounding rockets and have been flown, with considerable success, on fifteen rocket launchings at the Woomera Range in South Australia. Only minor mechanical changes were needed to make the unit suitable for use on this balloon experiment.



the launch – by US Air Force

Preparation of the balloon and the whole of the launching operation is carried out by a skilled team of about thirty American Air Force personnel. The balloon is uncrated and laid out on a wide canvas strip down the centre of the airfield runway and the recovery parachute is attached to the bottom end of it. This is for lowering the payload gently (?) to the ground at the end of the mission when an explosive cutter will be fired, by radio command, to sever the connecting cable. The parachute shroud lines are attached to a triangular yoke locked into a quick release mechanism at the end of the jib of a twenty ton mobile crane and the payload with its gondola is suspended from this yoke about eight feet from the ground.

Checkout of all the onboard equipment starts at about half past four in the morning under the light of floodlights and continues until the Sun rises over the Sacramento Mountains (fifteen miles away) at a quarter past six. Final checks of the pointing equipment are completed and it is aimed at and 'locked on' the Sun. (Apart from a few seconds during the actual launch it remained 'locked on' for the whole of the eight hour flight.) The payload is now clear for flight.

Up to this point in time it is still possible to cancel the operation though it would not be a popular decision – imagine the problems of re-packing half a ton of balloon back into its box! However, as soon as the payload status is 'GO' and the Met men are satisfied that the weather conditions are 'GO' and the surface winds are 'GO' and everything else is 'GO' the point of no return is reached. The order to fill the balloon is given.

For safety reasons helium is the gas used rather than very much cheaper, more efficient and more dangerous hydrogen. Only just enough is used to lift the balloon and gondola, plus a carefully determined margin. This margin is influenced by a number of factors such as time of year and ground and high altitude air temperatures. While the balloon is still on the ground this amount of gas is sufficient to fill only a small part of its volume, but as it rises through the atmosphere the helium expands, in the lessening atmospheric pressure, until it fills the whole sphere.

The actual launch procedure is, in principle, very simple. The balloon is released from its trailer and as it rises the crane is driven underneath it so that at the critical moment the payload with its gondola is gently picked up from the end of the crane jib and carried smoothly into the sky. So much for theory – in practice it is more than a little hair raising, to say the least, and takes a five man team to do it with split second timing and judgement. The signal to release the balloon is given and with a roar the huge envelope rises majestically into the air. With an even bigger roar the crane moves off, accelerating rapidly in a cloud of blue smoke. The payload and gondola hanging from its jib swings and sways, buffeting violently from side to side until it seems certain that something will either fall off or batter itself to destruction against the crane jib. Suddenly everything is quiet and still and the balloon gently picks the load off the end of the crane jib and carries it smoothly into the sky. A perfect launch!

To the men of the Holloman Balloon unit it was probably just another successful operation but to the group of men now standing in the warm early morning sun (it is now half past seven) it was the start of a very successful experiment and an example of international co-operation designed to further man's knowledge of the universe and the world in which we live.

The photographs for this article and the cover were provided by the Culham Laboratory Photographic Section using the author's 35mm colour transparencies.

Far left is the payload gondola and inflated balloon ready for launch and on previous page the balloon and payload soon after launch Overall length is 420 feet.
Cover picture shows the balloon before launching.

2 x-ray astronomy

the astronomer and the space age

J B Alexander

The advent of high-altitude rockets, artificial satellites and space probes has given the astronomer new techniques of investigation. Spectacular advances in the study of the Moon and the Planets have been made possible by their close examination from space vehicles of various kinds. Although there is no hope in the foreseeable future of sending space probes outside the solar system to other stars, the space age has opened new frontiers in the study of stars and galaxies because it is now possible to observe without the restrictions imposed by the presence of the earth's atmosphere.

Most of our present knowledge of the universe has been derived from ground-based observations made at those wavelengths of the electromagnetic spectrum to which the atmosphere is relatively transparent. It is very important that observations can now be made from space in regions of the spectrum where the atmosphere is essentially opaque. Even at wavelengths where observations from the surface of the earth are feasible, the presence of air between the telescope and the astronomical object being observed is a great nuisance. The resolution of large ground-based optical telescopes is limited by temperature inhomogeneities in the earth's atmosphere, and this is one of the main reasons why such instruments are usually placed on mountain sites above some of the layers of air which cause optical turbulence. The resolution of a telescope out in space is not limited in the same way, and it should become possible to discover double stars which are not resolved with even the largest telescopes on the earth.

Observations of astronomical objects from balloons, rockets and artificial satellites have yielded considerable information about the infra-red, ultraviolet and x-ray regions which cannot be observed from the ground. Although still in their infancy, the branches of astronomy opened up by the new techniques have already made significant contributions to our knowledge of the universe. As an example, we shall consider some aspects of x-ray astronomy.

Although x-rays from the Sun were detected several years ago, it is only during the last ten years that the first extra-solar source was discovered. There are now several discrete x-ray sources known. Investigations in the x-ray region alone are of considerable interest, but much more progress can be made if the object which emits the x-rays can also be identified at optical wavelengths. Unfortunately, very few such identifications have been made yet: this is because the positions of most x-ray sources are known to an accuracy of no better than a minute of arc or so. This state of affairs will improve when more accurate positions are available.

From the few cases where the optical identification of an object in the direction of the x-ray source seems well established, it is clear that the x-ray sources are far from being a homogeneous group of objects. X-rays have been observed from both the Crab Nebula itself and from the pulsar within it. (These two objects are believed to be the remnants of a supernova, a star which exploded in 1054 AD and was recorded in ancient Chinese records). It is also claimed that x-rays have been observed from the peculiar galaxy M87 which is also a strong radio source. The mechanism by which x-rays are emitted also probably differs from object to object. In some cases, the emission is probably caused by the synchrotron process whilst in other sources bremsstrahlung emission in a hot gas appears more likely.

It is very desirable to obtain more accurate positions of x-ray sources so that further optical identifications can be made. A method which can be used in certain parts of the sky is that of lunar occultations. If the Moon in its monthly orbit around the Earth passes in front of a star, the radiation from that star will rapidly decrease to zero as soon as the star is in line with the limb of the Moon. (See the article 'Time, The Moon, The Stars and Man' by Leslie Morrison in *Quest* Vol. 4, No. 3.) Suppose that an x-ray source is occulted by the Moon and the time of the sudden disappearance of the x-ray emission is accurately recorded. Then it is known that at this time the x-ray source is somewhere on the limb of the Moon, and that a line from the x-ray source to the x-ray detector is tangential to the surface of the Moon. From a knowledge of the motion of the Moon, it is then possible to say that the x-ray source is situated somewhere on a curve in the sky corresponding to the profile of the limb of the Moon as viewed from the x-ray detector at the time of the occultation. If two distinct occultations of the same source are observed, it is then possible to say that the x-ray source lies at the intersection of the two curves which are derived separately for each occultation. In this way, a unique position accurate to within a second of arc or so can be obtained.

the GX3+1 experiment

A group from Leicester University led by Dr. K. A. Pounds have recently been very successful in recording an occultation by the Moon of the x-ray source known as GX3 + 1. This project was financed by the SRC. Although the idea of the experiment was first envisaged as recently as December 1970, it was possible to arrange for the detecting equipment to be launched from Woomera in a *Skylark* rocket only nine months later, on September 27, 1971. The relevant data on the Moon's position were calculated by Leslie Morrison, who works in the Nautical Almanac Office. As a result of the measurement of this occultation, it was known that the position of GX3 + 1 lay somewhere on a narrow strip of sky. A second occultation of the same source on October 24, 1971 was recorded successfully by a group from the Mullard Space Science Laboratory of University College London under Professor A. P. Willmore (also using equipment launched on a *Skylark* rocket from Woomera). From these two occultation measurements, an accurate position of the source is now available. At optical wavelengths a star likely to be associated with the x-ray source has been found in the appropriate position on photographic plates.

John Alexander is a senior scientific officer at RGO. At present he is working on problems in stellar spectroscopy and photometry especially those pertaining to the abundance of the elements. He is also RGO's local correspondent for Quest.

The picture shows the GX3+1 experiment being assembled at the British Aircraft Corporation's Filton works by a Leicester Experimenter (up the ladder) helped by BAC staff.

3 space on atlas

Barbara Stokoe

It all started in 1963. But we never realised what was going to hit us!

Those were the early days of the Atlas Laboratory. We had no machine – not even a building; but we were laying the foundations of what was to come. A small nucleus of people, temporarily housed in the Rutherford Laboratory, we had the dedicated purpose of starting up what was to become a major computing laboratory. Buildings, machines, software were our goals – and their potential users. Partly with the latter in mind, we held a one-day symposium to which many people interested in space research were invited, and many papers were given on the problems which they were then considering. Little happened for some time after that, apart from a small number of jobs which were used to try out the software on our embryo machine, now in Ferranti's factory at West Gorton, Manchester. The author looked after these jobs, with the result that all future 'space' jobs tended to come to her.

In the early days of the international collaborative programme with the United States, the satellites UK1 and UK2 were produced – to be re-christened Ariel 1 and Ariel 2 on their successful launches. None of the data processing for these satellites was performed at Atlas, and not much attention was paid to this side of the experiment – with the result that AWRE Aldermaston received an SOS to do something with all the data from Ariel 2 about two weeks *after* the launch! Which they nobly did, with many very fair comments about inadequate notice. As a result, when UK3 was planned much more note was taken of the data processing requirement, and Van Raalte of AWRE was involved at the early design stages.

There are 3 basic parts in the processing of UK3: (a) digitisation (performed at RSRS); (b) preliminary checking (performed at AWRE); and (c) separation of results (performed at Atlas). It was agreed that AWRE would do the considerable amount of programming involved in the project – with considerable help and advice from Atlas on (c).

Everything remained quiet for a while until about February 1967 when testing started on the Atlas work. Due to staff shortage, AWRE decided to use staff from their Foulness station to do the programming, and a large amount of effort was needed to keep the four programmers there happy – all married women who obviously did not want to come and spend any time at Chilton. They also did not have any experience of Atlas or its very powerful operating system or facilities. But with good-will on all sides progress was made, and shortly after launch in May 1967, we were able to give the experimenters some results. Then there was a short breathing space of a few months while modifications were made to the digitiser at RSRS.

In November, we were in business again at full production; starting at about three hours a week, and increasing over the years to a peak of ten hours. In addition to this, the experimenters themselves particularly Sheffield University, carried out much of their subsequent work at Atlas. They were willing to use our facilities to maximum advantage, including our brand new microfilm plotter, which enabled them to make sophisticated use of their results. Taken over-all, this has been a highly successful project, and is now just about completed.

Future work in store in this field includes UK4 (which we hope will be successfully launched by the time this appears) and the S68 experiment on the ESRO TD1A satellite.

For UK4, RSRS have replaced the role which AWRE filled in UK3; and much of the programming itself has been done at Atlas. Production is planned on our brand new ICL 1906A computer, now in the final stages of commissioning. This has of course created problems, since much of the testing has had to be done on other machines. Things are further complicated by having aboard a US experiment, from the University of Iowa, with the consequent difficulty of communications. We expect to use at least ten hours of 1906A time per week on this project.

We have taken over the processing for S68 from Edinburgh Regional Computing Centre. TD1A is planned for launch in February 1972. We plan to do the production work on the neighbouring RHEL 360/195, on which the Atlas Laboratory are entitled to 20% of the time for use on non-nuclear-physics work. Two members of staff are now working full-time on the programming of this project and we expect to take up a large amount of our 195 share with S68 – an hour a week may be the end result.

And so from small beginnings . . .

4 SAS-D

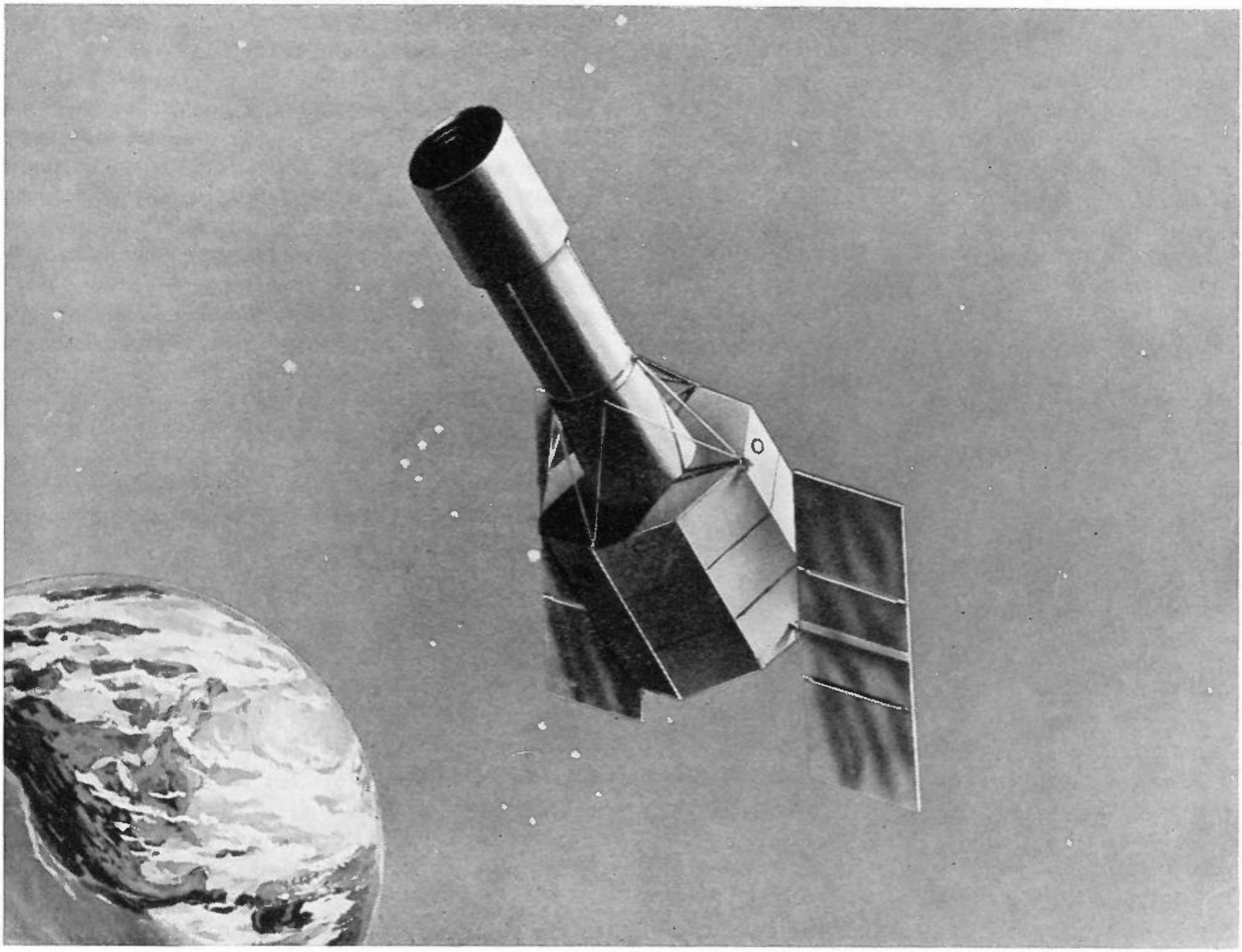
A team drawn from the Astrophysics Research Unit, the Radio and Space Research Station and University College, London is collaborating with NASA's Goddard Space Flight Center on a satellite project coded 'SAS–D' in the NASA 'Small Astronomical Satellite' series. This project is a derivative of an earlier study sponsored by ESRO and undertaken by a UK team for an 'Ultraviolet Astronomical Satellite' (UVAS). Some participation by ESRO in the SAS–D project is expected.

Briefly, the scientific package for SAS–D will consist of a 45 cm aperture Cassegrain telescope followed by an echelle spectrograph which has an image tube TV system as the detector. The satellite will be placed above the Atlantic Ocean in a geosynchronous orbit where it can be controlled from ground stations located on either side of the Atlantic.

A feature of the SAS–D system will be an observatory type of ground station in which the observing astronomer will be able to take direct control of the satellite, which should be capable of acquiring any star brighter than 12th magnitude and pointing towards it with an accuracy of one arc-second. The scientific mission covers studies of a wide range of astronomical objects, including planets, stars, the interstellar medium, galactic nebulae and external galaxies, by observations of their ultraviolet spectra in the range 1150–3200Å.

The UK is jointly responsible with GSFC for the scientific mission, and will provide the detector system, while GSFC will provide the optics and structure in addition to the spacecraft. The UK will also be contributing to the design of the telescope baffle system and of the echelle optics.

The current timetable for SAS–D provides for a launch in 1976. Both the UK group and GSFC have initiated design studies and long-lead tests which will continue until 1973. During this period a plan for completion of the project will be presented to NASA and the SRC for their consideration.



5 the sun as seen from space

A H Gabriel

On 10 October 1946, Dr. Richard Tousey of the US Naval Research Laboratory launched a spectrograph in a captured German V2 rocket, and recorded the ultraviolet spectrum of the sun from above the earth's atmosphere. This, the first space astronomy experiment, marked the start of a period in which increasingly sophisticated observations have been carried out, first on the sun, and more recently on other astronomical objects. At an altitude of several hundred Km, well above the earth's atmosphere, it is possible to extend the observable spectral range below the atmospheric transmission limit at 3000Å, down through the ultraviolet and soft x-ray regions. The outer layer of the sun's atmosphere – the corona – at a temperature of over a million degrees Kelvin, emits most of its radiation at these short wavelengths. In fact only a very few spectral lines are emitted by the corona in the visible region. It is for this reason that the ultraviolet and x-ray wavelength regions are of such great importance in understanding the physics of the solar atmosphere.

Shortly after the V2 experiments, the development of smaller sounding rockets, such as the UK *Skylark* and the US *Aerobee*, provided the vehicles for numerous solar experiments. More recently, advanced pointing controls have enabled these vehicles to be used for detailed studies of specific regions of the sun's disk. In 1962, the US National Aeronautical and Space Administration (NASA) launched the first Orbiting Solar Observatory (OSO) satellite. Seven of these have now been launched and a further three are being planned. In 1973, the first 'Apollo Telescope Mount' (ATM–A) will be launched into earth orbit. This mission, known as SKYLAB will be devoted to solar observations. It will be serviced by visiting astronauts, and will involve the periodic recovery of photographically recorded data. The primary objective, however, is to investigate the manner in which scientists/astronauts can carry out work schedules in such an environment.

There are a number of good reasons for concentrating initial measurements on the sun. It is our nearest star, and the only one in which one can foresee the possibility of spatially resolved observations, since other stars can be seen only as point sources. It is also the only star for which the entire spectral range is accessible because absorption by neutral hydrogen renders the interstellar medium opaque between 100Å and 912Å for even the next nearest star. Measurements aimed at determining the structure and behaviour of the solar atmosphere must have as their ultimate aim the understanding of the origin and heating mechanism of the outer layers, the chromosphere and corona. These layers are heated to well above the temperature of the visible disk of the sun or photosphere. It is now widely accepted that the source of this heating is mechanical energy waves, propagated upwards from the turbulent convection in the photosphere. A quantitative understanding of this heating mechanism will be of great value in predicting the behaviour of other stars with convective layers.

An important aspect of solar spectroscopic studies involves the exploitation of the unique properties of the solar plasma which are not available in laboratory plasmas. Thus, the low density enhances the intensity of the so-called 'forbidden' lines. A number of these, observed during the 1970 eclipse, have contributed important advances in our understanding of the atomic structure of the ions responsible. Observations of solar soft x-ray spectra have led to the discovery at the ARU of a new forbidden line from helium-like ions, which has subsequently been used to measure the densities in solar-active regions. Plasma effects, such as wave propagation and thermal conduction can also be studied in the solar corona.

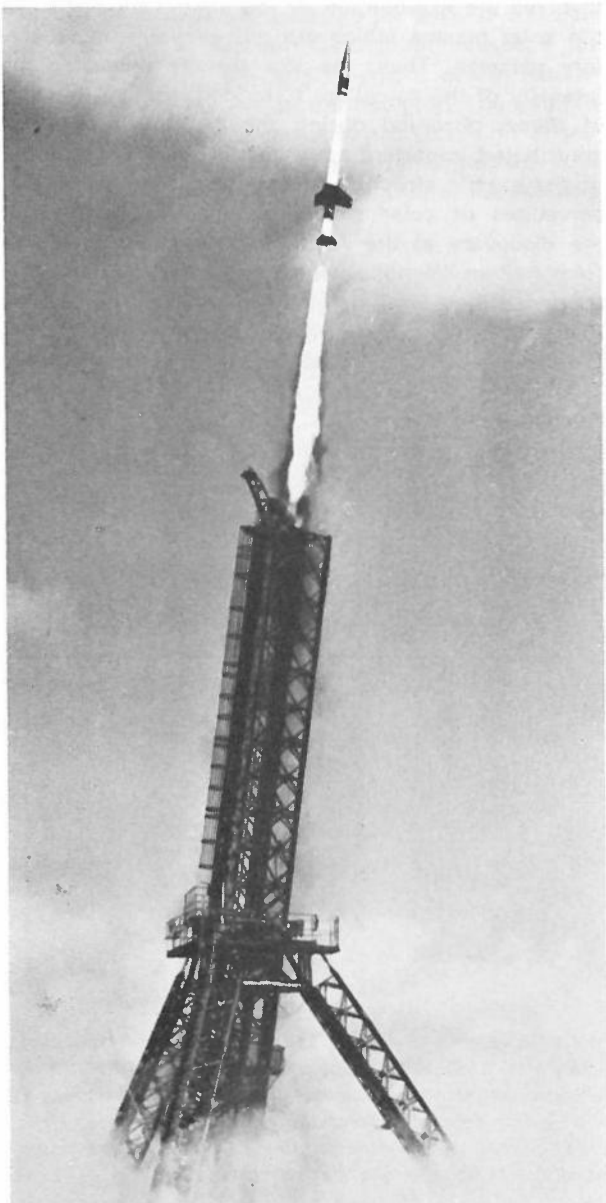
The Science Research Council is contributing to solar space research in various ways. Its Space Research Management Unit is responsible for providing the UK National programme of Skylark rockets, launched from Woomera in Australia. The SRC also supports experimental programmes in University groups, which provide scientific payloads for Skylark rockets and also for other rockets and satellites.

Dr. Gabriel is a Group Leader at the Astrophysics Research Unit with responsibility for the ARU Solar Programme. He was recently given a special promotion to Senior Principal Scientific Officer (see Quest Oct. '71, p. 14) and is an Honorary Lecturer at University College London in the Department of Physics.

Finally, the SRC Astrophysics Research Unit (ARU) at Culham is involved directly in carrying out solar experiments in the ultraviolet region. Many of these experiments are carried out in collaboration with other University Groups. All of these various activities are the responsibility of the Space Policy and Grants Committee of the SRC.

solar structure

A theoretical model of the quiet solar atmosphere developed by Woolley and Allen in 1950, and based entirely on observations from the ground, contained many of the essential features of the best models available today. In these, the temperature falls to a minimum just above the photosphere and then rises slowly to around 10,000°K at the top of the chromosphere. There follows a very steep transition region in which the temperature rises to nearly 1 million °K in only about 100 Km, leading to the corona in which the temperature rises to a maximum of nearly 2 million °K at a height of about 50,000 Km. The details of this structure are determined by the balance of energy flow through the region. This means that although the improvements in the temperature structure over the past 20 years have not been large, the implications of these changes on the mechanism of heating and formation of the corona will be very important. In particular, we require precise information in three areas. These are the value of the temperature minimum, the thickness of the chromosphere/corona transition region, and the temperature variation at the top of the transition region.

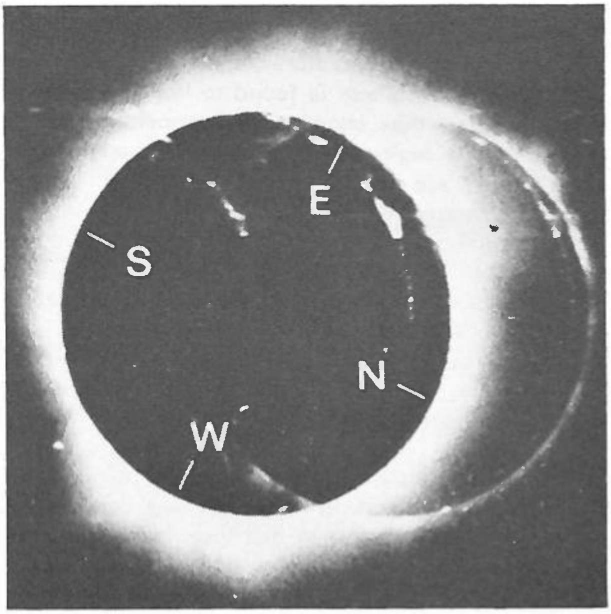


Observations are also complicated by the fact that the chromosphere-corona interface is irregular. The transition region varies in height from point to point by as much as 5,000 Km. Since this is more than 50 times the thickness of the transition region, it is clear that simple geometric observations will never be able to resolve this layer directly. The solution lies in combining such observations with an alternative technique, which involves the measurement of the absolute intensities of the spectral lines emitted. This technique, developed by Pottasch and by Jordan, determines in effect the quantity of material present at each temperature, in the line of sight.

Several of the experiments carried out by the ARU are aimed at determining this structure. In one, the image of the solar disk is accurately stabilized on the entrance slit of an ultraviolet spectrograph in order to record the spectrum which is emitted by a clearly defined layer above the solar limb. Analysis of this data has confirmed the steep temperature rise in the transition region and also measured the extent of its irregularities. A further experiment, at present being prepared, will extend these measurements to the higher temperatures at the top of the transition layer. An experiment was carried out during the total solar eclipse of 7 March 1970, in which an ultraviolet spectrograph was launched into the region of totality using an *Aerobee* rocket from Wallops Island launch site in Virginia. For this experiment, which was carried out in collaboration with other US and UK groups, the rocket payload was designed and built at the ARU. The project was a spectacular success, and a series of 35 consecutive solar spectra was obtained during the second contact and totality phases of the eclipse. Analysis of this extensive data is still in progress and will continue for some time. It contains much information on a variety of solar phenomena, including the quiet transition layer, the corona, active regions and prominences.

Radiation from the solar atmosphere near its temperature minimum dominates the continuous spectrum lying in the wavelength region 1500 Å to 2000 Å. A study of this emission is thus of great importance and a number of groups, including the ARU have carried out such measurements. The precision which results from interpretation of this region has lead to a determination of the value of the temperature minimum which is probably good to within 5%.

The widths of low chromospheric emission lines in the visible spectrum were measured during the 1940 total eclipse, and found to be much larger than could be readily explained. The strong resonance lines of the ions formed here, occur in the wavelength range 1000 Å to 1900 Å, as do lines from the higher layers in the transition region. With space technique it is now possible to study these higher layers in greater detail and an ARU rocket payload has been designed for this purpose. It uses the crossed dispersions of an echelle grating and a concave grating to produce a two dimensional raster format spectrum, covering the above range with a resolution of 0.02 Å. This experiment has recorded emission profiles for a number of lines formed in the transition zone and shown that the observed ions have kinetic energies which are an order of magnitude greater than the local thermal kinetic energy. One possible interpretation is that these additional non-thermal components represent the passage through this region of the mechanical waves which are responsible for heating the corona. Experiments of this type are clearly very important in providing a unique method for increasing our fundamental understanding of the solar corona and it is therefore planned to extend their scope to include other ions formed over a range of temperatures.



Pictures: far left *a stabilised Skylark rocket carrying ultraviolet solar experiments and,* **above,** *the Solar Corona during the total eclipse of March 7 1970, recorded in the emission of hydrogen Lyman* α *at 1216***Å***.*

the active sun

Some aspects of solar activity can be effectively studied from the ground. These include magnetic effects in the photosphere, sunspots ,the formation of plages or active regions, and the behaviour in the cooler layers of solar flares which represent the impulsive release of energy in very localized regions. These phenomena can be broadly understood in terms of the magnetic effects of a star in which differential rotation occurs, *ie* in which the equator rotates slightly faster than the poles. However, a detailed understanding of these phenomena is far from complete. Early observations in the ultraviolet and soft X-ray region showed that solar activity produces a relatively larger change in the emission at these shorter wavelengths. These results clearly indicated that the most important aspects of such phenomena might remain undetected if observations were limited to only the visible spectrum.

While much useful work has been carried out from rockets, it is obvious that for the study of fluctuating or transient phenomena, the longer observing time provided by a satellite has important advantages. Thus, the first solar satellite OSO–I carried an ultraviolet spectrometer which was able to monitor the intensity variation of different emission lines as the sun rotated on its axis. As the principal active regions rotated with the sun, the degree of activity seen from the earth varied periodically. The degree of variation of the line intensities then showed which lines were characteristic of the entire quiet corona, and which came only from active regions. In this way it was shown that the temperature associated with active regions could be well above that of the quiet corona.

More recently it has been possible to obtain spectroheliograms in the ultraviolet. These are complete maps of the solar disk recorded in the radiation of only one spectral line. By selecting a series of spectral lines which are formed at progressively increasing temperatures, the area of the emitting regions on the sun is found to become progressively smaller, thus showing the temperature structure in active regions, where peak temperatures of 10 million °K are observed.

As the temperatures increase, it is necessary to make observations at still shorter wavelengths in the x-ray region. Satellites such as the OSO–III, OSO–V and the Russian Intercosmos–4 have made detailed studies of flare spectra in the 1.8 Å region, which are formed by iron atoms so highly ionised that only 2 of the original 26 electrons remain. These lines are emitted at temperatures in excess of 20 million °K.

Observations of a different kind have been carried out by a US group using rockets. These concentrate on high spatial resolution but use broad spectral bands in the soft x-ray region. They show emission originating from arch-like structures extending some 100,000 Km high in the corona above active regions. It may be a few years before high spectral and spatial resolution can be achieved simultaneously in the x-ray region but one can then hope to unravel the detailed structure of active regions, and their relationship to the magnetic field. Much of this information could never be obtained if observations were limited to ground based observations.

the outer corona

The outer region of the corona is continually escaping from the sun's gravitational field and streams past the earth's orbit as the solar wind. Where this wind meets the magnetosphere, the region of magnetic field surrounding the earth, a shock wave of unusual properties is set up. Satellites, acting as probes, have successfully traversed these regions and sent back much valuable data, both on the solar wind and on the so-called 'bow shock-wave'. Analysis of the distribution of chemical species, velocities and charge states in the solar wind has important implications for understanding the physical processes occurring in the outer corona.

It will be seen that with the help of space observations, a great deal of interesting new information about the behaviours of the outer layers of the sun is being obtained. We are now entering a phase in which we can hope to fit this together to form a better quantitative understanding of the origin and heating of these layers; first for the sun and then for other stars.

6 Hebridean holiday

how our experiments get off the ground at South Uist

Eric Williams of the University College of Wales, Aberystwyth tells the tale his own way. He and Les France are part of a team who launch experiments in Petrel and Skua rockets from S. Uist and they drive 700 miles to do it. Pictures by author.

So you are off on a jolly to the Uists, flogging the old expenses racket and touring Scotland at the expense of the Science Research Council. Well that is how the tea-room have it and they could be right, for after all it is high summer and the hired, self-drive van has just been serviced. Actually it is a little after nine on the morning of Sunday July 4 and Les has just arrived with the vehicle.

'Apres moi le deluge', yes, pouring with rain and shows no signs of letting up. Still, consolation in all things, the Mid-Wales Golf Alliance is at Aberystwyth today and sure enough had you not been departing for the Hebrides you would at this time be half-way up the third and soaked to the skin already.

Always did fancy driving a truck. My god, gear changing's a lottery and third to second is impossible. Our language would evaporate the snow and we are not in Ponterwyd yet.

Turn and turn about, an hour and a quarter in the driving seat apiece and by lunch-time we join the M6 east of Crewe. Driving somewhat easier now, though with the heavy load of steel sections for our 24 metre aerial masts the van rolls at the slightest pretext and struggles up even the merest incline.

We have ensured the posterity of this vehicle by christening her 'The Pinking-Pig', a pretty obvious choice really when you bear in mind her performance in either third or top gear between 25 and 30 mph. Still she is only using one gallon every 25 miles and that does impress us.

Off the motorway north of Carlisle and into a garage at Gretna Green for re-fuelling. Dip-stick says 'Add-oil', cannot unscrew this filler cap. Try tapping it with a heavy tyre-lever. No good, though hello, it's not moving round, it's coming out. Ah, it pulls off, just swollen with the heat. Another problem solved – you can't beat the trained scientific mind.

A74 north is a pretty good road but time rolls by. Seven o'clock and we are still way south of

Approaching the Isle of Skye

Glasgow, we'll never make Dumbarton in time for dinner. Better ring ahead and see if we can't arrange a late meal at the Dumbuck. Chef's off at 8.45 and we estimate arrival at 9 o'clock – they'll leave us a chicken salad out. Make it a mixed grill – we only had a snack lunch.

Diversion through Glasgow, my goodness they still have cobbled streets, littered with railway lines. Get into reverse as the lights change – chap behind fails to see the humour of the situation. Dumbarton at last, 9.15 and they's kept a steak for us, drop of vino to wash it down, ah, that's better. Walk round the block, wash up and bed. My god all the gear we've got in that truck and here's me minus toothbrush and toothpaste. Not to worry, worse things happen at sea.

Slept like tops, excellent breakfast and back on the road heading north by nine next morning. Loch Lomond's all it's cracked up to be but what tortuous narrow roads follow its banks. This vehicle's got a built in queue, 200 yards behind it. Dour people these Scots, not a single horn honked though one or two of them have got damned good headlights.

Refuelled at Ardlui and found reverse at the first attempt – pity I couldn't get out of it – still that sheepdog was pretty nippy. There was a massacre at Glencoe, wasn't there? If these brakes don't hold history could repeat itself. Thank god we wedged those boards behind us, don't fancy a ton of aerial masting behind my left ear if we have to stop in a hurry.

Loch Leven and the solitary piper, can't make that out. Standing right at the edge of the loch a Scot in full regalia, tartan kilt, sporran, the lot and blowing

The author (left) trying to convince Les France that his route is the best.

Hebridean holiday continued

away in blissful isolation. (Discover subsequently these chaps are tinkers and when they accumulate a big enough crowd of onlookers round goes the hat – they make fortunes at it).

Fort William for an early lunch and the 'pig' is in the garage for brake adjustments. Can recommend the tatty-leeky soup; was almost in a position to pronounce judgment on haggis but courage ran out at the last minute – pity we saw them in the raw in that butcher's window.

Brake adjustment has certainly been effective, heading north again up A82 and then west to the Kyle of Loch Alsh. Short ferry to Kyleakin on Island of Skye. Up the Isle of Skye and some of the most beautiful scenery yet, through Portree to Uig reached by 7.30 p.m. – better than last night. We're booked in at the Uig – find we're sleeping in the annexe, 'Primrose Cottage'. Quite picturesque this, no locked doors and an intriguing notice to close the garden gates to avoid the ravages of itinerant sheep.

Early start Tuesday morning, long ferry from Uig to Lochmaddy on North Uist and we have to be on the quay by nine o'clock to collect our tickets. Arrive there in ample time, in fact we're amongst the first alongside. There's a ton and a half of highland bull standing alongside us. Yes, so he is tethered but he's not happy about it and I'm staying right here in the comfort of the 'pig' – funny the attachments you can form.

Eventless crossing, these ships are remarkably stable and they only have a seven foot draught, well stabilized and very effective. Manoeuvring the van in the confines of the ship on docking not without its moments. Incurred the wrath of a Morris 1100, sporting four spinster teachers is our guess – Les silenced them with a glance or could it be they lip-read.

Last lap now over the bumpy single-track roads of North Uist, Benbecula and South Uist with their passing points marked by white diamonds. Seems to work quite well this passing point business, simple rules, pull in if the passing point is on your side except when you are driving up hill, you then have the right of way. Ignore these rules when the other vehicle is a lorry, especially if it is loaded high with seaweed as many of them are, these chaps operate on a might is right basis. Quickly gather that acknowledgement of correct passing procedures is by raising one finger, yes, ONE finger.

Our Guest house on South Uist reached in nice time for lunch. Science Research Council have negotiated some pretty good digs here, purple carpets, large lounge with TV (though reception is hopeless), darts-board, Scrabble and well thumbed packs of cards. Hello you two, where have you been, there was room on last night's ferry. By the way you're in the annexe.

Les has been in the annexe before – solid floors two foot thick of concrete, corrugated sheet walls and a tin roof; my wrangler pants will fit in here all right. Only thirty yards to the nearest hot water tap, keep the loo door closed with your foot, but the beds are very comfortable and the furniture adequate.

So was that lunch, now down to the rocket range and let's get these aerial masts up. No problem here, they've flogged these in large quantities to the Scandinavian armies we hear. Four men can put

The Ben Mor Guest House, South Uist, with the annexe in foreground of picture.

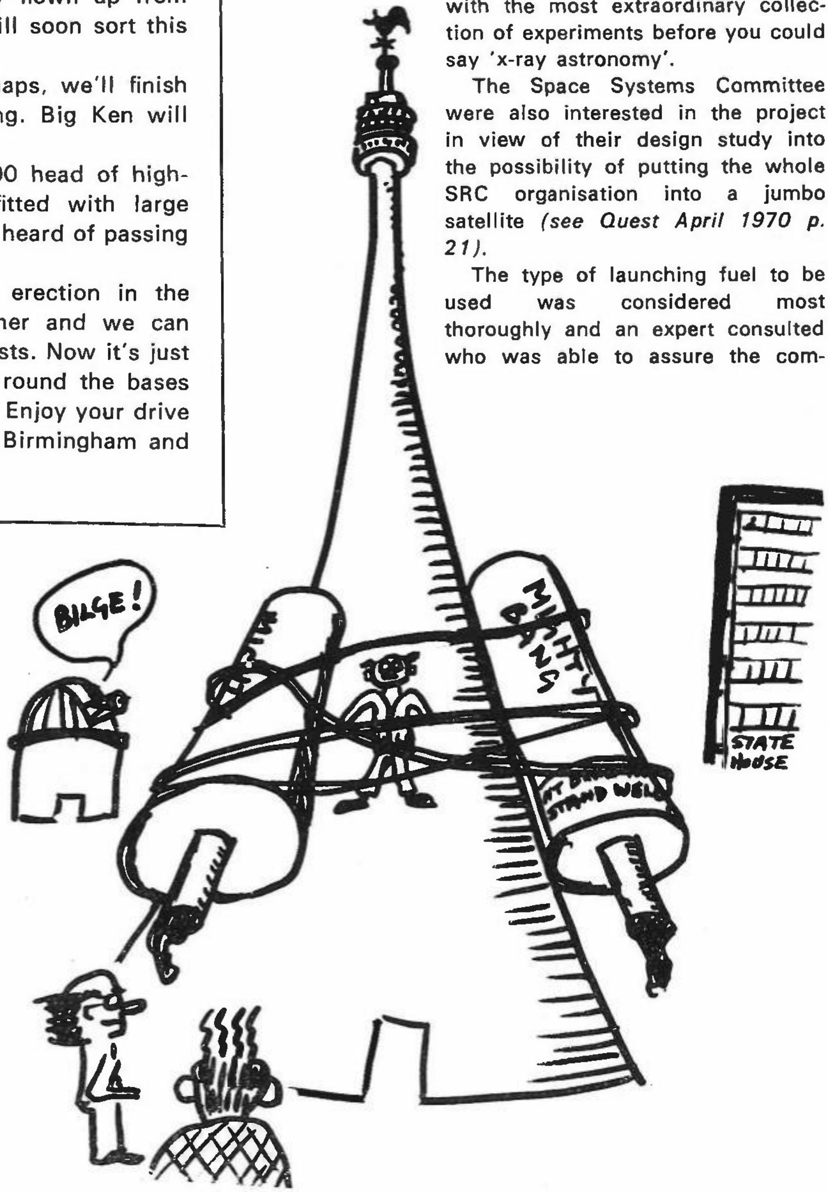
a 75 foot mast up in an hour and take it down in 40 minutes and with Ron specially flown up from Aldermaston to show us how we will soon sort this lot.

Six-thirty already, never mind chaps, we'll finish putting this mast up in the morning. Big Ken will join us from Aberystwyth then.

Found our way home through 200 head of highland cattle, many of which are fitted with large handle-bars and none of whom have heard of passing points.

Two more days of aerial mast erection in the chill wind of the Hebridean summer and we can stand back and admire our three masts. Now it's just a matter of stringing cattle fences round the bases and I'm on my way home on Friday. Enjoy your drive back Eric, that I will; I'm flying to Birmingham and Ken has left my car there!

tall story



Picture shows Professors O'Flanaghan and Rafferty, co-opted members of the ASR Satellite Committee, before the launch. 'F' can be seen on right shaking its head over travel claims.

As we understand it the hot air brigade claim that they exploded the Post Office tower and the provisionals say that it was nothing whatever to do with them. If so both of them are wrong.

Now if Special Branch had looked a bit further, at a nearby fifteen storey building in fact, they might have found a hotbed of clues. This very tower had been the subject of discussion by the Astronomy, Space and Radio Board Satellite Committee for some years, in fact ever since this blatant instance of Total Technology first arose in the Landscape.

By 1968 some agreement had been reached to promote a design study. When that was scrapped Finance Division suddenly stepped in. They had become increasingly worried, they said, by the receipt of travel claims from the Whitley Council sub-committee on 'London Office – Dispersal or Disposal?' Each member of the committee had been given the powerful binoculars they had asked for (the 'best but most expensive' as recommended by the Consumers' Association) but being concerned about the occlusion of the view of the most likely western regions by the tower they had been doing their scanning at Ascot and Henley where, they claimed, they got excellent results.

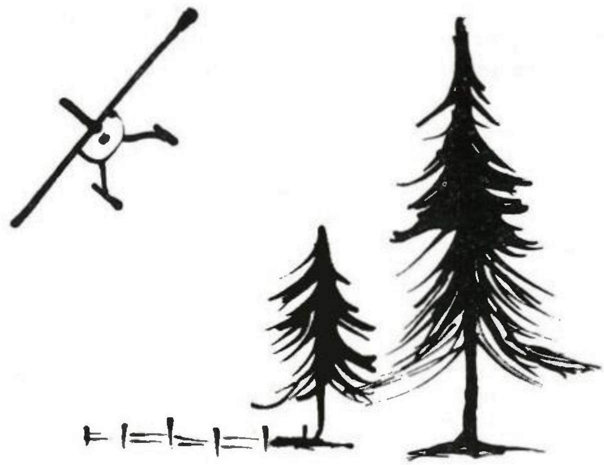
Because of the seriousness of F Division's concern over the travel claims, the Satellite Committee knew that provisions of funds would be no further problem and they quickly had the top of the tower packed with the most extraordinary collection of experiments before you could say 'x-ray astronomy'.

The Space Systems Committee were also interested in the project in view of their design study into the possibility of putting the whole SRC organisation into a jumbo satellite *(see Quest April 1970 p. 21)*.

The type of launching fuel to be used was considered most thoroughly and an expert consulted who was able to assure the committee that 'Just 15lb will be sure to blast the very soul of it and t'would as likely go round in space as land in the next world, being no sort of a christian', he said.

Well as you know from the press reports the top of the tower stayed where it was and at the next meeting the experiment was formally recorded as 'The Launch That Failed no. 40,291'. We also returned to the expert for his opinion which was as follows: 'Be jaysus ye've done it! Ye've done it!' This seemed rather unusual in the circumstances.

spacebird?

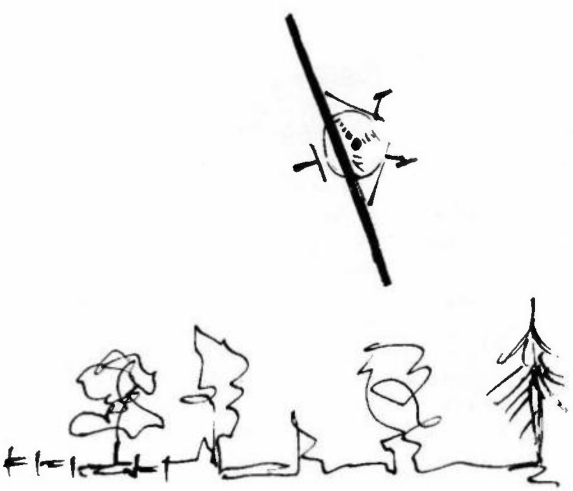


The contents of the cover on the last issue of *Quest* having caused so much comment, we searched around for some more talent for the Space issue. To our disappointment we found no female of the species SRC in a rocket package, on the launching pad or even up in a balloon. However we did find one in an aeroplane at Denham. Angela Killick of Private Office has just acquired a private pilot's licence and who knows where she may get up to now.

Angela Killick

'Would you like to fly upside down?' said the instructor, with his arm round my shoulder. It was at least a new approach, but I declined. We looped the loop a couple of times before I said 'You'll have to stop now or I shall be sick.' We always carry a stock of brown paper bags for emergencies and it is the only sanction left to the pupil pilot over wilder instructors!

I had been learning to fly for a couple of years, slowly acquiring the number of hours dual and solo needed to apply for a private pilot's licence. To gain a licence one must do certain long and short distance solo cross country flying and quite a stiff practical handling test, and there is also an oral exam on airframes and the principles of flight, a written exam on aviation law, and another test on navigation and meteorology. Everything has to be completed within a six month period – and therein lies the rub as the weather can hold you up mercilessly until time has run out.



'Have you ever flown blind?' the instructor said and gave me the verbal directions I might get in an emergency from an information point equipped with radar. I promised not to cheat by looking out of the cockpit window.

The difficulty lies in believing the instruments. It is very easy to become convinced that you are flying crooked and that the instruments are wrong! Pilots' tales (rather like seamen's) assure you that people have been known to fly out of cloud upside down without knowing it. 'Fly 10° to starboard, you are now five miles from the airfield, descend 500', change your altimeter from Chatham QNH to QFE 1012, turn onto 160° . . .' He brought me to within 300' of the runway before I actually saw anything out of the window. It was good practice . . .

There are many tricks which instructors use to liven up the learner-pilot hours. Dodging imaginary radio masts is one. Pulling back the throttle 300' after take-off is another. It is not so bad provided you have done the homework: nose down, trim for 70 mph, select any remotely possible patch for landing, as near straight ahead as possible, take a deep breath, check throttle closed (a sudden burst of speed on touch down could be disastrous), shut fuel tap, switch off magnetos, ignition, open door just before impact in case airframe should buckle and trap you inside. Speed is essential and you have to know the checks off pat: they must be automatic, there is no time to think.

Engine failures are practised from dizzier heights but at least one has more time. It was an immense relief to me when I first learned that I would not just drop out of the sky when the single engine was switched off. On the contrary, a single engined Cessna 150 can glide about 2¾ miles in still air from 2000' before touching the ground. With a strong wind of course, the distance (and time) is sharply reduced. During these precious seconds, there are lots of things to do. If the height is sufficient, you might have time to discover why the engine has failed – perhaps the fuel tap or the ignition switch have been knocked to 'off', or the petrol tanks are empty. When you have noted the wind direction, selected a field, and decided on a landing course, you are supposed to give a radio 'mayday' (m'aidez) call, though to what purpose it is difficult to imagine. In any case, conversations are the last thing you want at such a moment – the mayday call being acknowledged and you acknowledging the acknowledgment.

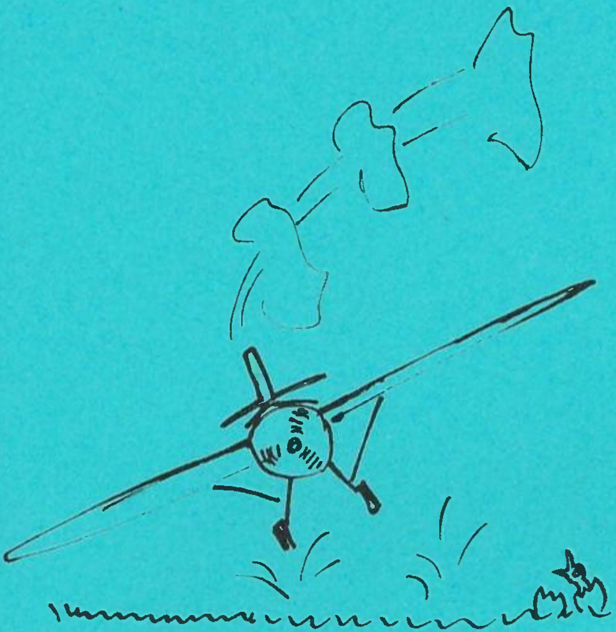
Having practised this manoeuvre to within a few feet of the ground, you climb away by pushing in the throttle slowly – to apply full throttle at once gives a burst of sound, all the local chickens crack their eggs, the cows drop calves, sheep get stuck in the fences, farmers complain and the noise abatement societies ring up the police and write to their MPs.

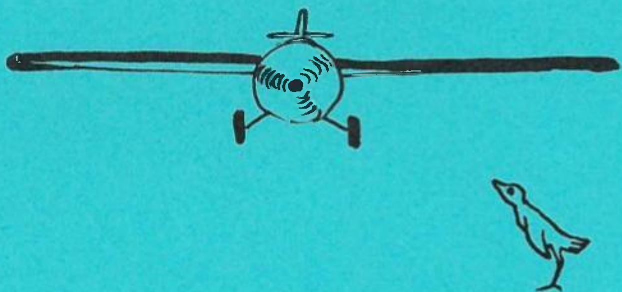
Other excitements of learning to fly include spins and stalls. The first time one is inclined to think 'O God, give me a ladder; I want to get down'. Then it becomes a challenge – to conquer emotions and instincts and master the machine, the air, and the curious feel of moving in three dimensions.

The exercises are exactly what the words imply. To stall, you point the nose high in the sky (the earth drops out of sight) and close the throttle. The sensation is like one of those bad dreams in which you run harder and harder only to fall further behind. For a fraction of time there is a sense of minus-G, and then you drop, your intestines apparently whizzing through your head.

For the spin, you let a stall develop. The nose drops steeply downwards, and the sky vanishes. The plane goes round and round – like an autumn leaf – and the fields 4000′ below whirl dizzily by. The degree of blood-pressure is an indication of how well developed the spin.

After all that and having spent what seemed to be enormous sums of money, the flying club sent off my application for a licence to the Board of Trade.



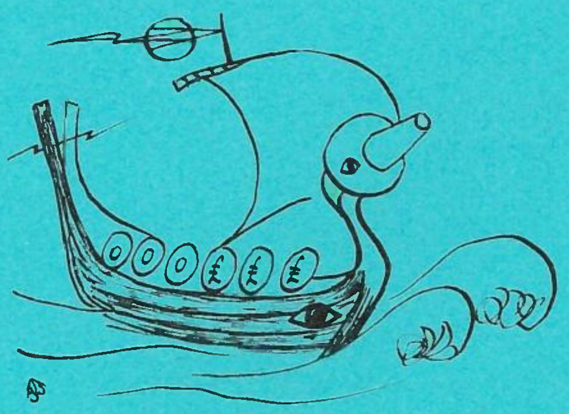


Drawings by the author.

nutcracker 6 – collaboration

stop press The following problem has just arisen. Please send your solutions – urgently – to **Quest** or a Council member. The names have been changed to preserve our natural reticence in such matters.

The six-member European Council for Underwater Transport is having difficulty in assembling a 4-nation consortium for its latest project, the Supersonic Nuclear Livestock Carrier, or SNARK. The idea is that each nation should be responsible for one of the four major design elements, but the plan has hit some snags. Belgium will only join if both France and Italy do, Austria will only join if Germany does, and cannot build the steering gear. The UK will only join if it can build the hull or the reactor, and even then only on condition that the reactor is not built in France or the electronics in Italy or Austria. Neither Germany nor Italy can build either the hull or the steering gear, and if both these countries participate, they can only be kept from quarrelling if France builds the reactor. France will only build the steering gear if the reactor is made in Germany. So who builds which piece of the SNARK?



SR at/C

'. . . staff may be required for duty in aircraft in flight, in ships afloat or in submarines submerged'. Memories still survive of the earnest debate around the inclusion of this in the terms of service and six years later one of us at least began to think it was going to be altogether too apposite. Well, perhaps it wasn't exactly a duty, but when the SRC crew assembled at Gosport on October 22 for the Inter-departmental Race (yes!) to Cherbourg, gales had been blowing all week and the Channel reports were 'very rough'. Imagine *sailing* at the end of October! Well there we were – Skipper Paul Dickinson (RSRS), Phil Warner (LO), Norman Walker (RGO), Joan Paton (LO) and Les Barber who joined us when the sudden illness of Martin Hall (RSRS) left us without a 'qualified' skipper and Paul got promoted.

The cross channel race was a new venture organised by the Civil Service Sailing Association. The forecaster insisted that we should continue to get fresh to strong wind from the SW – just where we wanted to go. So, despite brave words from some members, I suspect that more than one was secretly relieved when the original plan was called off and the 'heavy weather' course substituted – Gosport to Cowes on Friday evening, with a second race on Saturday, aggregate results to decide.

We promptly set sail, reefed down as far as we decently could, in 'Precedent' – the new Hustler 30 belonging to the CSSA which we had been lucky enough to draw. Equally promptly the wind disappeared (we really shall have to tackle those chaps on the LO roof) and we were left battling a foul tide. Perhaps too we were under other handicaps – having to make do with cruising sails and having at the start suffered a broken jib halliard and discovered the need for one or two other things such as minor sail repairs. Oh well, it *was* the end of the season. Even without a log, we achieved a speed of nearly 1.5 knots. I suppose sailors get to be philosophical about these things.

Saturday having seen the CSSA boats practically alone at the mooring piles at Cowes a conference of skippers agreed, as there was still little wind, on a circuit of the Isle of Wight for the second race. Again it turned out to be not so much a race as a trial of patience, despite the odd sacrifice to Poseidon (don't get me wrong – $\frac{1}{2}$ np a time – I suppose we just haven't come to terms with inflation).

We drifted, we anchored, we did clever things with the tide, we discovered some new features of a foggy early morning Solent (the next morning). What might have been a tedious experience was lightened by a most splendid night – warm, clear, bright with stars and meteor showers. The description 'almost photometric' must have entered the vocabulary of several crews.

At last we completed the 60 mile course – in something over 26 hours – and somewhat wearily made our way back to Gosport. This SRC team can at least claim a satisfactory degree of consistence – we finished last each time – but somehow perhaps

because others were less persistent the final result gave us third place. If the general organisation had a faintly ad hoc flavour well surely even the Civil Service must relax. Anyway the crew certainly enjoyed themselves in the not altogether comprehensible way of sailors generally and hope to be allowed another try next year when maybe we will make a better showing.

Proposed grant for 1972

Q column by 'observer'

letters

If you want to make a protest, why not write to Quest while you're sitting. Your message could get to 3,000 people.

Dear Editor
There seems to me to be little doubt that the two persons posing with UK4 on the cover of the last issue of Quest *were not female. I have a strong suspicion, moreover, that they were members of SRC's scientific staff moonlighting (or satelliting) to enhance their meagre salaries. I fear there will yet be worse to come in the wake of the recent disgraceful pay settlement.*

Yours etc.
IPCS member

MISSING: SSO.SAL.2655–3255. Last used for tightening the bolts on the ARU package for Skylark rocket SL 902X.

It is believed that this may be the rocket that became directly involved in ping-pong diplomacy. If anyone's listening in (this page is bugged) please may we have our ball – sorry! – our rocket back. The SSO is replaceable.

IS good handwriting holding YOU back?

ADVERTISEMENT

Detailed statistical analysis using the most modern computer methods has shown that an awful lot of senior people can't write legibly. We conclude that there are positive advantages, promotion-wise, in cultivating a distinguished but indistinct scrawl.

FOR FURTHER INFORMATION send £1 with a sample of your handwriting to Box 131. You will receive ABSOLUTELY FREE an unbiased assessment of your promotion chances.

IF YOU HEAR NOTHING within ten days you can take it that your letter was not delivered because the address was indecipherable. In that case, congratulations! – FOR YOU THE SKY'S THE LIMIT!

Quest Box 131.

Quest footnote to Ad. above

'fair copy'

We have thought about this and have decided that in most cases the top man's secretary can't read his handwriting either. Like many another power behind the throne in fact she is expected to rewrite his notes and edit his speeches. His scrawl obscuring whether her transcript is like the original or not, serves to preserve the myth that He is the boss and She the mere amanuensis. We have also noticed that the handwriting of all the top women we know, and likewise of aspiring secretaries, is plain enough for anyone to read.

(inserted on behalf of FD (Feminine Deliverance) 2 Ed.)

wide open

Almost fifteen husbands, wives, children, and staff from various SRC establishments attended the 'SRC is one big happy family' Day at State House last month. After a brief visit to see the newly installed liquid soap dispensers, whose presence unequivocally demonstrates the proud part which Whitleyism plays in the everyday life of the Council, our guests toured the offices and meeting rooms to see the exhibitions and live demonstrations of LO activities specially arranged for them.

The high-spot of the day was to have been a visit to the Council Room to hear the third day of discussion on Foreign Postdoctoral Assistants (Employment on Grants) but unfortunately this had already been referred back to the Boards for further consideration. Instead, the visitors watched the Senior Officers' Luncheon Trolley Race, an event which has only recently been introduced but is already very popular, especially with the junior staff.

They also saw an example of the magnificent teamwork of which we are so proud when two of the scientific staff demonstrated the technique of transferring an incoming telephone call from one extension to another. The executive staff also played their part, with a notable lecture with lantern slides on 'The History and Development of the RG2 Form' and an equally lucid exposition entitled 'The Functional Directory – Fact or Fiction?' But perhaps most impressive from a visual point of view was the moment when the clerical staff released a million sheets of paper, representing a year's output of Committee papers, from windows on the fifteenth floor. It was a moving sight as they floated to the ground.

And so our guests left and we went back to our normal routine. We hope to see every one of them again next year – you have to have something to look forward to, after all.

top copy

It has frequently been suggested that scientists are poor at expressing themselves in English. To refute this claim, we present extracts from the current Forward Look exercise. The Council minutes will be published in full in the Times Literary Supplement.

Brian Flowers of Holborn
By the Four Boards he swore
That the proud Nuclear Physics
Should hold its funds no more
By the Four Boards he swore it
And named a cutting day
And bade his minions all write forth
East and west and south and north
To summon his array.

But in his Northern fastness
Sir John did gird for war
Prepared to fight for Nimrod
Till he could stir no more
And Paul stood on his left side
(A leftish man was he)
'Now, who will stand at my right hand
To hold our funds with me'.

(and so on for 3850 more verses)

From 'The Merry Wives of Holborn'

Mistress Ford

Now is the winter of our discontent
Made glorious summer by our flowery king
And all the scorn that poured upon our heads
Beneath our metal mountains buried
Now are our cunning works displayed in galleries,
Our praises sung, and honours richly heaped.
But yet remain some envious, churlish, knaves
Who will not bow and render all they have
To raise the glory of great Engineering's name,
They shall not stand; their stiff necks shall be bowed
Now secretly to Flowers, then in Council room speak loud.

Meanwhile, back in Science Division

'We gotta act now', muttered Athenaeum Chris, absent-mindedly filing his nails on B/SR/986. 'So what's up?' asked Gentleman Geoff. 'It's the Oily Hand Gang, Adams' mob. They been growing too fast, and now we gotta bust'em once for all'. 'So who do we send in?' 'Crystals' Mason?' 'Nah, he's a new boy. Hatchets Henry 'ed make mince-meat of him. It'll have to be Many-Hans-make-light work Kornberg, and even he'll not do if the Brain's with 'em. We gotta problem'. 'Can we do a deal?' 'With the Oily Hand Gang, never. Hold it though. Maybe we make an alliance. Get me Big Jim.'

Footnote *All the names mentioned above appear in the SRC Directory of Council, Board and Committee Members, published by the Council Secretariat. B/SR/986 and many more like it may be found in SS & E Registry at London Office.*

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chaser

A recent advertisement in *Quest* for GEORGE (was it from Miss IR of Bromley?) got no less than seventeen calls (three obscene, five cranks, eight misunderstood husbands and a man who claimed to be the Isaac Newton Telescope) but they either turned out not to be George or to be the wrong variety.

But QUEST FOUND HIM! In fact we decanted him from a bottle of Chinon (no. 5) at a recent wine tasting at London Office.

After we had wrung him out to provide enough of the no. 5 for the gathering to taste he let fall a few broken words '. . . away . . . at Atlas . . . it worked! (*gurgle*).' It is our recommendation that the back of the Atlas computer should be taken off at once and the contents examined.

3C 48

Send your advertisement to **Quest** at London Office

all in a day's work

A. G. Wilson

Outside of the laboratories we in SRC have little chance of discovering anything of interest and we have no antiquity. It is of course different in many of the older Departments. Not long after the last war, in the Ministry of Transport, I was given the task of examining the old Board of Trade railway papers prior to their despatch to the Public Record Office. These papers had passed to the Ministry on its establishment in 1919, when it had assumed the statutory responsibilities for the railways hitherto exercised by the Board. Historical records of this character were required under the Public Record Office Acts to be deposited when no longer required departmentally, but oversight and war-time storage had delayed matters.

The papers were delivered to me from the registry. They were in bundles, well ingrained with dust and if ever they were adequately indexed the indices had become depleted or lost. Old records in bundles emit a fine dust which penetrates and irritates the skin. Pulling them apart was a disagreeable experience, but the contents soon had me fascinated. I was handling the original survey reports, drawings and correspondence from the time that the railways were laid down in the 1840's. Most were in the handwriting of the engineers, but occasionally a fair copperplate ended in a rough signature of another hand indicating a clerk's assistance. The plans were in ink and colour wash, identical with those shown today in the Science Museum.

As I sifted through the papers I recognised the signatures of men whom history had associated with early Victorian engineering, including George Stephenson, and one particular document in George's handwriting was of current interest. It was peculiar in that having filled up the sheet of paper, he turned it sideways and continued to write across what had already been written. It was not easy to read, but I saw that he was giving his views to the Government on whether it should control the new railway systems. This had particular relevance around 1947 as the Transport Act, which nationalised the railways for the first time, was under preparation.

During my examination of the letters among the documents I was at first puzzled why so many had holes in the middle. Then I noticed that they had been folded with the ends tucked in, and sometimes sealed with wax, before being posted without envelopes. The holes had been caused by some enterprising rogue's removing the stamps, the early and valuable Penny Blacks! I suspect that this had occurred during the war-time storage. I was anxious that the Stephenson letter should not find its way into some private collection so had it registered in the Ministry's strong room. The custodian, to whom I explained what I was depositing, took it upon himself to shew it to a colleague in the Railways Division, who in turn took it along to the Chief Inspecting Officer of Railways. This worthy was a typical retired army officer of the old school, who like his fellow inspectors had spent most of his active life in India. (Only in the army could experience be gained of laying down new railways of any magnitude at that time). He was Lt. Col. Sir Alan Mount, who was prominent in the Institution of Mechanical Engineers, and the I. Mech. E rightly honour George Stephenson.

The next I heard of the document was that Sir Alan had obtained the Principal Establishment Officer's approval to present the document 'that he had discovered' to the I. Mech. E. But Acts are Acts and after confirming that I was on safe ground with the Record Office I gained some small pleasure in formally telling my Establishment Officer that other claims on the document were paramount. The document duly went to the Record Office with the rest of the papers (among which was the file on the Tay Bridge disaster, starting with the telegram saying that the bridge was down) and for some time was in the museum in the Chancery Lane building. It was written up with photographs in, I believe, the journal of the I. Mech. E.

This little episode came back to me recently during a Sunday evening stroll through Putney Vale cemetery. My eye alighted on a stone emblazoned with the badge of the Royal Engineers. It was the grave of Sir Alan Mount.

centenary visit

A Divide-by-8 Scaler from the Cavendish Laboratory of 1932 must have stirred some memories during the Royal Society visit to the Rutherford Laboratory.

The visit formed part of the celebrations organised by the Royal Society to mark the centenary of Lord Rutherford's birth (see Quest October 1971 p.6). The Laboratory laid on special exhibitions and demonstrations. These included Nimrod itself, the K12A experiment (an RHEL-Birmingham University collaboration on Kaon/Nucleon scattering) and experimental techniques on counters and target technology.

The Laboratory is used to welcoming eminent scientists but perhaps not so many at once. In the photograph (taken in the coffee lounge) can be seen:

Professor H C Webster, Emeritus Professor of Physics, University of Queensland, and Scientific Counsellor at the Australian Embassy in Washington. 1

Dr G H Briggs who was Chief of the Division of Physics, Commonwealth Scientific and Industrial Research Organisation (Australia) until his retirement in 1958. He then became an Honorary Research Fellow of the Australian National Standards Laboratory until 1969. 2

Sir George Thomson, the son of the late Professor J J Thomson, is Emeritus Professor of Physics at London University. 4

Lord Bowden is Principal of the University of Manchester Institute of Science and Technology. 8

Dr D M Robinson is President of the High Voltage Engineering Corporation, Burlington, Massachusetts, USA. 10

Dr J B Adams is Director of the CERN 300 GeV Accelerator project. 12

Professor E Amaldi came as a representative of the Accademia Nazional Dei Lincei and he is also President of the CERN Council. 13

Talking to the visitors are some of the Rutherford Laboratory hosts:

Dr G H Stafford, Director of the Laboratory. 9

Mr D A Gray Head of Nimrod Division. 5

Mr N M King Leader of the Accelerator and Beam Theory Group, Nimrod Division. 6

Mr W Walkinshaw Head of Computing and Automation Division. 7

Professor W D Allen who holds a joint appointment at the Rutherford Laboratory and Reading University. 3

D Sc

Dr. B. C. Fawcett

The University of London recently awarded the degree of D.Sc. to Brian Fawcett, a Senior Scientific Officer in the Astrophysics Research Unit at Culham. Dr. Fawcett has been engaged in spectroscopic studies of high temperature plasma sources since 1957. After working at Harwell on the ZETA project, he moved to Culham in 1964 where his work has been concerned with the identification and classification of atomic spectra. Using the techniques of extreme ultraviolet spectroscopy, Dr. Fawcett has identified many new spectral lines of highly ionized elements and so provided data of great importance for astrophysics research. The D.Sc. degree was awarded in recognition of Dr. Fawcett's published work in the field of spectral line classification.

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new year honours

We congratulate Dr. D. E. Adams who receives an OBE and Mrs. M. F. McMillan who receives an MBE.

Dr. Adams is a Senior Principal Scientific Officer in Engineering Division, London Office, and Mrs. McMillan, a Senior Personal Secretary, works for the Director of Science Division, Mr. Jolliffe.

Honours were also received by a member of the Council, Professor F. Hoyle FRS who is created a Knight Bachelor for services to astronomy, by a member of the Engineering Board, Mr. D. J. Lyons, Director of the Road Research Laboratory, now a CB, and by a member of the RSRS Committee, Professor R. L. F. Boyd, FRS, Head of the Mullard Space Science Laboratory, University of London – a CBE.

here and there

Promotions to Senior Principal Scientific Officer during the second half of 1971 include Mr. D. B. Shenton who is now Projects Manager at the Astrophysics Research Unit. Also included are Dr. A. H. Gabriel of ARU and Dr. P. F. Smith and Mr. N. M. King of the Rutherford Laboratory who received Special Merit Pro-

1 2 3 4 5

6 10

7 11

8 12

9 13

Number references to photograph above – see 'centenary visit' opposite

motion. Quest apologises for an error in the October issue (p. 14) which indicated the wrong grade. Dr. B. E. J. Pagel of the Royal Greenwich Observatory is Deputy Chief Scientific Officer.

Mr. J. Fox of Rutherford Laboratory has a temporary appointment for three years at CERN as a Visiting Scientist on the 300 GeV project. He will work on the powering problem of the superconducting option for the machine and related power supply topics. He is also a member of the Power System Planning Committee of the IEE.

Mr. P. Wilde of Rutherford Laboratory has been appointed Visiting Professor to Westfield College, University of London.

Mr. C. T. Bocutt, formerly Secretary of the Computing Science Committee, has joined the Civil Service Department on a five year term of secondment.

report six

launched into 1972

The need for an independent Research Council entrusted with real powers and responsibilities is stressed by the Science Research Council in the sixth Annual Report. It points out that a Research Council is well able to judge the merit of educational and research proposals and to relate them to work in other disciplines and to the main needs of Industry and Government. It is also uniquely placed to attract people to voluntary public service who have the right experience and qualifications to advise on the best use of public funds. *(See page 2 of the Report).*

The report goes on to say that the Council is certain that there will not be sufficient funds to carry out the full programme that could be justified on educational and scientific grounds and expects that the university population will grow faster than the Council's resources for the support of research and higher education. Determination of priorities is therefore more important than ever. The pressure to spread resources more widely, and therefore more thinly, may make it more difficult to carry through the long-term capital projects that are needed if British workers are to continue to make an important contribution to scientific advance. *(p. 3).*

The Council is to continue to give priority to engineering and the applied sciences and to selected areas in the biological and physical sciences. It plans to increase support for neutron beam research and to maintain some priority for astronomy with a view to building a new northern hemisphere observatory. In the field of nuclear physics the domestic programme will have to be reduced to allow for the cost of taking part in building the 300 GeV accelerator at CERN. *(p. 3-4).*

In optical astronomy some projects which got under way in 1970-71 were: the decision to build a 48 inch Schmidt telescope on the same site as the 150 inch Anglo-Australian Southern Hemisphere telescope; the agreement with the South Africa Council for Scientific and Industrial Research to set up a new observing station in the Karoo based on the present Cape Observatory; and testing of possible sites for a new Northern Hemisphere Observatory. *(p. 13-15).*

The construction of the 5Km Radio Telescope at Cambridge was nearing completion, as were the repairs and modifications to the Mark I Radio Telescope at Jodrell Bank; and a detailed design study was commissioned for a 375 foot dish that could be linked to the Mark I at Jodrell Bank to form an interferometer with a baseline fifty miles long. Studies began on a proposal for an accurately figured dish to work in the millimetre band. *(p. 15-16).*

The building and dome for the 60 inch infra-red flux collector at Isana, Tenerife, were completed under the collaborative programme, ready for the telescope to be installed, and a design study was begun on a large 120 inch flux collector. *(p. 16).*

In space research preparations on the scientific satellites UK4 and UK5, due for launch in 1971 and 1973, were under way and the geosynchronous ultraviolet astronomy satellite project SAS–D was under discussion. The sounding rocket programme continued from the sites at Woomera, Kiruna and South Uist and included the first flight of the moon-pointing attitude control unit (ACU) and the flight of the first prototype model of the star-pointing ACU in Skylark rockets from Woomera. *(p. 17-21).*

The development of a young engineer's postgraduate education and training to meet both his own specialisation and the needs of industry was an immediate concern of the Engineering Board. It set up a working group which recommended wider training in the fields of research, development, design, production and marketing, their interrelationships, the function of management and the employment of

A new body in the sky brought 1971 to a fitting close for the space researchers. Formerly known as UK4 but now renamed Ariel IV to mark its successful transformation into a heavenly body, the satellite really begins to work for us in 1972 when data transmitting from the experiments gets into full swing. It should be visible through 7 x 50 binoculars from the United Kingdom by the end of January.

With our eyes rather on Europe at the moment, Ariel IV is also a reminder of the many ventures we undertake in collaboration with the United States.

Photos: on left is the satellite container and, on right, the four-stage Scout rocket ready for take-off.

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economic criteria: a concept that has been labelled 'Total Technology'. *(p. 23).*

The completion of the CERN Intersecting Storage Rings four months ahead of schedule and within the original budget was a highlight of the year for the Nuclear Physics Board and so too of course was the Government's agreement to let Britain take part in building the CERN GeV Accelerator. The Board had pressed for this for four years. These two machines, with the other accelerators already on the site, will give CERN a collection of high-energy physics equipment superior to any in the world and British physicists will now be able to take part in work of the highest class until the end of the century. *(p. 26).*

At home the Rutherford Laboratory's work on superconducting magnets made great strides and a design study was completed on a 15/20 GeV electron synchrotron which could be built at Daresbury using NINA as an injector. Both Laboratories had teams working on important experiments and installations at CERN, and Rutherford began its collaboration with Karlsruhe (Germany) and Saclay (France) on development of the superconductors. *(p. 27-29).*

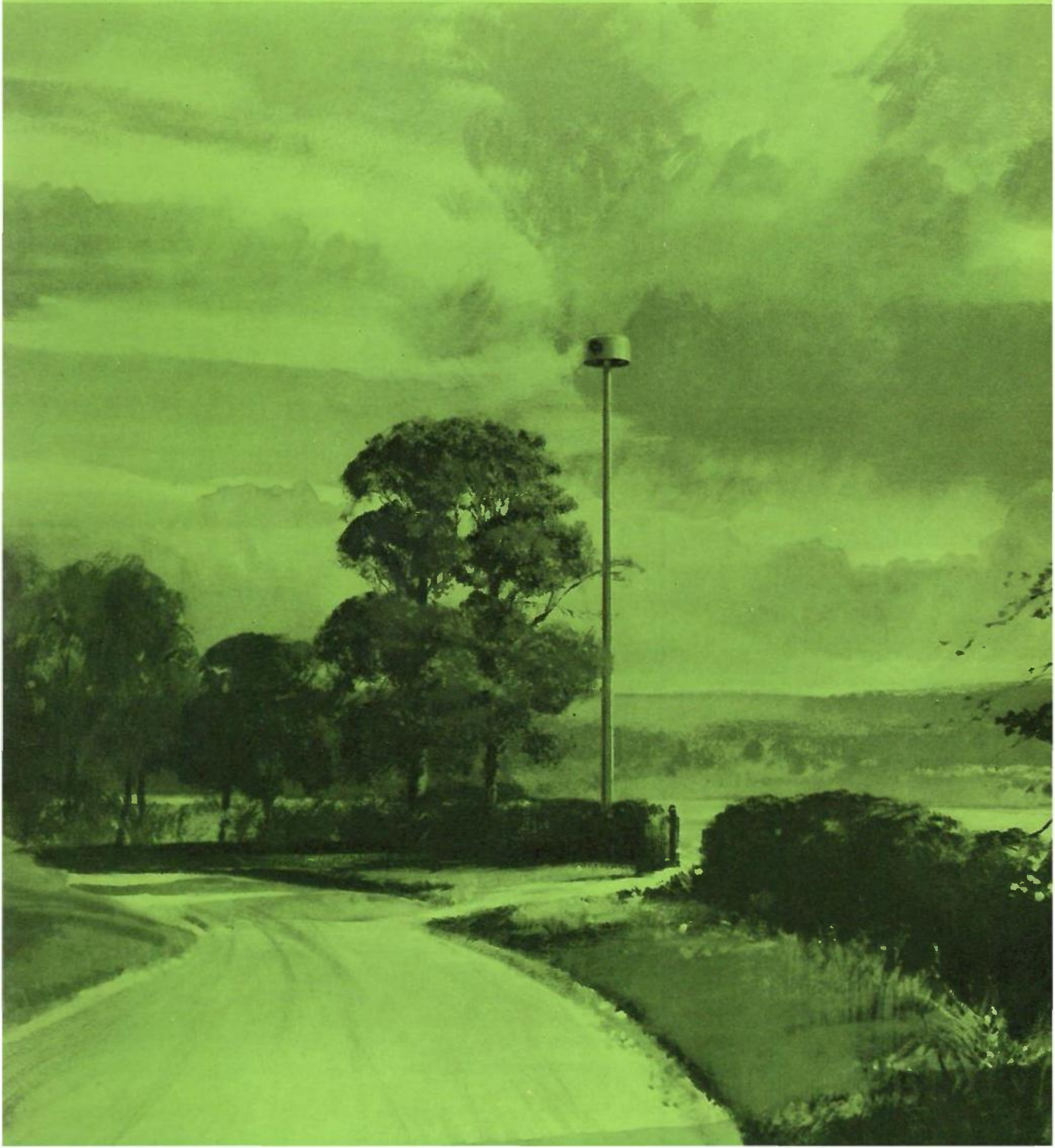
At universities a start was made to renew equipment for the film analysis units so that they could measure film from CERN's new large bubble chambers BEBC and Gargamelle (a heavy-liquid bubble chamber).

The Computer capacity at Atlas was about to be trebled by the installation of the new British Computer, ICL 1906A, due to be working by late '71, and the central computer at Rutherford was to be replaced by the IBM 360/195, six times as powerful as the present model 75, that could also be linked up to augment the new Atlas Computer. *(p. 34).*

A special section on Research in Physics is an important part of the report. Physics in its various fields takes about three quarters of the SRC budget and all four of the Council's Boards have some part in it. The Nuclear Physics Board supports high energy and nuclear physics; the Science Board supports atomic, solid state, plasma and applied nuclear physics through the Physics Committee and neutron-beam physics through the Neutron-Beam Committee; the Engineering Board supports materials and applied physics; and the Astronomy, Space and Radio Board supports astrophysics. *(p. 35-54).*

The special section concludes 'There is no doubt that the achievements chronicled here have made a substantial contribution to our knowledge of matter and radiation and are greatly to the credit of the people concerned in the universities and SRC'.

QUEST



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QUEST

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Cover picture
An artist's impression of the slender pole that will carry Post Office microwave equipment of the future. The research into microwave propagation that is being carried out by the Radio and Space Research Station in collaboration with the Post Office and the ITU is described by John Lane in the article on page 14. In the picture the mast head canopy carries all the electronic equipment and the two dish antennas. It will be possible to lower it to ground level for maintenance using a cable and winch inside the pole.

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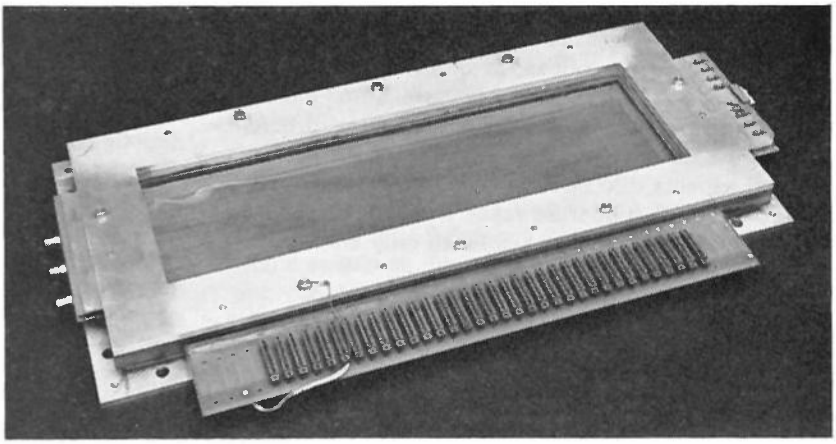
QUEST

The theme of the supplement in this issue is Technology. The supplement covers some aspects of how we help to improve the ways and means of carrying out basic research and, from another angle, how basic research leads to progress in technology.

Both sides have featured of course in the discussions, arguments and press comment following the Rothschild and Dainton reports on the organisation of Government research and development. The Science Research Council's own views, as expressed to the Select Committee on Science and Technology, are recorded in a shortened form in our first article.

An example of one of many new developments designed at one of our laboratories to help basic research, is shown in the picture.

The multiwire proportional chamber (seen right) is one of the newest types of instrument developed for the detection of charged particles in high energy physics experiments using particle accelerators. Designed and built at the Daresbury Nuclear Physics Laboratory, it allows high counting rates with good spatial resolution. The proportional chamber, signal wire electronics and the serial read out unit were shown at the 1972 Physics Exhibition.



after Rothschild

After the publication of the Rothschild and Dainton reports 'A Framework for Government Research and Development' as a Green Paper (Cmnd 4814), the five Research Councils gave evidence at an inquiry into the Government's involvement in and policy towards R and D. The inquiry was undertaken by the Select Committee on Science and Technology, Chairman Mr. Airey Neave, MP.

Speakers who appeared for the Science Research Council on March 8 were the Chairman Sir Brian Flowers, FRS, Sir Alastair Pilkington, FRS—a Member of the Council and the Engineering Board, Dr. J. A. Saxton—Director RSRS, and Mr. R. St. J. Walker, CBE – Director Administration.

The Council's comments on the Green Paper were published beforehand. The submission to the Inquiry stressed certain important points and four extracts are quoted here. The first two contain a summary of the SRC's programme and the kind of work it is supporting. The second two are a summary of SRC's comments on the reports and its proposals for the future management of the DES Science Vote.

What SRC does

The SRC manages some national services, such as keeping the time and providing data for navigation and radio communications. But almost all its funds are devoted to basic research and postgraduate training in mathematics and the biological, physical and engineering sciences. Nearly all the research is done by universities which employ about 14,000 academic staff in the science and engineering departments. SRC uses its resources of manpower (about 1,000 scientists) and money to supplement those already available in universities and similar teaching institutions in order to enable effort to be mobilised for promising research and to ensure advanced training relevant to national needs.

In many fields covered by SRC, firms and government departments carry out in their own laboratories, through research associations and through contracts, R & D which costs several times the SRC budget. The research which SRC supports is basic, as originally defined in paragraphs 6 and 7 of the Rothschild Report, and aims to provide the information, understanding and trained manpower required for applied R & D performed elsewhere. An additional aim, particularly in the engineering field, is to enable university departments to attract support from government departments and industry for applied work which helps to ensure the relevance of their research and teaching. When a programme undertaken to increase basic understanding also tackles a practical problem of interest to individual firms or departments the Council expects it to be funded jointly. It is, however, rare for an SRC-supported research programme to be valuable, or potentially valuable, to only one user.

Comments on the green paper

The Council finds it disappointing that Lord Rothschild gave such cursory attention to the two most difficult problems for government R & D:

a. determining which programmes are most worthwhile and what should be spent on them; and
b. ensuring that the results are exploited to the greatest public benefit;

and instead devoted disproportionate attention to the DES Science Vote in a report purporting to be concerned with the applied R & D.

SRC feels that a continuing dialogue between the users and the providers of R & D is essential to the solution of both these major problems. Much of the R & D financed by the government is for the general benefit of the community rather than for direct application by government departments. Most users of the R & D are in industry and the professions. Government organisation should therefore ensure that the knowledge and skill of industry, the professions, universities and polytechnics, executive departments, NRDC and other Government agencies contribute to the management of public expenditure on R & D. Wide participation in choosing research programmes not only leads to better decisions but automatically generates the dialogue which increases the prospect of useful results being applied.

So far as to the work of the Research Councils is concerned, the SRC thinks that a government department should certainly commission any applied R & D it needs for its own purposes. But the results of most of the work supported by Research Councils are potentially applicable by many users. Appointing a single department as a proxy customer for many users (including other government departments), coupled with the complete separation which Lord Rothschild recommends between the responsibility for basic research and applied R & D programmes financed by government through Research Councils, would lessen the chance of the right projects being chosen, would prejudice the natural interaction of research projects, would increase the difficulty of ensuring that the results are applied and would lead to wasteful duplications. To ensure that this does not happen, good governmental coordinating machinery as well as the continuing dialogue which Lord Rothschild recommends is essential. This machinery can readily be developed through the research council system on the lines suggested by the Dainton Committee with the added advantage of wide participation in the management of the programme.

Whatever framework for government R & D emerges for the future, Lord Rothschild's proposals for strengthened departmental chief scientist organisations are most welcome. Since these organisations will take two or three years to become fully effective in determining policy toward R & D the sooner they are set up the better. SRC would be glad to help in this. However, the timetable suggested for the transfer of responsibility for whatever part of the Research Council programmes is eventually agreed to be applied R & D commissionable by government departments is much too short to allow the build up of the necessary chief scientist organisations, to examine what work should be covered by the transfer and to ensure the maintenance of financial control.

the DES Science Vote

In its proposals for the future management of the DES Science Vote the Council says that executive departments cannot play their proper part in helping to manage the work of the Research Councils simply by being given an arbitrary fraction of the budgets of some Research Councils so that they can decide whether to commission R & D or to spend the money for other purposes. They need to be able to influence appropriately the course of whatever applied R & D and basic research (especially the part which the Dainton Committee describes as strategic) is undertaken by the Research Councils. Whatever arrangements are made for the commissioning and control of research, departments will only excercise influence if they set up effective chief scientist organisations and actively use the machinery of government to further their own policies. The present research council system provides a good basis for developing the necessary arrangements along the following lines:

- Each executive department should be responsible for commissioning the applied R & D (as defined in paragraphs 6 and 7 of the Rothschild Report) which it either needs for its own purposes or for whose potential users it is manifestly the best proxy customer
- The remainder of the Research Council programme should continue to be financed through the DES Science Vote
- Members of the Research Councils and their committees should be appointed either in consultation with the appropriate departments or in part on their nomination. The industrial and professional organisations concerned should also be consulted directly about some appointments to councils and committees. Departments should ensure that at least one member of each body with which they are concerned carries the departmental brief
- The appropriate departments should be represented on a new Board for Research Councils on the lines of that recommended by the Dainton Committee
- Departments should make effective use of the existing machinery of government to influence the allocation of resources to all R & D programmes including the DES science budget.

The SRC believes that the re-allocation of responsibilities for programmes between Departments and Research Councils in accordance with these arrangements should be made in the light of joint reviews of the current programmes and needs. Such reviews will be required whatever decision the Government takes about the future organisation of R & D. The Department of the Environment, the Department for Trade and Industry and the SRC have therefore begun a joint review of the work which they support in selected fields to check whether there is any undersirable duplication, whether any work now funded by the Council would be more appropriately funded by the Department (or vice-versa) and whether any improvement can be made in the present arrangements for collaboration both in managing R & D programmes and in trying to ensure that the results are used. The first fields to be considered are control engineering, transport, mechanical and production engineering and computing science.

Finally the SRC says that setting a framework for managing the DES Science Vote on the lines proposed would enable all departments concerned with research and development to have an appropriate say on the broad allocation of resources between programmes, on the division of the DES science budget between individual Research Councils and on the programmes pursued by the Research Councils with the resources made available to them. It would ensure that the important research financed through the DES Science Vote continued to be managed openly with regular reports laid before Parliament and with typical users of the results having a voice in the determination of programmes. It would give the benefits sought by Lord Rothschild's proposals without administrative complications and without enervating the creativity and inspiration which alone makes scientific research worthwhile.

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council commentary

december

The main item on the agenda was preliminary consideration of the Government Green Paper "A Framework for Government Research and Development" (Cmnd 4814), on which the Secretary of State had asked for the Council's comments. The Council gave guidance for the preparation of its reply and agreed to consider the question again in January.

The lease of the Annexe to the London Office expires in 1973 and, in view of the Government dispersion policy and the high cost of accommodation in central London, the Council considered the whole question of future accommodation. Proposals for a joint London Office have been discussed with the other Research Councils but there is not a close enough identity of circumstances to enable an immediate plan for sharing accommodation to be feasible. The Council decided that, wherever the London Office was to be established, it would be necessary for ease of communication to have a base in London for holding meetings of Council, Boards and Committees. The Office were asked to prepare for consideration at a later meeting proposals for the future accommodation of the London Office staff. It is hoped to submit these proposals in May, following a survey by a joint Official/Staff Side Working Party.

Council went on to consider the future role of the Atlas Computer Laboratory. The Laboratory was set up in 1961 to help provide central computing facilities for universities. For the most part universities now have access to their own computers provided through the Computer Board and the University Grants Committee and have less need to use the ACL. Council approved the new function of the Laboratory, put forward by Dr. Howlett, that the Laboratory should concentrate on carrying out large or otherwise special projects for universities, particularly projects supported by SRC grants and requiring substantial guaranteed blocks of computing time. In addition the Laboratory will continue its own programme of development of system architecture, software and computing techniques.

january

The Council finalised its submission to the Secretary of State on Cmnd 4814 (The Rothschild and Dainton Reports) in the light of the discussion at the December meeting and subsequent developments, including discussions with the Department of Trade and Industry and the Department of the Environment. The submission was subsequently published. The main points are summarised on page 1.

Council approved a grant of £155,000 to Dr. Pounds at Leicester University for his part of a joint experiment with American Science and Engineering for flight in the NASA OSO-J satellite. The aim of the experiment is to carry out detailed high-resolution studies of the active and quiet coronal regions. Observation of the inter-relation and development of physically identifiable features will greatly help the study of the quiescent corona, the large-scale solar magnetic fields and the structure and evolution of the active regions. Council also approved expenditure of £300,000 for a rocket campaign to be held at Kiruna or Andoya in 1973. There is considerable interest in space research experiments flown at high latitudes, because of the upper atmosphere conditions in the auroral regions, and the 1973 campaign will include both Petrel and Skylark rockets to enable experimenters to get the maximum scientific return.

In engineering, Council approved a grant of £243,700 to Professor Rosenbrock at the University of Manchester Institute of Science and Technology to continue his work on design of multi-variable control systems. The UMIST Control Engineering group is one of three in this field on which the Council has concentrated support. The central research of the group represents a new approach to control of multi-variable systems and the first version of the design package has now been developed. After detailed assessment, a second more advanced version will be produced and it is expected that the highly developed system capable of implementation will be available by late 1975. This work involves the use of results from a series of industrial projects and the system being developed will have many applications in industry.

Whenever a suitable opportunity arises, the Council discusses the work of one of its subject Committees, in relation to the health of UK research in that subject.

february

At this meeting it reviewed the work of the Mathematics Committee and Professor Cockcroft, Chairman of the Mathematics Committee, and Professor Jeffrey, Chairman of the Engineering Mathematics Panel, took part in the discussion. Professor Cockcroft spoke of the substantial growth in mathematical research in recent years and particularly mentioned the useful part played by symposia in making advances in chosen areas. Notable examples were the symposium in topology of manifolds held at Cambridge in 1964 and more recently, that in differential equations at Warwick. The Mathematics Committee are hoping to arrange symposia in statistics, operational research, numerical analysis and other branches of applicable mathematics. Professor Jeffrey spoke about the recently published report of the Engineering Mathematics Panel. The Panel had been set up to assess the mathematical needs of engineering and technology and to consider how these needs could be met. The most benefit is likely to come when engineers and mathematicians are working side by side and the Panel are considering joint engineering/mathematics projects at postgraduate level, study groups where research workers from industry and government

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selectivity

'Staff Side will wish to know that RHEL propose to introduce a new industrial shift system called the Second Harmonic Cavity Assembly Shift.'

O. S. Letter

Do they do it with tuning forks and amalgam and then transpose – or the other way about?

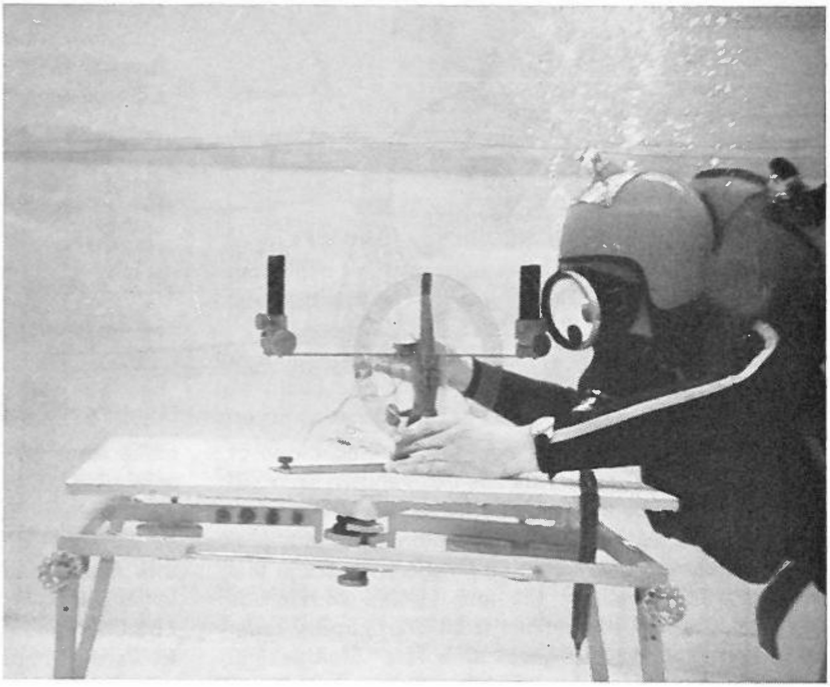
oceanology

A new method for surveying the sea-bed that is being developed under grants from the Science Research Council and the Natural Environment Research Council was displayed at the Oceanology International Exhibition held in Brighton recently (March 20–24).

The SRC grant, to Strathclyde University, covers the development of surveying instruments for use underwater. These include a modified plane tabling system, to use with an underwater alidade, and an illuminated target staff.

The NERC grant covered the design and construction of a collapsible catamaran which is suitable for both diving and hydrographic work and can be packed up and carried in a car-drawn trailer.

The exhibit was displayed by the Department of Education and Science (on behalf of the two Research Councils) and formed part of a joint display to show the UK Government's part in oceanology research and development.



In the picture Dr Peter Milne, Lecturer in Civil Engineering at Strathclyde, is seen testing the alidade and table in the University swimming pool.

council commentary continued

laboratories would be invited to discuss their research problems with mathematicians, and seminars in areas of engineering which rely heavily on mathematical techniques.

The Council went on to review its various post-doctoral Fellowship schemes. It was agreed that in future there should be one unified scheme providing about 60-70 awards each year. It is proposed that the value of the new Fellowships should be linked to the university lecturer scale, which would bring them more into line with other sources of support, and Government approval for this increase in their values is now being sought.

Council also approved purchase of an IBM 370/165 computer for the Daresbury Nuclear Physics Laboratory, at a cost of £2.1m., to replace an existing IBM 360/65 which will be transferred to Liverpool University. In order to satisfy the requirement of the on-line links to experiments and interactive computing by the use of display terminals, the Laboratory's need is for computing speed. The maximum power of the 370/165 is about four times that of the present 360/65, which was purchased in 1966. If the Government approve the purchase, the new computer should meet the needs of Daresbury up to 1980.

summer school

Culham Laboratory is running another Summer School introductory course on Plasma Physics and its applications in other branches of physics and in technology. The course is suitable for final year undergraduates and postgraduate research workers. Apply to UKAEA Culham for further details.

concentration

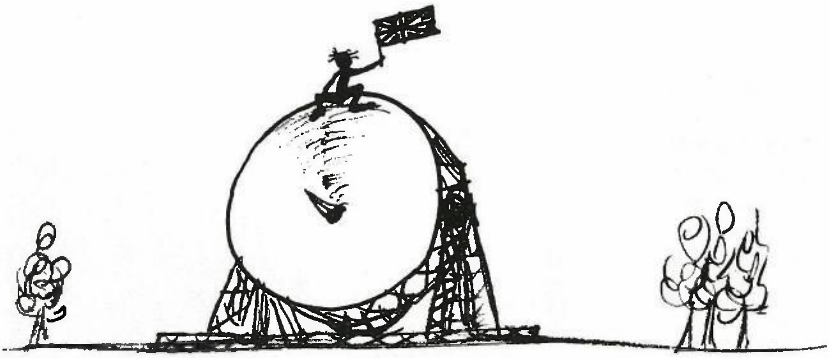
On the flight to a meeting at London Office, two chaps from ROE were busily going through the paperwork in case they found something they should know about, when one took time off to remark 'I must get hold of that Rothschild/Dainton report sometime.'

He nearly leapt out of his seat when a man across the gangway leant over and said 'I think you'll find it's out of print but I have a copy here I can let you have'.

'Who are you then – Lord Rothschild?' he said, recovering a little. 'Oh no I'm Dainton' he said.

a place in the sun

How and why we built a 60 inch Infra-red Flux collector in Tenerife **Richard Harris**



... the grant was increased ...

The rewards of entering a new field or technique of science are often great. This has been shown dramatically in the last quarter century by radio astronomers: UK scientists have drawn inspiration from the pre-eminent position enjoyed by radio astronomers in this country who started in the late 1940's with crude radio telescopes, often built from war-surplus radar equipment, and now have elaborate facilities at Cambridge and Manchester.

Back in 1968, infra-red astronomy was judged to be another such exciting new field. Already groups in the USA were making infra-red observations with small telescopes, or rather "flux collectors" as they are called, since infra-red astronomy does not demand the same optical precision as optical astronomy.

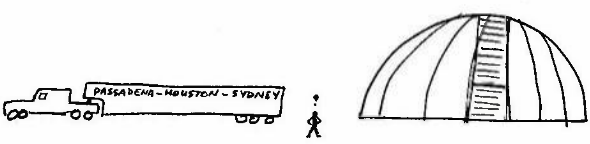
In 1968 a proposal was put to SRC by Professor Jim Ring, head of Imperial College's Infra-red Astronomy group for a large — probably 120 inch — flux collector which would be available to UK infra-red astronomers. As a first step, a simple 60 inch device was to be built quickly and cheaply for site testing before embarking on more permanent and costly facilities.

Other groups expressed interest and it was decided to provide a joint facility. A grant of £27,000 was made to Imperial College in October 1968 for the construction of the site testing instrument and for a design study on the larger one. All the interested groups were associated with the project and a Management Committee was constituted including not only members of these groups but also a number of engineers including Gordon Carpenter of the Royal Observatory, Edinburgh. As design work went on it became apparent that a little more money spent on the flux collector structure and on the building would make the 60 inch instrument capable of useful scientific work for a number of years. The 60 inch mirror, then being polished by Sir Howard Grubb Parsons & Co. Ltd., was known to be adequate for this more exacting role without additional cost. So in September 1970 the grant was increased to £56,000 and detailed design work was pressed forward at Imperial College on the new basis.

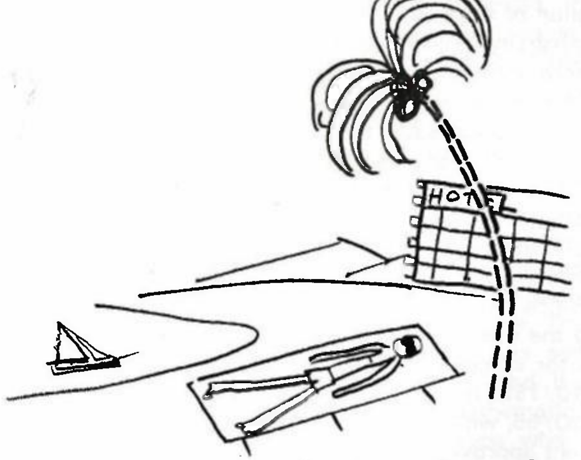
It was clear that there could easily be a lot of delay in getting the flux collector operational unless the job was planned adequately so Astronomy section of London Office weighed in with a series of network analyses of the project.

The contractor for the flux collector structure was Dunford Hadfields Ltd. of Sheffield whose research and development team undertook the work in one corner of the company's huge erection shop (their normal work is making rollers for use in steel rolling mills). Working closely with the designer, John Long of Imperial College, the firm was able to meet his exacting specifications accurately with the result that a highly engineered job has been produced.

The list of possible sites for the flux collector read



... shipped in segments ...



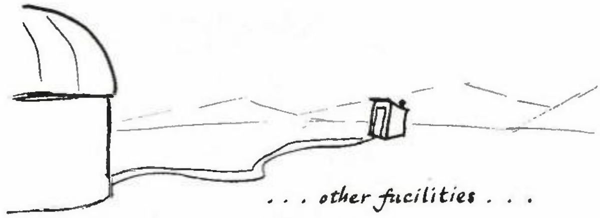
... attractions of Tenerife...

like part of Thomas Cook's brochure. Finally the choice lay between a spot near a remote meteorological station at Izana on the island of Tenerife and a site in the Sierra Nevada mountains of Southern Spain, so site testing was started. There is no space to record this process in detail here (somebody may write the troubled story of astronomical site testing one day), let it suffice to say that the attractions of Tenerife proved to be stronger. A building contractor was instructed to erect a circular concrete structure on the slopes of Mt. Teide (an extinct — we hope — volcano) in readiness to receive the flux collector and the dome.

Then due to a misunderstanding, workmen engaged in re-laying a nearby public road extended their operations horizontally rather than vertically, as they had been directed, with the result that the road surface, somewhat thinner than planned, extended almost to the door of the observatory. The dome was prefabricated in USA and shipped in segments to the site for erection under the guidance of the manufacturers.

Meanwhile, back at Dunford Hadfield's the flux collector had been shop assembled and people from the Royal Observatory, Edinburgh, had arrived with black boxes containing the complex drive and control system, which had been designed and built in the ROE workshops. After trials had been completed successfully, the flux collector was despatched to Tenerife where it arrived in January 1972. It was followed soon after by the mirror, which had been

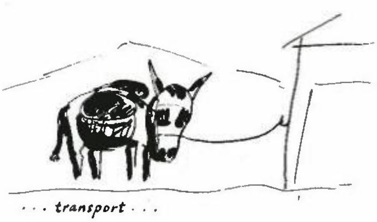
Richard Harris is an SSO in Astronomy, Space and Radio Division. Drawings by the author.

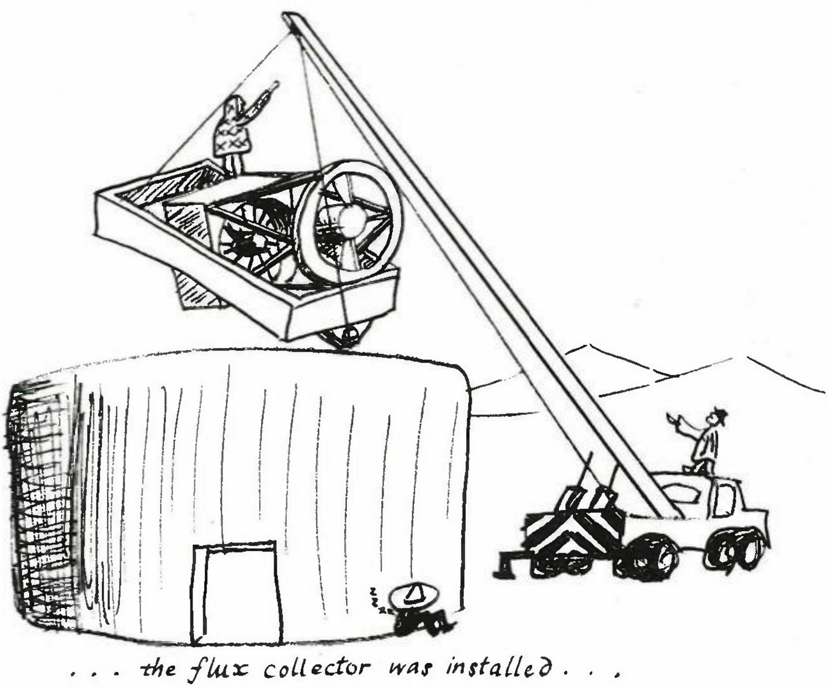


aluminised in the Isaac Newton Telescope coating plant at the Royal Greenwich Observatory.

On Tenerife, transport to take the flux collector up the mountain road and a crane were ready but dense low cloud and three metres of snow also visited the site. In spite of this the flux collector was installed by Professor Ring and his team and the dome securely fastened over the whole. We know that it is secure, because there was a storm of unprecedented violence within days of completion. All that remains to be done is to build a small office and workshop, with other facilities, on the site near the dome. By the time this is in print it is hoped that the flux collector will be sending a flow of astronomical data to the various groups of IR astronomers in the UK.

Already the design of the larger flux collector—the goal of the whole exercise—has been narrowed down to two possible concepts and design studies will be put in hand shortly. This next step is essential if UK astronomers are to achieve and maintain a significant role in the field of infra-red astronomy. The creation of the first instrument provides a good example of cooperation between SRC establishments and University groups, led by Imperial College.





We think this may be the long-lost team from ROE who have been studying possible sites for a new northern hemisphere telescope. Apparently, no doubt worried that a site south of the border might be chosen after all, they have taken the matter into their own hands. The new astrophysical dome is 9ft. 3ins., built at a cost of £12.97* and we believe may be used to house a 6 inch magnifying glass for observing astronomer's frostbite.

**Unfortunately work did not begin until March when funds for 71-2 were sorely depleted by 'Foreign Travel' (cf seasonal greeting under sub-head A.2).*

SEARCH

An exhibition called 'SEARCH' of scientific research supported by the SRC and the Agricultural, Medical and Natural Environment Research Councils is now on at the Science Museum, South Kensington, until the end of October 1972. The overall theme of the exhibition is the relevance of scientific research to everyday life and exhibits are designed to show the general public and especially young people what research scientists are doing. The four aspects of the theme are science and agriculture, science and health, science and the environment and science and space. Four associated lectures will be given to science teachers. The exhibition is sponsored by the Department of Education and Science.

maths
moths
meths

— or divine inspiration ?

What lies behind closed doors in the labs of SRC? Are you, for instance, the spanner in the works or the genius of the lamp of progress ?

TELL QUEST

SEND IN ARTICLES, NEWS, PICTURES AND ODD ITEMS WHENEVER YOU CAN.

The theme of Quest's July issue will be SRC in Europe and international co-operation generally. If you have any ideas, short anecdotes or pictures please tell your local correspondent or the editor (as listed inside the cover) **before May 26.**

The theme for October will be computers and their uses. Please send articles (250 words to 1000), pictures and suggestions as soon as possible and **before July 14**.

write for Quest now

QUEST INTO TECHNOLOGY

Supplement on technology and research in the Science Research Council

In the days of DSIR "technology" was used as the generic term for all activities other than the sciences. In the UGC structure the "Technology" Sub Committee incorporates "engineering and other technologies." In SRC however it is the "Engineering" Board which covers the traditional engineering disciplines and some other subjects which are primarily technological. By extending the scope of technology to include the methods of human and social sciences as well as the physical sciences the circle is completed with the adoption by the Engineering Board of "Total Technology" as the definition of a proper subject of study for a general background in engineering. So much for our understanding of the meaning of the terms we use.

In SRC it is a cardinal point of policy to give special support and encouragement to engineering - and its relevant technologies - independently of any support which arises as a natural consequence of the pursuit of the "big sciences."

Space availability here permits only the briefest statement. In 1962 out of nine sub-committees of the Research Grants Committee of DSIR, only one was devoted to technology. Its grants totalled in that year about £1m., some 40% of the sum committed by the "little sciences". In 1963 metallurgy and materials was recognised as an independent subject incorporating what had been low-temperature and solid state physics. Despite its partial content of pure science this was later, with technology, to be incorporated into engineering. At this time the two subjects committed £2m. about 60% of the sum committed by the pure sciences. In 1964 the Computing Science Committee came into being, another subject to be incorporated later into engineering. With the setting up of SRC in 1965 several more engineering committees were instituted. Recognition of the special requirement to help the development of engineering in the universities was highlighted with the setting up of the Engineering Board in October 1969. Compared with one committee and £1m. of grants in 1962 the situation in 1972 is nine committees and nearly £9m. of grants – more than the total for the "little sciences".

A physicist at the Daresbury Laboratory operating a remote graphics terminal to examine the nature of the data being collected.

fast data links

The development of on-line computing and data links at the Daresbury Nuclear Physics Laboratory.

Trevor Daniels

The term 'On-line' computing, like many concepts in a rapidly expanding field, is not precisely defined, but at the Daresbury Laboratory we mean the intimate connection of computers and experimental equipment for the purpose of data acquisition and experimental control. If the computer and equipment are not adjacent, 'Data Links' are used to transmit information between them.

Fast data links continued

In the course of a high-energy physics experiment four distinct phases may be identified: design, setting-up and checking-out, data taking and data analysis. Each of these phases can benefit tremendously from the application of on-line techniques. For example, in the setting-up and checking-out phase, on-line connection to a computer enables the tedious checking of electronics or the measurement of magnetic fields to be performed quickly, accurately and with full documentation. In data acquisition a computer is almost vital as a means of data collation and validity checking. If it can also perform partial analysis on-line and feed graphical results back to the experimenter, as well as keeping an eye on the correct functioning of experimental equipment, it becomes a powerful tool.

early uses

On-line computing is not new. Small computers were first attached to experiments a decade ago, and considerable improvements have been made since then. Small computers are, however, unable to perform complex data analysis on-line, and we cannot afford to dedicate larger computers to a single experiment. Clearly one answer is to share the facilities of a large powerful computer between many experiments. This has been achieved in several laboratories by a variety of techniques. At some there is intermittent connection to the central machine while others provide a continuous service to selected users. At Daresbury we have attempted to provide a continuous service to many users.

the Daresbury system

The data link system at Daresbury was developed with the following aims. The system should be painless to use and users should not have to be aware that between their own equipment and the central computer there is a complex system of data handling equipment. All users should be insulated from the activities of other on-line and normal users. In particular it should not be possible for an error on the part of one user to have a disastrous effect on another. The links must be capable of handling the highest data rates likely to be produced by experiments and it must be possible to invoke any data analysis program and have its results relayed to the experimental area. The adoption of these ideas has covered many fields in hardware and software design. These include the writing of a complete operating system for an IBM 1802 computer which controls the operation of the data links and the design of a communication system between the IBM 360/65 and the IBM 1802, which is not susceptible to users programming errors and which permits the users to write programs for the IBM 360/65 in a simple language (FORTRAN) for on-line operation. The reliability of the IBM operating system also had to be improved in order to achieve the design aim of a mean-time to failure (for any reason) in excess of 24 hours. The hardware design included the development of fast reliable data links and graphics terminals which allow two-way communication with the on-line program.

The system has been developed during the past few years and by now most experimental groups are reliant on their on-line programs for the normal running of their experiments. Most groups use the power of the main computer to make extensive checks on the validity of incoming data and on the correct functioning of the equipment, and to follow the course of the experiment by partially analysing data as it is collected.

The benefit to the physicists was best described by one of the group when the IBM 360/65 broke down, due to hardware failure, and he said 'We can continue to run, but it's as if we were running blind'. At Daresbury we have tried to provide facilities which will enable experimental physicists to run with their eyes fully open.

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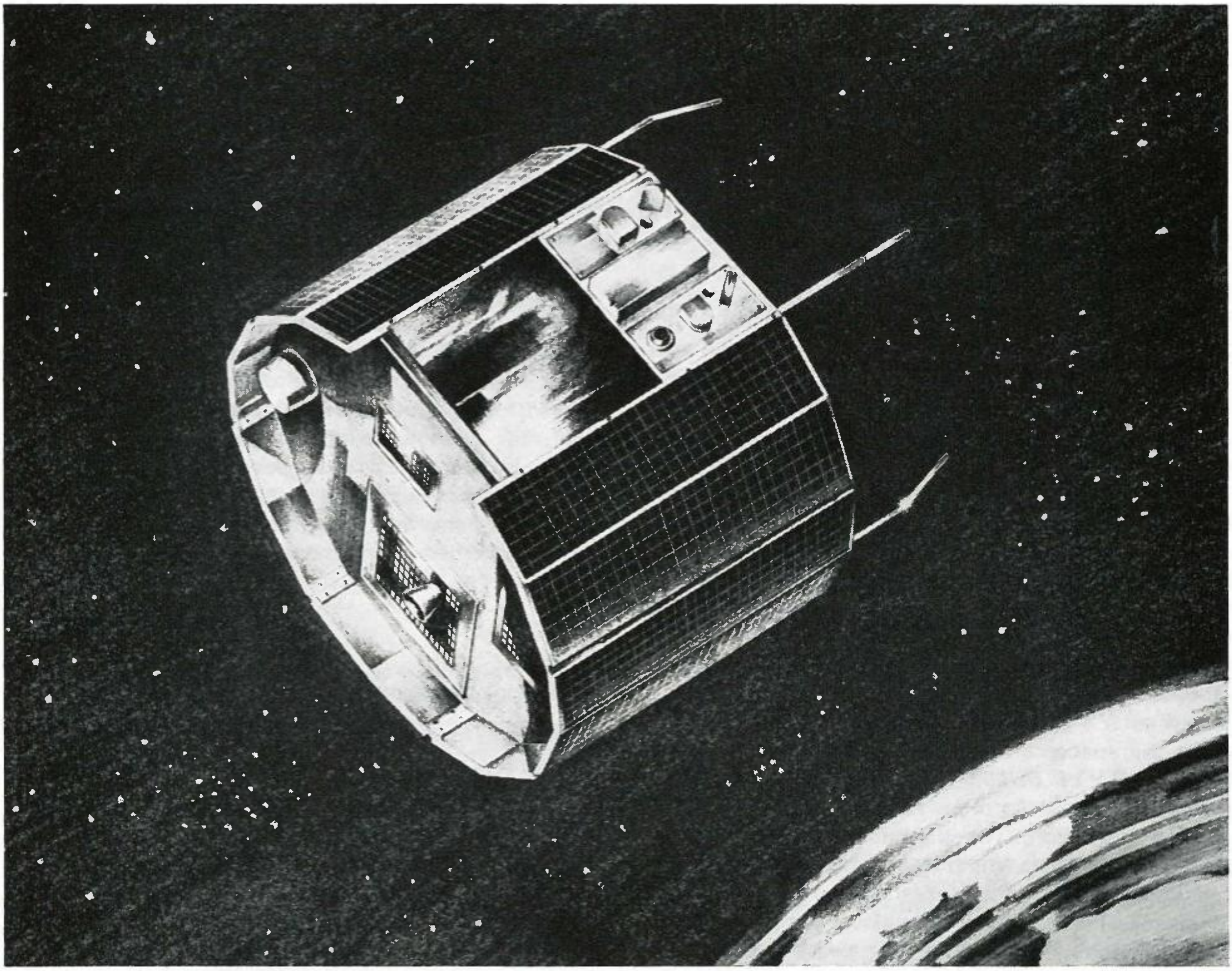
problem

The Engineered Mathematics Committee has obtained approval from the Pure Science Board (motto "To the pure, all things are pure") for a high growth rate for its Parallel Lines programme. In a slight fit of absent-mindedness the Board has allocated £1m. for the first year of the programme and agreed that expenditures may increase at an average rate of 20 per cent a year for the next five years. The Committee are confident that this is a bankable assurance.

What expenditure, in total, has the Board committed itself to or, looking at the situation from a different point of view, for how much has it been taken?

answer

If your answer is about £10m., or if you have given any numerical answer, you're wrong. The Committee can (and will) take the whole of the Board's funds in years 2, 3 and 4 whatever the growth rate specified, provided that it takes nothing in years 5 and 6. It all depends what you mean by "average".



Artist's impression above is reproduced by courtesy of Marconi Space and Defence Systems.

satellite technology UK5

J. F. Smith

The overall management of the scientific satellite programme in this country has been the responsibility of the SRC since its formation when the Space Research Management Unit was transferred to it from the Office of the Minister for Science. The satellites concerned comprise the Ariel series (called 'UK' before launch) which are the product of collaborative programmes with the US National Aeronautics and Space Administration (NASA) who supply the launch vehicles. Ariels I and II were American satellites with British experiments, whereas Ariel III was built in this country. Ariel IV was a development based on Ariel III, with increased control capability and an attitude control system. It also had, for the first time an American experiment on board, and had an overall scientific objective rather than being a collection of experiments.

The UK5 satellite is devoted entirely to x-ray astronomy, an exciting new science (*see Quest January 1972 page 9*). It is the most sophisticated SRC satellite to date and its construction is well under way. The launch will probably take place from the Italian San Marco platform off the coast of Kenya using a NASA Scout rocket, in late 1973. Launching from this site will enable an equatorial orbit to be achieved, which is preferable so that the payload of six cosmic x-ray experiments will be less affected by the radiation belts and the South Atlantic anomaly.

The UK5 Programme Management covers all aspects of the project and is concerned in all its phases. It has a headquarters function in collaboration with both NASA Headquarters and the Ministry of Defence Procurement Executive Headquarters staff. MOD (PE) act as SRC agents in the procurement of the spacecraft from contractors who are, for UK5, Marconi Space and Defence Systems, Portsmouth. The management team also work at project level with

UK 5 continued

the Goddard Space Flight Centre of NASA, with the Royal Aircraft Establishment (RAE), and with the experimenters. It has a special responsibility for the experiments to ensure that they are produced on time, correctly tested and built to the right standards. All aspects of the programme are covered – from payload inception through to launch operations, post launch control and data processing.

UK5 is a spin stabilised spacecraft which is designed to rotate at 10 rpm in orbit. During launch the Scout fourth stage and the payload will be spun up to about 170 rpm to give stability to the assembly while the fourth stage is burning. After separation from the motor the satellite spin rate will be reduced using gas jets, fired on command from the ground, until the correct rate is achieved. The gas used will be propane, and a ten pound charge of this will be adequate not only for de-spin and subsequent spin maintenance operations, but also to power the attitude control gas jets for all the attitude movements required for about two years of operation. This will be the first time that propane has been used in a satellite attitude control system although RAE has already tested such a system in a Skylark rocket payload.

As the spacecraft is spinning the attitude control jets have to be pulsed one at a time at a specific rotational position in order to tilt the spin axis in the required direction. The direction is determined by reference to signals from the spacecraft sun roll-phase sensor, and the amplitude by the duration and number of pulses. These quantities will be computed at the control centre, based on the existing spacecraft attitude and the next point in the sky at which the satellite and the four pointing experiments will be aimed. The other two experiments observe sideways from the spacecraft and hence continually scan the sky as it rotates.

Although one experiment uses a relatively simple and direct command system to turn it on and off and to control its modes of operation, the others, and also the attitude control system, use command registers. Commands from the ground station are given in a tone-digital form, and these are decoded in the spacecraft, routed to the appropriate register, and then a succession of noughts or ones are, as it were, pushed into it from one end until it is full. There may be as many as 25 of these, which in theory means that that particular register can be loaded in 2^{25} ways, each of which could represent a different command state. Of course only a fraction of these possibilities are used but it still represents a large number of available conditions. After the register has been loaded the exact state of each part is telemetred back to the ground where it can be checked. The command condition which has been set up is not acted upon by the satellite until a further enabling command is sent, and this is normally only transmitted after checking the command register loading.

The data obtained from the experiments will be sorted, and stored in one of two core stores on board the spacecraft. These stores and their accompanying circuitry act as computors with a limited number of programs which can be selected by command. In general the experiment outputs obtained while the satellite is in one particular sector of its rotation are stored, and added to on later rotation, this being carried out over a finite (and variable by command) number of sectors. Once in each orbit signals representing the contents of the stores are transmitted to the ground, on command, and these represent, for each experiment, a set of x-ray pictures taken in each scan sector and integrated over the orbit. By combining the signals in this way in the spacecraft, the amount of information to be stored and transmitted is enormously reduced.

'the most ambitious undertaking of its kind'

Satellite control is a disembodied type of activity, as one can never see or touch the equipment one is controlling. The UK5 control will be the most ambitious undertaking of its kind to be operated from this country. The satellite will be in an equatorial (or near equatorial) orbit and will not pass within telemetry range of the United Kingdom. There will only be one NASA STADAN station covering UK5, at Quito, Ecuador, although the NASA Ascension Island station will be acting as a back-up facility. UK5 will pass over the Quito station once in each orbit, 15 times a day, when transmission of the core store data should be commanded. All of the data taken will be collected together, probably at the Goddard Space Flight Center (GSFC) near Washington, and sent via the NASA data links to the control centre at RSRS once a day. This data will be processed on the control centre small computers and the station 1904A, and passed by data links using telephone lines to the experimenters in Holmbury, Leicester, and Imperial College. The necessary commands will be decided by the control centre staff based on the previously agreed observing programme and requests from experimenters and the project scientist, and technical limitations or problems.

In addition data from one pass will be transmitted directly it is received, to RSRS, so that the spacecraft attitude can be computed using both the data from the on-board sensors and the known orbital positions when the data was taken. The commands decided will be checked by computer and then transmitted over the data links to Quito where they will be verified and stored in the station command encoder. On the appropriate pass the commands will be passed to the spacecraft, the achievement of the correct state verified either at the station or at the control centre, which would then be receiving the data at the same time over the links, and after verification the enabling command will be sent. The spacecraft will then execute these commands, *eg* by changing atitude or experiment command state, and the next 24 hours observing will begin.

The technologies involved in UK5 cover telecommunications, data processing, electronic components manufacture, structural design and testing, gas control system design and proving, electronic equipment and test equipment manufacture and test, and environmental testing. No one person can have a thorough knowledge of all of these subjects but it is this wide variety of technological activity together with the scientific interests and the range of personalities encountered, and also the excitement of a live project which make satellite programme management such an absorbing occupation.

John Smith is the Satellite Programmes Manager (Eng I) in the Space Research Management Unit (SRMU). The Unit was transferred from London Office to the Radio and Space Research Station on February 1, 1972.

The UK experiments in UK5

- **Measurement of source positions and sky survey in the energy range 0.3 — 30 KeV. MSSL/UCL.***
- **A sky survey in the energy range 1.5 — 20 KeV. LU***
- **A pointed experiment to study the spectra of individual sources in the 2-10 KeV energy range. MSSL/UCL***
- **An x-ray polarimeter for the 4-20 KeV band. LU***
- **A pointed experiment to study high energy x-rays. IC***

the experimenters*

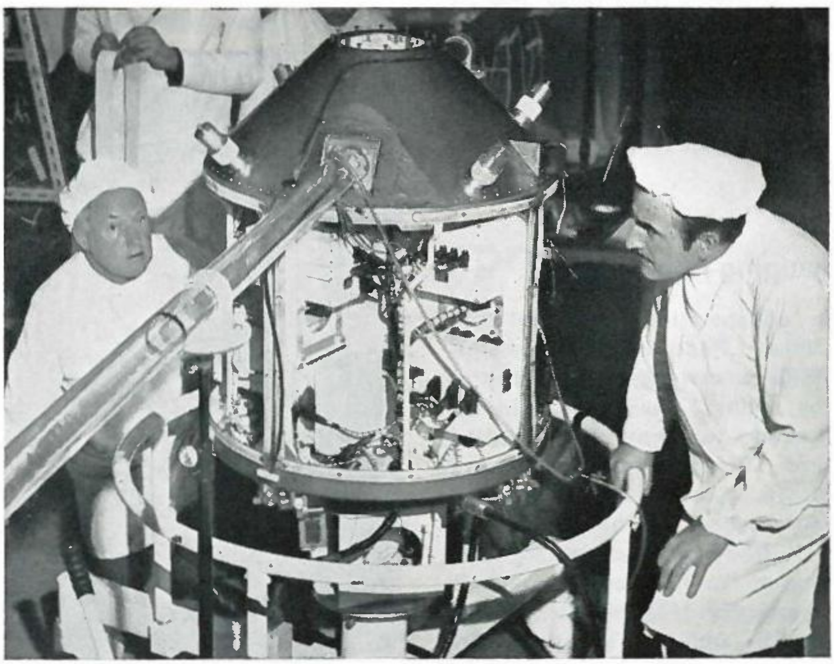
The Mullard Space Science Laboratory of University College London (MSSL/UCL)

Leicester University (LU)

Imperial College, University of London (IC)

all systems go

Fine adjustments to the data output systems before the launch are most important in satellite technology. Seen in picture below are V.A.W. Harrison (l) and D. G. Carter, of the Radio and Space Research Station, carrying out a pre-launch check of the UK 4 (renamed Ariel IV) pay load. The satellite went into orbit in December and is now transmitting data from all five experiments to measure the intensity of the electromagnetic radiation (noise) over a wide band of radio frequencies (for details see Quest Vol. 4, 3 p8).



a systematic look

'Investigations are under way into the yields and reliability of strippers' says the first NSF newsletter. Eager to find out more we began at the beginning and discovered that the newsletter is an account of progress on the design study for a new nuclear structure facility – a large tandem electrostatic generator.

If it is eventually decided to build the generator it will be a national facility and studies are centred on siting it at Daresbury. The newsletter will be published periodically for the benefit of possible future users to give them a chance to comment on the proposed plans – and, no doubt, on the peripheral studies on which we look forward to hearing more.

microwave propagation

millimetre investigation at RSRS aids progress in communication

J. A. Lane

A feature of modern technology is the rapid growth of radio-communication links, in both terrestial and earth-space systems. Telephone traffic, data communication and telex services are all expanding rapidly and several new systems may be in use by the 1980's. While some of the demands can be met by the installation of more coaxial cables, considerable extension of radio links will be necessary, especially at very short wavelengths—'microwaves'. But the existing microwave system which has formed a major part of the Post Office trunk network in the last 20 years, has no more channels available. The use of even shorter wavelengths is now vital.

Unfortunately, the advantages of very short wavelengths – large information capacity and compact equipment – are off-set to some degree by the fading caused by various weather conditions. Large changes in humidity and temperature on the radio link can occasionally cause serious fading. Even more important is the absorption produced by heavy rain. For example, at a wavelength of 1 cm, thunderstorm rain could cause a reduction of ten times in received power for every kilometre of path through the rain. These effects need to be studied so that the most efficient use can be made of millimetre waves, for both ground-to-ground and earth-space systems.

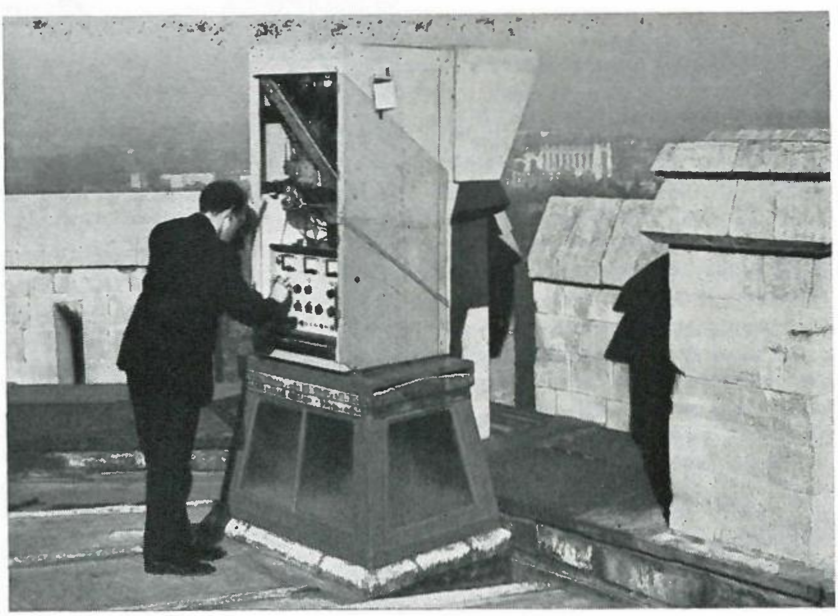
gauging rain fading

In collaboration with the Post Office Research Department, RSRS is carrying out a study of the fading caused by rain on ground - to - ground microwave links. The main experiments are located in the Martlesham-Mendlesham area of Suffolk.

RSRS has constructed a new type of rapid-response rain-gauge specifically for use in these studies and has installed forty gauges on two lines of a network of microwave links near Mendlesham. The readings from each gauge can be transmitted, via a radio telemetry link, to a central control and data-handling station. A reading can be obtained every 10 seconds and will be recorded together with data on fading from the several links. The latter are of various lengths, spacings and frequencies so that a comprehensive investigation will be possible of the experimental and theoretical features of fading caused by heavy rain. A particular requirement of great practical importance is the study of the spacing needed between adjacent, alternative routes in a microwave system so that if serious fading occurs on one path an alternative route with little fading can be used.

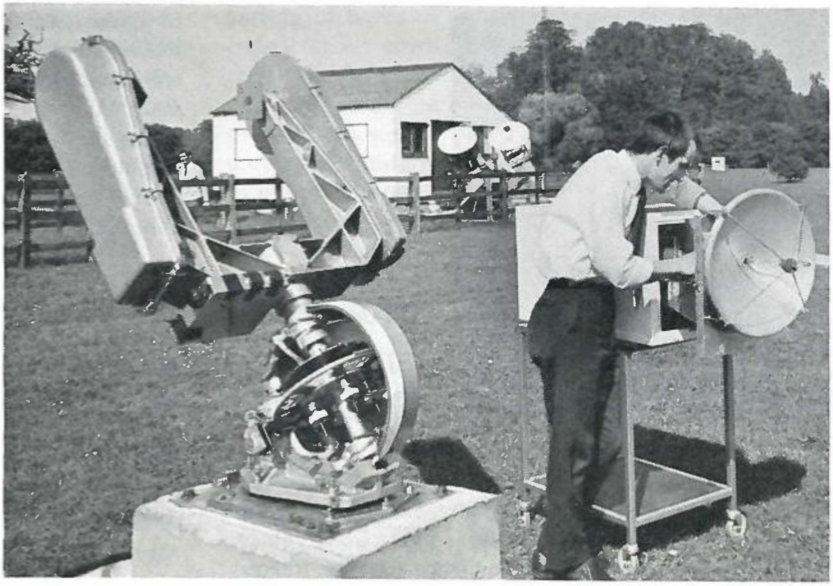
To supplement the rain-gauge information, two radars (one 3-cm band; one 10-cm band) have been installed at a site just to the NW of the network. These radars will provide information on the location and approximate intensity of rainfall structure over the network. Radar observations and combined microwave and rainfall measurements are now in progress, and the full scheme will be be in operation later this year.

Several other investigations are in progress which will extend the experiments on terrestrial links to wavelengths shorter than in use at Mendlesham .For example, a 3mm link was set up in 1970 between Windsor and RSRS, a distance of 2.7 km. The results on the fading observed during 1970 and 1971 show that even wavelengths as short as 3mm are of significant practical application for local distribution of telecommunication services, and the information has already been used



by the Post Office to make a preliminary assessment of the feasibility of such local networks.

Studies of the theory of absorption by rain are also in progress, using results from a short link (500 m long) equipped with 4 rapid-response rain-gauges. Furthermore, on the basis of both the Suffolk experiments and the more fundamental studies at the RSRS site, attempts will be made to extrapolate the results of the effects of rain on millimetre links to other regions of the UK.



other obstacles

In relation to terrestrial microwave links, experiments have been carried out in collaboration with, and largely funded by, the Post Office, to measure directly the extent to which tall buildings can scatter microwave energy. Such scattering could seriously limit the information capacity of radio links. The technique used is to irradiate a building with pulses from a radar transmitter mounted in a helicopter near the building. A fixed receiver a few kilometres away measures the relative amplitudes of the direct and scattered signals.

Other studies are related to the important problem of the reliability of earth-space links. Microwave radiometers are being used at several wavelengths to measure the fading caused by varying weather conditions and to investigate the relationship of the results to meteorological data. Two techniques are employed. In one, the radiometers automatically track the sun, which serves as an extra-terrestrial microwave source. In the other technique, measurements are made of the "noise" radiation from the absorbing media in the troposphere (rain, clouds, water vapour and oxygen). The results obtained at wavelengths near 1 cm have already been used to provide a guide on the reliability of earth-space links for the UK area. The results are also being used in international discussions, especially in the International Radio Consultative Committee of the International Telecommunication Union, to help establish an agreed procedure for predicting the performance of earth-space links on a world-wide basis.

Equipment is being assembled for a project, in which several international groups will participate, designed to acquire information about the effects of rain-storms on the propagation of 2.5-cm radio waves transmitted from a nominally geostationary Communications — research satellite called SIRIO, to be launched in 1973. RSRS will be using 5 receivers at various spacings along an East-West line together with an additional receiver to the North of the line. The results will provide data both on the spacings required for "switched-path" operation (to minimize the effects of rain), and on the information capacity of the links. Data from the receivers will be fed to the Station over land-lines and recorded on magnetic tape for subsequent analysis.

Dr John Lane is a Senior Principal Scientific Officer and leads a Division at RSRS that carries out Troposphere and Radio Wave Propagation work.

pictures: left installing a radio telemetry link on a church tower near Mendlesham.

Above: R J Powell at RSRS adjusting one of the solar-tracking radiometers.

spring

Give me green fields
Give me blue skies
Give me cool breezes to cool my brow
A track to walk through
A dog at my heels
A singing bird in the tree
A bee a-humming
A pair of eyes to see the beauty of life
My favourite season of all: Spring.

Jeanette Aird, RHEL.

Figure 1

progress on GALAXY

N. M. Pratt

The General Automatic Luminosity and X Y Measuring machine, GALAXY, at the Royal Observatory, Edinburgh, was designed to measure the star images on photographic plates taken with Schmidt telescopes. The 48 inch Schmidt telescope being constructed for the Science Research Council for erection in Australia in 1973 can photograph an area of sky 6½ degrees across on a single 14 inch square plate. Such an area of sky is nearly that of the bowl of the Plough. With this telescope, one plate with an exposure of about ten minutes will contain of the order of one million star images, the faintest of which are one million times fainter than can be seen with the unaided eye.

To measure such a store of star positions and brightnesses by hand is out of the question. GALAXY was designed to carry out this task completely automatically. The machine was designed in consultation with ROE staff and built by Faul Coradi Scotland Limited. A description of the machine and its modes of operation appeared in *Quest* Vol. 3 No. 2.

The prototype machine was completed in March 1969 and by October that year had exceeded the performance specification and had been formally accepted. An automatic fire system installed in January 1970 increased the usable time on the machine from about 8 hours a day to full 24 hour operation, including weekends. This has been achieved with two full-time operators, whose duties include preparation of the plates and the preliminary examination of the output by means of an offline computer and two part-time operators – part-time because of other associated duties. One of them (the author) is responsible for developing the computer software necessary to handle the enormous amount of data output by the machine.

In the two years of full operation, GALAXY has measured four and a half million star images on 400 plates sent in from fifteen establishments.

About half of GALAXY's output has originated at ROE. The very first job involved the measurement of about 20,000 stars on each of nine plates, four inches in diameter, of the same region of sky. Software had to be devised to identify each individual star, using its X and Y coordinates only, on all the plates and to bring the measures of position and brightness for that star from the different plates together. Writing the basic procedures required only about six weeks, but building them into an operational system which could cope with different conditions and requirements required a further fifteen months – an example of the ratio of design to development.

Areas of sky including galactic clusters, general fields and parts of the Large Magellanic Cloud – one of the nearest external galaxies – have been measured and the results are now being analysed GALAXY has enabled the measurement of faint stars in a cluster which is embedded in nebulosity, and results of work on very young T Tauri variable stars have been given at an IAU Symposium. Other plates have been measured to study the interstellar polarization of distant stars. On each of these plates there are three images for each star, corresponding to different orientations of the polarization analyser. The software to reduce these plates is stil being developed. GALAXY has also been used for the measurement of timing gaps in satellite trails.

Originally designed for the study of Schmidt photographs, GALAXY can also measure plates taken with refracting or reflecting telescopes. In order to do this, three different magnifications are available in the measurement system to meet different ranges of image size. The positional accuracy of all three systems is about half a micron in both X and Y. The accuracy of the brightness measures of the high magnification system is about 2 per cent, better than the intrinsic errors in photographic emulsions of 4 to 5 per cent.

So far, sixty plates have been measured for observers at the Royal Greenwich Observatory, some for proper motions, others for star brightnesses and colours. A second GALAXY machine, a copy of the prototype, has recently been delivered to Herstmonceux.

GALAXY has measured eighty plates for other British institutions which include plates taken with the Isaac Newton Telescope and also the Hartmann test plates for the 150 inch mirror of the Anglo-Australian Telescope. A series of parallax plates for an investigation of the distance of the nearby Hyades star cluster has also been measured.

About half of GALAXY time has been spent measuring 150 plates for foreign observatories: Lund in Sweden, Padua in Italy, Leiden in Holland, Max Planck Institutes in Germany, Copenhagen in Denmark, Laurentian University in Canada and Kitt Peak and NASA in the United States. The types of measures have been varied: multi-colour photometry, proper motions, quasar positions, searches for very young objects, a search for variable stars in a nearby dwarf galaxy, and meridan circle plates used to derive fundamental star positions.

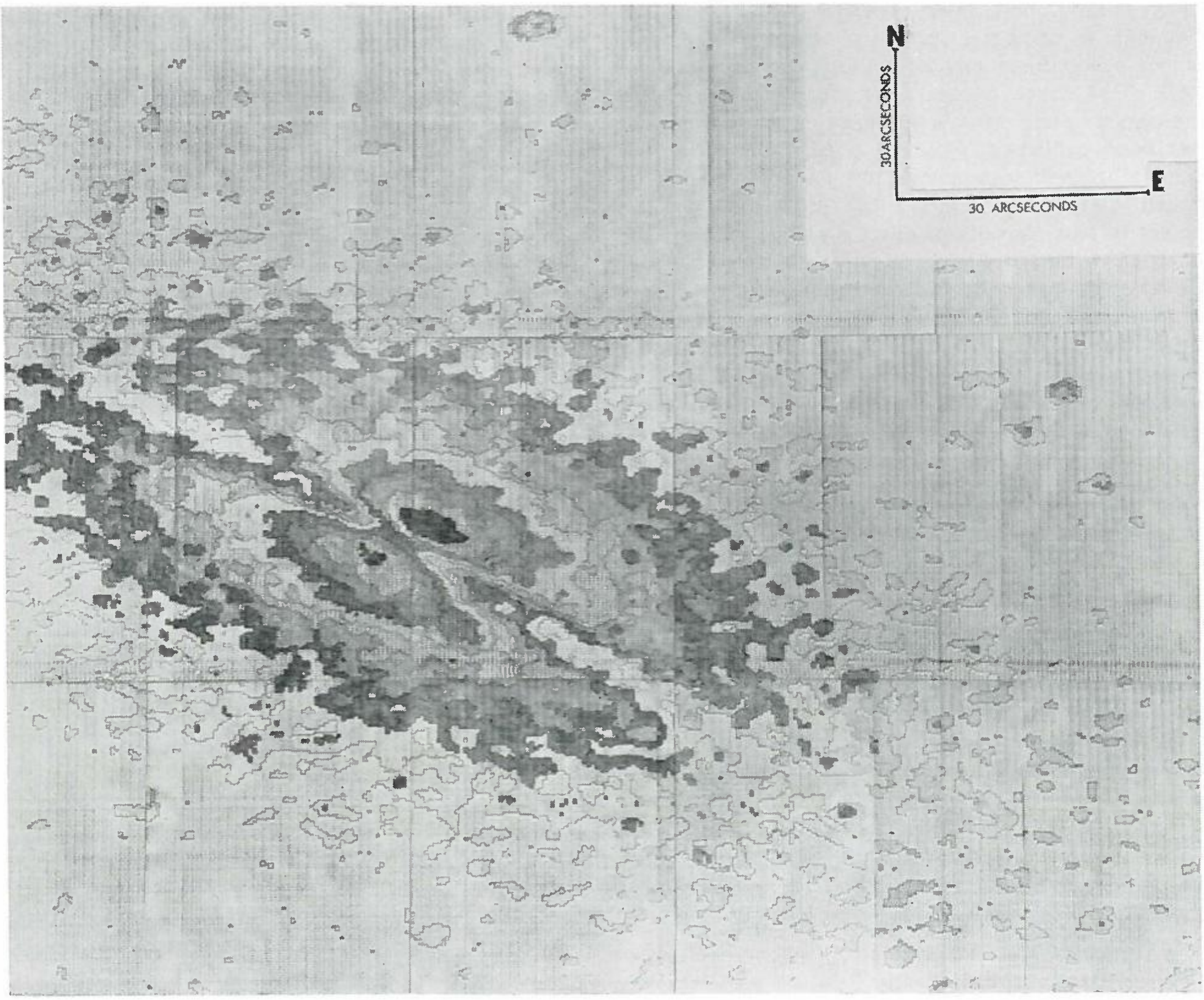
The actual measurements have been sent to most of these investigators, always after some reduction at ROE. Coping with the unprecedented quantity and quality of data which GALAXY has provided presents a major problem. When one investigator received part of the data for the half million images which GALAXY had measured for him, he wrote back by return of post to say that he was happy to wait until ROE had developed the software to investigate the material!

A number of modifications have been carried out on the prototype machine. Several of these have been to simplify the operation of GALAXY and to make the operator's task easier when handling such a large variety of types of plates from many different telescopes, about twenty so far. Others have been to extend the use of the machine. At first there was only one paper tape punch, allowing about twelve hours of continuous use. Now there are two and a control unit which automatically switches from one punch to the other when the paper tape is low.

Another major modification has been to the plate-holder carriage. Originally the largest size of plate which GALAXY could measure was ten inches square. This has now been increased to 14 inches square so that GALAXY can measure the 48 inch Schmidt telescope plates when they come. The positional accuracy of GALAXY was measured before and after the changeover, and remained unaltered.

Yet another modification was intended to investigate the fact that the Search Phase apparently only found about 80 per cent of the stars on a plate even

Figure 2 — A brightness map of the edge-on spiral galaxy NGC 7814.
Figure 1 (opposite) is the original Schmidt photograph enlarged from 1 mm square.



though some of these stars were not very faint. In the normal search phase, using a spot size of say 16 micrometres in a raster scan, an image of 100 micrometres diameter is recorded in several elements on each of five or six successive scans. This is taken into account in the electronics logic and the parameters of the image are stored until the image is passed and complete, when one set of coordinates is calculated giving the approximate centre of the image. To investigate the missing stars, an 'all increments' facility was incorporated which outputs every element of the star image found in search—say thirty outputs for the 100 micrometre image.

With this facility the cause of the fault was soon found – a poor connection which gave an intermittent fault causing occasional errors in the search calculations. This is now corrected and a 100 per cent finding rate has been achieved on plates with few enough images on them to enable us to check.

It was then realised that a new and powerful mode of operation had been devised which enabled GALAXY to carry out surface photometry! *Figure 2* shows a brightness map of an edge-on spiral galaxy, NGC 7814 which is about one millimetre across on the original plate. This is the first time such a picture has been published. *Figure 1* shows a copy of the original object (reproduced by Courtesy of Dr J Peach, Oxford University). The band dividing the object in two consists of opaque clouds of gas and dust which hide the large numbers of stars near the centre of the galaxy behind the clouds.

At present, this facility is fairly slow, depending on paper tape output, and requires much computer time to compile a contour map which has half a million elements. However, when developed, this should become an extremely powerful tool for the investigation of external galaxies, and nebulae in our own Galaxy.

The machine has also completed two non-astronomical applications. One was the measurement of features on aerial photographs for photogrammetry – the accurate determination of the relative separations of points on the surface of the Earth. The other was the measurement of the intersections of grid lines on a photographic réseau plate which is used as an offset reference for measuring aerial photographs. The symmetric crosses on the réseau plate were measured well. When the aerial photograph was measured twice in the same orientation, the normal accuracy of half a micron was achieved. However, when the plate was rotated through 90 degrees, offsets were found which were traced to the asymmetry of the amorphous features and slight differences between the sensitivities of the X and Y servos.

A steady flow of enquiries is still coming to ROE which range from the counting of elephants to the measuring of the strain in soil under piles during construction work. Others fall into the field of pollution – counting fibres trapped in filters to assess their effectiveness, and into that of Earth resources – measuring the extent of different types of vegetation, ice, etc., from orbital photographs. It is not always easy to convert the records in such requests into a form suitable for actual measurement in GALAXY.

GALAXY is fully scheduled for the next twelve months, and we may look forward to another exciting year with the machine.

Dr Neil Pratt is a senior scientific officer at the Royal Observatory Edinburgh. He carried out the initial testing of GALAXY, has developed the computer software for handling the reduction of the GALAXY output and now schedules and supervises the work on the machine.

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the universal law of cussedness

This law is well known, possibly by a shorter name, and it states that
"Inanimate objects are Perverse"
However the widspread and devious ways in which this law makes itself felt may be recognised in the following corrollaries to the law as applied to a specific situation.

FAULTY EQUIPMENT COROLLARY

1. *The Fault will occur when the equipment is most needed.*
2. *An obvious cause of the Fault is remedied, but does not cure the trouble.*
3. *The Fault will not occur for demonstration or for diagnostic testing.*
4. *When the repair man has left, the Fault returns.*
5. *Most Faults occur in inaccessible places.*
6. *Faults in easily accessible places conceal their accessibility until the equipment has been dismantled.*
7. *The Fault will lie dormant until the maximum amount of data obtained from the equipment has been invalidated by the Fault.*
8. *Instruction manuals hide.*

However one must bear in mind the important fact that
"The Law will not operate reliably if its operation is anticipated"
In fairness to The Law it must be exonerated from blame for the following axiomatic situation
"You always find it in the last place you look"
(only a nut would go on looking)

PHGD, RSRS

whither technology

John Andrews

The following article is an extract from a paper read at the Society of Arts on March 5, 5000.

Discoveries at Chilton

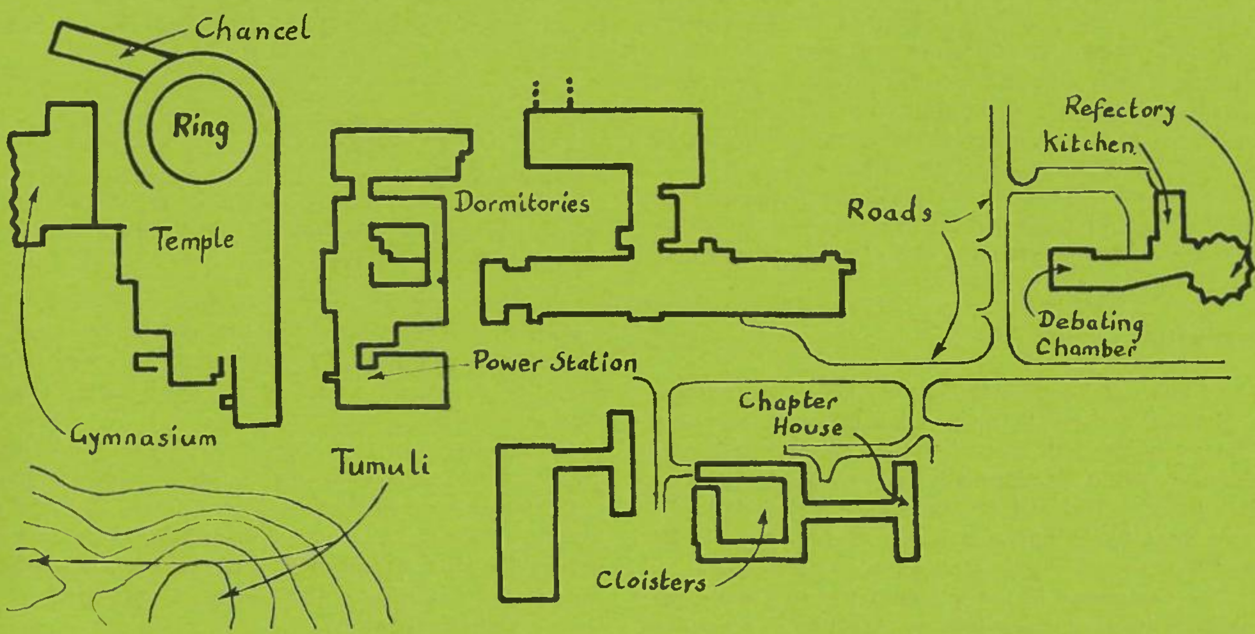
Interest has been aroused amongst anthropologists by the discovery of a site near the ancient village of Chilton in Berkshire believed to have been inhabited by people living in the 20th Century. The foundations of several rectangular buildings have been uncovered, and also a large area in the centre of the site sunk below ground level.

In its original state this area was covered with earth, and inside it lay the foundations of a curious circular 'ring'. It was first thought that the 'ring' was the remains of an ancient temple and that the site was inhabited by an exclusive sect who lived an enclosed life in the surface buildings and conducted secret rituals in th etemple. There is evidence of a communal eating place within the complex. No records have come down to us to explain why the temple was constructed underground, or to indicate what rituals were performed there.

A research team led by Professor Kokcroft, who claims descent from a long line of eminent scientists had discovered further evidence that large quantities of iron and lead were used in the construction of the ring. Professor Kokcroft has advanced the startling theory that the excavations are the site of a 20th Century laboratory, which contained apparatus for a specialised form of scientific research. A world-wide search is being made for similar sites and at present, two have been recognised from satellite surveys. One lies in Britain on the northern border of Cheshire, and the other site, much larger and apparently containing two rings, lies near Geneva in Switzerland. Reports have also been received of further sitings in America and Russia.

Dark Ages

We in the 50th Century have very little evidence as to what life was like in the 20th Century. Older civilisations have left a permanent record of their culture – primitive man made drawings on the walls of caves; the ancient Egyptians and Greeks carved their records in stone, and left a legacy of sculpture and architecture which survives to the present day. It enables us to see clearly the heights to which their civilisation reached. The Babylonians, having little access to suitable stone, resorted to clay as a writing



Sketch map showing the present extent of the excavations at Chilton material. Inscriptions were pressed into a clay tablet by means of a stylus resulting in the formation of wedge-shaped (cuneiform) characters. The tablet was then baked to a hardness which resulted in a permanent record.

The people of the 20th Century, however, committed all their records to paper, important events were photographed and recorded in nothing more substantial than a thin gelatine immulsion. Nothing written or recorded in this era has survived the ravages of time. Such pieces of sculpture that have survived depict the inhabitants as grossly misshapen figures with expressionless features. We know nothing of their architecture as their buildings, constructed of concrete and steel, have long since crumbled to dust.

The 20th Century is truly known to us in the 51st Century as the dark ages. Legends handed down from generation to generation tell of great technological achievements at this time. We know, for example, that the people succeeded in reaching the moon and that great advances were made in all of the scientific disciplines, but they left us no permanent record of their discoveries, or of their experiments and the apparatus used. Of all the civilisations that have existed on earth, that of the 20th Century was the most ephemeral; it rose like a rocket in the sky, burst into a shower of stars and disappeared without trace.

The Ideal of Learning

The excavations at Chilton are therefore particularly important in throwing some light on this mysterious age. Interviewed at his home, yesterday, Professor Kokcroft said: 'We have indeed made some very exciting discoveries at the Chilton dig. We have been able to date the building within a reasonable degree of acuracy: they appear to have been constructed between the years 1955 to 1965. My physicist colleagues who I have consulted, are of the opinion that the excavations are the site of an ancient laboratory used for research in nuclear physics. You must bear in mind that we have no primary sources covering 20th Century physics and that we rely chiefly on manuscripts dating from much later periods. Historians writing in the 30th Century mention fragmentary documents relating to the site and containing cryptic words such as RHEL, NIMROD, PLA, HFBC. These were thought to be the names of deities worshipped at the site, and lent support to the temple theory.

'In my view, however, our investigations completely discount this idea. We are unable at present to explain what the names refer to; it may be that the earlier historians were wrong and that the documents did not relate to this site at all. It has always been thought that the laws of natural forces were a comparatively recent discovery but the evidence we have found at Chilton indicates that the people of the 20th Century were already conducting experiments in this field and they may well have achieved considerable success. The site appears to have been abandoned as a laboratory at the turn of the century; the equipment which would have been valuable as scrap metal was removed.

'This makes our work all the more difficult but we have at least two other sites to work on which may give us clues as to the existence of this lost civilisation. One thing we can say for certain is that the people who lived in this community were little different from us today; they too were pursuing the ideal of learning, seeking understanding through mind and matter. They were the worthy descendants of those who in previous ages searched for the philosopher's stone.'

John Andrews works in the Service Unit for grants and Awards at London Office and is perhaps better known as the Staff Side Secretary of the SRC Whitley Council. He is grateful to Mr. J. R. F. Hayes, Joint Secretary of the Mechanical and Production Engineering Committee for checking the archeological references.

a bit further off

Have you fixed your holidays yet? Do you like informal travel and what do you think of a trip to Israel? These are questions that might be answered by Dennis Fogerty (Audit Section) who wrote about his minibus trips to Turkey last year *(Quest Vol. 4, 2 p 16)*. This year he is taking a group of fifteen to Israel and the trip will include an eight day sea cruise.

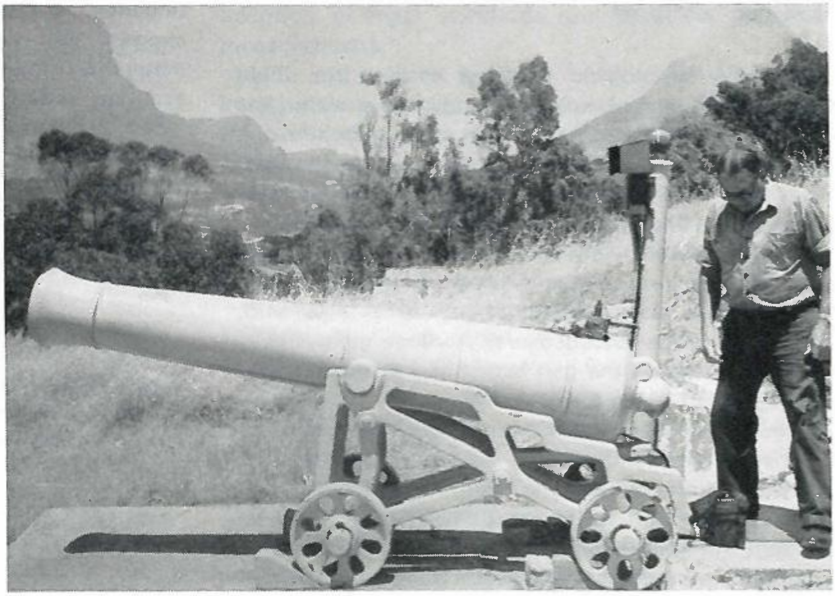
The first stage is the overland trip to Turkey (as before), the second is a four day Mediterranean cruise from Istanbul to Haifa with time ashore at many ports of call including Izmir, Rhodes and Cyprus. The third stage is eleven days visiting the most interesting places in Israel, many of them off the beaten track, including a desert journey to Eilat in the far south, near Akaba on the Red Sea. The return journey is a repeat of the outward journey and fits in some extra time at Istanbul.

Dennis has had full cooperation from the Israel Tourist Office and Camping Union in planning the holiday which takes 30 days from Friday, July 14 to Sunday, August 13. If you like camping, odd stops at wayside inns, and have an explorer's curiosity why not ask for a brochure. The address to write is:

Dennis Fogerty,
Topkapi Safari,
48 Earls Court Road,
London, W8 6EJ.
Tel: 01-937 4569.

noon gun

How timekeeping kept pace with technical progress 150 years ago at the Cape Observatory Time Department.



G. A. Harding

Every visitor to Cape Town whose stay extends over the middle of a day realises that the time of noon, South African Standard Time, is indicated by the firing of a gun from Signal Hill which overlooks the city. The gun is fired by an impulse from the Time Department at the Observatory, in continuation of a service which has existed for nearly 150 years.

Although the chronometer was available to the early nineteenth century navigator, thus enabling him to find his longitude at sea, no means of checking the rate of the clock was available in the southern hemisphere. The inauguration of the Royal Observatory at the Cape of Good Hope in 1820 must therefore have been very welcome news to the navigators rounding the Cape because after two or three months at sea on the passage from Europe their chronometers had probably accumulated considerable errors.

The erection of the instruments for time-determination began in 1821 and within a few years the astronomers were ready to provide a time-service to ships in Table Bay but the problem lay in how to signal it. Unlike the present when urbanisation prevents a direct view of the Bay from the Observatory, in those days there was no obstruction and so it was decided to use a visual system operated at night from the Observatory roof. Still on the inventory of the Observatory is the flash pistol and powder magazine which were used. This item also appears in the cash book entry for 1833, January 4:

'To John Constable for castings . . . and for a brass percussion pistol for the making of night signals to vessels in Table Bay, for the regulation of their chronometers – £5.5.0.'

However, the weakness of the flash made it difficult to detect three miles away so Sir Thomas Maclear put a daylight 'time-ball' system into operation. The first 'ball' consisted of a black cube which was to be raised on an apparatus constructed in Simonstown Dockyard and dropped at an agreed time. Unfortunately this device did not conform to normal naval standards of workmanship and having no springs or checks of any kind, eventually disintegrated on impact.

Poor visibility was, of course, still a problem and so in 1850 a 'two ball' system was started. A specially constructed wooden tower was erected in the Observatory grounds and the ball was mounted above it in full view of the signal station on the hill overlooking the bay. There, at the repeater station, a similar ball was erected, and the signalman, on seeing the Observatory ball drop, would immediately release his trigger to provide the time signal. Unfortunately, such a system must involve the 'time constant' of the two operators and the navigator and could sometimes be in error by two seconds. Nevertheless an extremely useful service for the mariner was provided by this apparatus for many years.

With the coming of telegraphy in the latter half of the nineteenth century the instantaneous transmission of signals became possible and an impulse from the Observatory clock was used to operate a time-ball and fire a gun on the waterfront. Then soon after the beginning of this century a gun was moved to Signal Hill and its firing mechanism connected to the Observatory time service. The first recorded firing of this gun was on August 4, 1902.

To this day the gun remains a muzzle-loader and just before noon a soldier of Lion Battery removes the stopper from the muzzle, cleans and dries the barrel and loads the three pound bag of gunpowder.

Occasional misfires do occur and it has been

noon gun continued

known for the gun to be fired early – no doubt because the gunner anxious to get to a date, has cocked the firing mechanism too soon, thus allowing detonation by an earlier time signal impulse. In either case the Observatory switchboard is immediately loaded with enquiries as to how the mishap occurred. Then there is the story of the careless soldier who forgot to remove the ramrod from the gun – on firing it shot down into the city and, it is said, knocked a horse unconscious! Another gunner they say was sitting on the gun barrel and at noon he too almost landed in the city!

Legend also has it that the gunners befriended the local wild cats leading to a substantial increase in the population. When this was discovered by an inspecting General he ordered their immediate destruction. An unorthodox but humane, and certainly economic, method was adopted. Bacon titbits were placed in the barrel after loading to entice the unsuspecting: precisely at noon they met their end.

Although the telephone calls when things go wrong can be annoying it is encouraging to know that the public do still take an interest in the continuance of this tradition. Although we would not suggest that a navigator should set his chronometers by the Signal Hill gun when he can use accurate radio time signals, it is nice to see the 'noon gun' tradition retained in a bustling modern port.

George Harding, a Senior Principal Scientific Officer, was Officer-in-Charge of the Royal Observatory, Cape of Good Hope, for the three years 1969-71. During this time the plans for the development of the South African Astronomical Observatory as a joint SRC-CSIR project were completed and the design and construction of the new observing station at Sutherland begun. Under the new administration he becomes Deputy Director of the new Observatory.

It has been said that the present method of choosing SRC Board and Committee members is not the fairest that could be devised. Perhaps we should try a different one – like open competition.

The Chance of a Lifetime— in our FREE Competition !

1st prize

3 years on the Board or Committee of your choice

2nd prize

4 years on the Board or Committee of your choice

plus

500 consolation prizes of 1 Research Student each!

Just answer this simple quiz.

1. How many letters do you have after your name? ('Failed' counts as -1.)
2. Is this year's prevailing style of administration:
   a) ivory-tower purity?
   b) white-hot technology?
   c) please, ma'am . . . ?
3. Is a Van de Graaff Generator:
   a) a pop group?
   b) the Council's standby power source?
   c) an excuse for a £200,000 consolidated grant?
4. Place in order of difficulty
   a) getting approval for a £5M project.
   b) getting approval to travel to Paris.
   c) getting through to the right extension at State House.
5. Are you prepared to move to Bristol?
6. What has the SRC achieved? (Answers to the Select Committee on Science and Technology.)
7. In which years were these famous catch-phrases popular:
   a) selectivity and concentration?
   b) timeliness and promise?
   c) total technology?
8. Are you willing, if required, to play Bach piano duets for an SRC film?
9. Finally, complete in not more than 2587 words:
   'I think Sir Brian Flowers is wonderful because . . .'

Set by **PC**

# of pips and peeps

So They were at it again. Last year it was decimilisation and this year They turned the BBC's traditional six pips into five pips and a peep. Was this another step towards internationalism we asked. Yes it was.

This time though it was the new Universal Co-ordinated Time (UTC) we were getting in step with and if there's one thing this Country is a leader not a follower in, it's time. The new UTC is a compromise between an atomic time standard based on the fundamental properties of the caesium atom, and Greenwich Mean Time also known as Universal Time (UT) which is based on the rotation of the earth on its axis.

Under the new system standard frequency emissions and radio time signals are now broadcast in conformity with the International Atomic Time Scale in which the time intervals between pips correspond exactly to the second, as defined in 1967 by the General Conference of Weights and Measures (CGPM), the international body concerned with the adoption of legal standards and units for physical measurements.

UTC will be kept within 0.7 second of UT by the introduction of a leap second, when necessary, on the last second of a month and, preferably, on June 30 and December 31. In BBC terms a plus second will give six pips and a peep and a minus second four pips and a peep. The start of the peep (or lengthened pip) indicates the exact minute (0h0m0s on the first day of a month).

Soon after the new system was introduced, Humphry M. Smith, Head of Time Department at the Royal Greenwich Observatory, spoke about the new way and the old at the Institute of Navigation. Mr. Smith is Chairman of a special Working Group of the International Radio Consultative Committee which is concerned with the practical aspects of getting UTC generally adopted. His talk is published in full in the Institute's journal (Vol. 25, 1, Jan. 72). We reproduce a summary here by permission.

Another article 'International Time and Frequency Co-ordination' will appear in the special Time and Frequency issue of the Proc. IEEE in May.

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right on time

time-keeping in the age of technocracy

Ninety years ago the Greenwich meridian was adopted as the standard meridian for the world for two very good reasons: nine-tenths of the sea charts in use were based on it and the observatory had been carrying out regular uninterrupted observation for more than two hundred years.

It seems that the unique significance of the Greenwich meridian was rather thrust upon the observatory, for the Astronomer Royal, Sir George Airy, was not at all enthusiastic and wrote 'It has been custom of Her Majesty's Government to abstain from interfering to introduce novelties in any question of social usage, until the spontaneous rise of such novelties has become so extensive as to make it desirable that regulations should be sanctioned by a superior authority.'

The Astronomer Royal for Scotland, Piazzi Smyth, was dead against it and regarded 'all attempts at breaking down the ancient bounds between nations as the work of the dread International Commune, and an attempt to form all mankind into one vast headless society.' If you think that argument has been brought out for an airing recently you may be interested to hear that France and Brazil abstained when twenty-two nations voted for the Greenwich meridian (at the Washington Conference in 1884) – France because it favoured the Paris meridian, or failing that the meridian of the Island of Ferro, or failing that a completely neutral one.

GMT corresponds to the average of solar time measured at Greenwich throughout the year. Solar time gives days of varying length because the annual path of the Earth around the Sun is not a circle and because the Earth rotates daily around an axis which is not perpendicular to the plane of the Earth's annual orbit. The mean, or average, length of a day forms the scale of Mean Time, and the difference between mean and solar time (the Equation of Time) may amount to about a quarter of an hour in each direction, as may be seen by comparing a clock and a sundial.

The two main variations taken into account in UT time scales are Polar Variation, the movement of the Earth in relation to its axis in space, and Seasonal Variation whereby the Earth turns slightly faster in summer and slower in autumn and winter. The three time scales are known as UT0 (UT as observed), UT1 (UT0 corrected for PV) and UT2 (UT with both PV and SV removed).

A Photographic Zenith Tube (PZT) is used at Herstmonceux to measure the Earth's rotation by observation of the times at which selected stars cross the observer's meridian near the zenith, in their diurnal

right on time continued

apparent motion across the sky from east to west. An interesting development has been the establishment of a PZT in Canada in the same latitude, which uses the same stars, the same adopted star places and the same methods of reduction. By exchanging results the Canadian observers and our own gain the full benefit from having similar observations at two stations. If we could persuade the Russians to put a PZT on the same parallel, this would strengthen the determination even further. (N. O'Hora of RGO will write about the PZT in the next issue of *Quest*).

A uniform time scale, the forerunner of UTC, began at Greenwich in 1944. Time signals were kept at a uniform rate based on the mean of the best quartz clocks available. 'Jump' corrections were made when necessary to maintain agreement with astronomical time. Atomic clocks brought in a much higher standard of uniformity and it was possible to introduce jumps or 'steps' to match UT within agreed limits.

Most atomic clocks use caesium because it can exist in either of two states and the transition from one state to the other is accompanied by an absorption or emission of electromagnetic energy at a frequency which is characteristic of the transition. The atoms in the two states are affected differently by a magnetic field. The clock contains an evacuated tube along which a beam of caesium atoms is directed towards a detector at the far end. The beam passes between the poles of a magnet which deflects the atoms in one state and allows the others to pass into an area where there is a radio frequency magnetic field. If the frequency of this corresponds to the characteristic transition frequency some of the atoms will absorb energy and change state. The beam then passes through the poles of a second magnet, the unchanged atoms are deflected and the changed atoms reach the detector. By this means a maximum number of atoms reaches the detector when the radio frequency is tuned exactly to the correct atomic transition frequency.

Atomic time scale intervals are uniform and free from all the periodic and irregular variations characteristic of the time scales based on the earth's rotation but they have no corresponding 'time of day' except in so far as one measures from a zero expressed as an instant of astronomical time.

'breaking down the ancient bounds between nations . . .'

At Herstmonceux the atomic time scale is based on a mean of selected caesium beam atomic standards at the observatory. Comparisons with national time scales in other countries are made by using the Loran C radio navigational system or vlf phase comparisons as well as conventional radio time signals.

Loran C emissions are monitored from Sylt (Germany) and checked with the master station of the Norwegian Chain at Ejdes (Faroes) and the Estartit (Spain) station on the Mediterranean chain. The system uses specially designed receivers that 'lock on' to a chosen point in the build-up of signal pulses and this is timed on a local clock to an accuracy of 0.1 microsecond. Comparisons are checked by periodic 'flying clock' programmes arranged by the US Naval Observatory in which a clock is taken from Washington to various observatories in Europe. 'Flying clock' checks have confirmed the routine comparisons to within a few microseconds *(see 'Operation Synchran' in Quest Vol. 4, 1 p 14).*

In 1936 when Mr. Smith went to Greenwich to take charge of the Time Department there were pendulum clocks, tape chronographs and 'wireless' equipment that could be tuned by moving external coils. The BBC time signal service had begun in 1924 and the international signals from Rugby in 1927. At one time equipment had to be developed and made at the observatory, nowadays it can usually be bought commercially and the Time Department's skill and ingenuity is devoted to getting the most out of the instruments.

Caesium beam atomic clocks are now being used to the limit of their capabilities but perhaps someone somewhere is working on an idea that will take precise time measurement into a new era.

Quest

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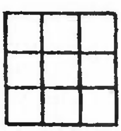
magic squares



In a magic square the numbers in each row, each column, and each diagonal add up to the same total (called the 'magic number'). Can you make a magic square (3 x 3) using the numbers 1 to 9? Each number must be used once only and the 'magic number' is of course 15.

If you find this problem easy, or know the answer already, can you find a logical way of arriving at the solution, rather than using trial and error?

A 4 x 4 square is rather more difficult, but it is helpful to know that certain groups of four numbers other than the rows, columns and diagonals must add up to the magic number. Can you say which these are? Using the numbers 1 to 16 in the square the magic number is 34.

Solutions next time, with some notes on larger squares and 'supermagic' ones.

Q column by 'observer'

Dear Auntie Joan
I recently applied for a post as a Principal in the Civil Service but they told me that I was not eligible To make matters worse I was told that I should try to get some administrative work to do here. This seemed to me to be a pretty silly answer in the circumstances. Please help me because I have no one to turn to.
Yours hopefully
Worried Blue-Eyes

Dear Worried Blue-Eyes
You must face up to reality. It may be difficult for you to accept the fact, but scientists (with a few notable exceptions) are not good enough to be in the Administrative Class. A first-class degree and a PhD are no indication of a person's suitability for the First Division. The ability to ad lib for thirty minutes on any subject presented to you is a much better test of the qualities needed and scientists fall down very badly on this. Try to recognise your limitations and I am sure you will be able to find more contentment in your present work.

Please write to me again at any time if you feel I may be able to help, but please do not use Council stationery for personal letters.
Yours sincerely
Auntie Joan

Dear Editor,
I note in recent vacancy notices that specific age groups are mentioned. I don't feel old but to see constant reminders that applicants between '20—40 years only' need apply is rather turning the knife.

Who said 'Life begins at Forty'. I feel I have been wiped off the slate already!

Sad at Heart
LO

a place for rowing

The Cygnet (Civil Service) Rowing Club at Chiswick has room for new members who can row or scull or who would like to learn. The Club is doing quite well and will be racing two, or possibly three, crews in open regattas this year, including the 'Thames Cup' at the Henley Royal Regatta.

This club is for men only but the boathouse at Dukes Meadows is shared with the Civil Service Ladies Rowing Club. Both are open to SRC staff. Write to: Roy Ellison, Civil Service Boathouse, Dukes Meadows, Chiswick W4 2SH, or telephone 928-7878 ext. 7845 for details.

Wanted SO cadet, good wages for keen young man

Every March we receive the new edition of the LO Functional Directory, a useful work of fiction full of interesting stuff about what they think we do all day. On this occasion, the Directory contains no less than two Georges, one at the bottom of p 14 and the other bang in the middle of p 25. Alas, neither Training Section admitted to knowing his whereabouts, nor could those in Eng. Div.* help. However rumour of a yellow Mini 1275 GT and an ever growing heap of Ch Canteloupe 1964 bottles (empty) at the prime focus of a certain 98 inch telescope, coupled with recent enquiries about gardrobes in medieval castles give a clue to his whereabouts.
GMT — beware!

** not apparently English Divinity as I thought*

---

spectators and sportsman

are welcome at

sports day 1972

date: Monday June 19

place: Civil Service Sports Ground, Chiswick.

Picture below is the full ROE football team who sent a six-a-side team to win the cup in 1971 but lost in the final to Rutherford C team.

Back row: W. Sherwood, M. Hartley, A. Houston, G. Barrett, E. Laidlaw, J. Hart, A. McLachlan, V. McCann.
Front row: R. Eberst, J. Campbell, A. Rosie, J. Johnstone, R. Tannoch, A. Kerr (Coach). photo by Ian Sheffield.

travels with a daughter

Pictures: left, daughter Mandy outside the log cabin near Toronto. Above: the french look in Ottowa.

Phyllis Beaven

Last May, having saved up my money and my leave, I took advantage of one of the Civil Service Sports Council's charter flights to America for a stay of three weeks to visit my daughter.

My main impression of the flight was that of tedium; there wasn't much room to move and there was just too much noise to make sleep a real possibility. But we had an excellent meal with drinks provided and several friendships blossomed rapidly.

We landed at Kennedy on time and I was pleased to see that it looked in much the same state of untidy half development as Heathrow. The Customs Officers weren't interested – I might have been carrying a case full of cannabis (surely it's the unlikely ones they should look at) – and the immigration officer used my christian name, which was probably intended to be friendly, but which annoyed me somewhat. I hadn't so far seen the famous skyline and didn't do so until we went over – I think – the Throgs Neck bridge on the way out and even then it was partly hidden in a veil of pollution.

New Haven where I stayed, is the home of Yale University (Elihu Yale was a rich Boston cloth merchant in the 17–18th century who made a donation of £562 when funds were first being sought for the Collegiate School, as it then was, on its move to New Haven. It was hoped by naming it after him to elicit further support but he did not oblige it seems). One could very well imagine oneself in Oxford or Cambridge – the buildings and atmosphere are very similar. My daughter is a librarian there and the library, which houses more than 2,000,000 books, is a huge rather gloomy Gothic style structure of recent date (1930s I think) with a tower that looks like a cathedral but is in fact book stacks. There is also the Beinecke rare book library whose walls are made of slabs of marble and glow like amber when the sunlight shines through them. There is a Gutenberg bible and I saw a document dated around 1620 relating to the original founding and funding of many of the Colleges at Oxford and Cambridge. Among many other interesting exhibits were some family letters written during the absence of the husband at the American-Mexican War. I would have liked to have been able to spend more time there.

I loved the large comfortable wooden houses and the way everything just seems to grow out of its surroundings in New England; there were rarely boundaries marked by brick walls or fences and it somehow makes one belong.

The formal elegant simplicity of the churches was delightful and so, as the Spring progressed, was the combined effect of pale green foliage, red maple flowers and white paint with occasional redbrick. It all seemed to be looked after with such thought and care and had such individuality.

Returning to New York to visit what a tremendous contrast it was there with its huge stark science fiction outlines and dilapidated scruffiness. One would develop a claustrophobic restlessness if one lived there, I think. I didn't have too many language difficulties (thanks to BBC TV I suppose) but was surprised when, determined to sample the local delicacles, I ordered an ice cream soda and 'pie à la mode' at lunch and found myself with two huge portions of ice cream served to me by a waitress who looked at me doubtfully, as well she might.

Washington was a city of beautiful buildings and tension; a feeling one could almost touch. The administrative part seemed somewhat too formal – it hadn't grown, it had been put there with great deliberation, but Georgetown was delightful and the White House had a pleasantly intimate atmosphere – I was embarrassed to discover the identity of the 'enemy' who burned it in 1814.

We also managed a trip North to Canada with our Plain Jane (an unromantic but efficient VW) through wide open spaces which in view of the urban sprawl practically all the way from New England to Washington I thought I wasn't going to find. Niagara was breathtaking and no amount of commercialising could alter that impression – it was also breathtaking in the air that came over the ice which still covered the basin; almost unknown at that time in May it seems.

We passed through miles of peach and pear blossom to visit London, Ontario, which has a Thames River and an Oxford Street (what nostalgia these familiar names must have held for those early immigrants who knew they would never see 'home' again) and we avoided Toronto to spend a night in a real log cabin by a beautiful Canadian lake surrounded, in picture book fashion, by conifers and birch trees.

Ottawa was dignified and restrained and slow moving. In Montreal one thought one was in Paris – even the smells were Continental and so were the drivers; but a city with a tremendous personality.

So to the journey home through great stretches of rolling countryside and some small Quebec towns which looked as if they had been built rather 'ad hoc' and back again to the well organised tidy beauty of New England.

As to impressions of life and people, I thought the Americans less relaxed than the Canadians who had some of the familiar steadiness of England. The amount of anti-American feeling in Canada was surprising considering the frontier is more or less a line on the map and the English language is common. (Vietnam desertions have something to do with it I think).

Canada would still seem to have an integration problem with her two peoples but as a matter of fact I was impressed by the basic loyalty of the coloured people in the States. The sense of tradition in New England is strong – even to the Puritanism which the original settlers brought to their sanctuary there and in Canada (Ontario anyway) there is almost defiant loyalty to English traditions – in St. Catherine's on Saturday afternoon I saw, of all unexpected things, a cricket match, played in the grounds of what was really an English boarding school. But I must add that everyone everywhere was very kind to me, and the standards of comfort in living were consistently impressive. And so, after a last awe-inspiring but very delicious dinner at the Yankee Silversmith I found myself at Clapham Junction at 7.30 am on a wet English Sunday morning. What a wonderful three weeks I had had and what pleasure it has given me to relive them by writing this.

I have since heard that Plain Jane has had to visit the doctor – I hope her 1500 miles in seven days were not too much for her.

Phyllis works in the London Office Administration Division. She has one daughter Mandy, who comes into this article, and a son Colin who also visited the States last Summer as a Camp Counsellor. Phyllis has appeared before in Quest as the poet 'Nona'.

DRAFT DUS LETTER

Dear Uncle Stan

I'm feeling very guilty about not replying sooner to the friendly note you sent me before Christmas letting me know when I am allowed to ride in a taxi at the Council's expense. I must say it really is a comfort to know that if I

a) arrive at the station after the meeting I am due to attend has started
b) cannot find any local inhabitant who knows (or will admit to knowing) anything about the geography or public transport of his native town
c) have more than two heavy articles of luggage
d) find myself in the sort of weather conditions which today's tiny tots will remember as old men
e) am not in Central London

I am actually allowed to claim the cost of a taxi. There is just this little doubt in my mind, Uncle, that there is a kind of 'Catch 22' (or should I say 'Catch 14/71'?) tucked away in your note. The trouble is that I am expected to explain the whole situation 'briefly' and, frankly, if this really happened to me I'm not sure that I could. And if I decided to write out a long explanation, I'm afraid I might be thought to be wasting Council time, because I would have to take time to write it and you would then have to read it. I know you're busy because you have to send us all these notices telling us how to interpret all the regulations.

I've just been wondering if we couldn't save a lot of time if we didn't all have to remember the clarification set out in LO Instruction 14/71 of CEM 5B.7 which reinforces CEM 5B.3. Couldn't we have a system whereby if you don't trust me to decide when I should take a taxi and refuse to repay me I simply overcharge you on something else the next time I go anywhere?

I hope, by the way, that while you are travelling round the country looking for a new roof to shelter us all, the trains are all on time, the natives numerous, knowledgeable and communicative, the weather always fine and your luggage neither bulky nor ponderous.

Love to you and Auntie Joan
Your affectionate nephew

newsfront

retirement

Mr. R. A. J. Savage B.E.M.

seen in picture with Dr. J. A. Saxton (r) Director of RSRS, and

Dr. D. H. Sadler

seen below right with Dr. A. Hunter (l) A/Director of RGO

Members of staff at RSRS were conscious of a milestone in the fifty-year old history of the laboratory when Mr Savage retired on 25 February. For forty two of that half century of years, Jack Savage has worked here making his particular and valuable contribution to the progress of radio science. He joined as a carpenter in 1930 with the Radio Research Station (as it then was) under the superintendence of Dr. Watson-Watt (as he then was). Within a few years, the first British radar experiments had been conducted by staff from Ditton Park, and with their success and subsequent incorporation into specialist groups working secretly at Orfordness and later at Barnsley, Jack found himself involved in matters of national history. His skills then and later were officially acknowledged by the award of the BEM in 1953 and his continued services at RSRS have been much valued.

His retirement was marked by a ceremony at which Dr. Saxton, the Director, presented him with a token of our good wishes for a happy future.

Our best wishes go with Dr. D. H. Sadler, Superintendent of the Nautical Almanac for thirty-four years, who retired in February. A Deputy Chief Scientific Officer by special merit promotion, Dr. Sadler's career with HM Nautical Almanac Office (which is now part of the Royal Greenwich Observatory at Herstmonceux) started in 1930. During the war he was also put in charge of the Admiralty Computing Service and received an OBE in recognition of his services.

Dr. Sadler's main interests have lain in the design of almanacs for use in astronomy, navigation and surveying and in developing improved methods for their computation. He has contributed a great deal to various national and international organisations of astronomy and navigation, which has been recognised by various awards – such as his honorary degree from the University of Heidelberg.

In 1970 Dr. Sadler was granted special leave of absence from his post of Superintendent to conduct his own research and to organise the 14th General Assembly of the International Astronomical Union. Dr. Sadler was General Secretary of the IAU from 1958 to 1964 and has also been Secretary and President of the Royal Astronomical Society and President of the British Institute of Navigation.

In his spare time Dr. Sadler was an active member of the Observatory's Social and Sports Club – from the day it started in 1949, and for many years a leading member of the Hockey Club. He also took part in staff side affairs and was Chairman for a time of the 'Association of Astronomers', the former title of the local branch of the IPCS.

An antique chair was presented to Dr. Sadler (both seen in left hand

photo David Calvert RGO

Continued at foot of next column

bread of charity

If you visit the Royal Greenwich Observatory on a Wednesday, you have a choice of lunches. There is the staff restaurant fare as usual or if you prefer to dine in the spirit of King Wenceslas there is bread and cheese set out upstairs in aid of good causes. Everyone who takes part in the second pays the usual lunch price for the cheaper fare and the profit goes to Oxfam and other charities. The lunches were started by Michael and Margaret Penston and are now organised by Elizabeth Epps. In three years the scheme has raised £340. Congratulations!

SPSO

Dr. B. R. Martin

Dr. Barry Martin of Radio and Space Research Station has recently been promoted to Senior Principal Scientific Officer as Head of the Division responsible for Space Systems Analysis and Computing facilities.

Dr. Martin, who is married, with two children, is a graduate of Merton College and joined RSRS as an SSO in the computer group just over four years ago. In July 1970 he obtained a D Phil. at the University of Sussex.

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picture) as a farewell gift, by Dr. Hunter (l), Acting Director, on behalf of the staff of the Observatory and the NAO, who all attended the ceremony. Several former NAO staff who had worked with Dr. Sadler for many years came to a special luncheon party and to attend the presentation. Mr. P. S. Laurie gave a talk on the history of the Nautical Almanac and the NAO, and publications past and present were on display. Another display of photographs of the staff at work and at play over the past thirty years sparked off many more reminiscences.

Footnote to Technology — an engine from the age of steam

(see pp 9-20)

Above: traction engine Red Gauntlet with Ken Humphries of Atlas Laboratory (left) and his 'steam gang' mates Jack Green and Ron Coventry from Burghclere. Restoration of this general purpose Burrell traction engine has been a spare time hobby for the gang led by Jack Green who made up to pattern by a good old-time 'steam age' blacksmith and some specialist welders made a new fusable plug crown housing, by reducer method, to a very high standard. The team put in nearly 1,000 hours' work and 17 of these had to be spent inside the fire box – 4 feet x 3 feet x 4 feet.

The engine was used for general haulage and farm work in the west country until the owner brought it to Jack for restoration. It weighs 11½ tons, has a capacity of 75 hp (6 steam) and moves at 4 mph in the small gear and 10 mph in the large gear. Now that the engine is fit again it works for its keep at sawing, hauling and tree pulling. It can pull out 14 large trees, root complete, in 7 hours.

Like the Scarlet Pimpernel, the gang say, it turns up in all sorts of places – occasionally at rallies but more often at charity functions. These are seldom refused unless dates clash. The gang are always there ready to answer questions but it is Ken who is usually pushed to the front.

Ken is an experimental worker V at the Atlas Laboratory. He is going to bring the engine to the next Families' Day on Saturday July 15.

QUEST

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QUEST

House Journal of the Science Research Council

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Vol. 5 No. 3

contents

P–J Violation

Cover picture: *A young and clearly enlightened audience at the Daresbury Laboratory's Open Day. While their parents looked at exhibits showing the part played in the nuclear physics programme by interacting particles, the children watched some violent interaction between Punch and Judy. This show, and other entertainment, was put on by the Laboratory's Sports and Social Association. Family Day was the last of the Laboratory's Open Days, which opened with a visit from the Council, see page 2. Photo Arthur Pickett, DNPL.*

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retirement

Dr William Francis CBE

On 31 July William Francis will retire after more than seven years as Secretary of the SRC and thirty-two years in the public service, mostly in DSIR.

He will be missed not only for all the work he does but for his quiet tenacity which enables those that would be deaf to hear, for his dry sense of humour which often helps to resolve tense situations, for his happy knack of putting things in perspective and for his friendly readiness to help all-comers.

Like Chaucer's Clerke of Oxenford (although he attended a different University) "gladly wolde he lerne and gladly teche". His perception and philosophic detachment make him an eager listener, a sharp analyst and a gentle debunker of accepted truth. These qualities, coupled with his constructive spirit and commonsense have enabled him to contribute both to the advancement of knowledge and to its useful application. In particular, he is due much credit for Government policies towards the encouragement of collaboration between research establishments, universities and industry.

In recent years his main contributions have been to ensure the smooth flow of Council business and its coordination with other Government activity; to give successive Chairmen the particular kind of support each asked for; and to guide and help his colleagues in carrying out policies and schemes for which they were executively responsible. His standing both in the SRC and other organisations is reflected in the way colleagues seek his help and advice. His standing with the Council is clear from the way in which members have made him the de facto Deputy Chairman.

(An account of his early career appeared in Quest Vol. 3 No. 2, p. 1. Ed.)

appointment

Mr. R. St. J. Walker CBE succeeds Dr Francis as Secretary of the Council. Previously Director of Administration, Mr Walker has been with the SRC and the former Department of Scientific and Industrial Research since 1962. His earlier Civil Service career was spent in the Ministry of Supply, later Ministry of Aviation, and included three years as Secretary to successive Ministers (Mr Strauss and Mr Sandys).

Earlier, he read chemistry at Oxford but was saved from completing his degree by the outbreak of war. His war service was spent in the Anti-Tank Regiment, Royal Artillery, and, after a Technical Staff course, in the Proof and Experimental Establishment.

Mr Walker is married with three sons and his chief recreation, shared by his family, is sailing.

we won !

One of Dr Francis' most recent duties was to preside at the SRC Sports Day and Mrs Margaret Francis presented the prizes. Dr Francis is seen sitting at left of picture watching Geoff Cox of Daresbury 'A' team receive the football winners' cup from Mrs Francis (right). — A trophy worth getting it seems! Photo J C Beach DNPL.

More pictures of Sports Day in next issue of Quest.

1. Members of the Council, the Council Secretariat and Daresbury Laboratory at the Daresbury Open Day 'Introductory Exhibition' — see 'the first ten years' on opposite page.
Front row (left to right): Mr R St J Walker CBE (the new Secretary to the Council), Mr M J Moore OBE (DNPL Group Leader, Engineering Services), Dr D L Johns and Miss F Jenkins (both of Secretariat), Mr C Jolliffe CBE (Director of Science), Sir Brian Flowers FRS (Chairman of the Council).

£1M A YEAR FOR ATOMS MOLECULES AND PLASMAS ++ BEST DATA YET FROM SKYLARK SPACE
PROBE IN SOLAR ULTRA-VIOLET SPECTRUM ++ SYMPOSIUM ON ELECTRON AND PHOTO INTERACT
++ £59,000 HARDWARE FOR MULTI ACCESS COMPUTER SYSTEM ++ BRITISH EXPERIMENT IN ORI
ING SOLAR OBSERVATORY OSO-G ++ FIRST LUNAR SAMPLES FOR BRITAIN ARRIVE AT SRC ++
[illegible] FOR SRC G
FOR CONTROL ENGINEERING RESEARCH ++ ANGLO-AUSTRALIAN TELESCOPE CONSIDERABLE CONTI
BUTION TOWARDS SCIENTIFIC DISCOVERY ++ RSRS PARTICIPATES IN UK4 SATELLITE TO MEA
INTENSITIES OF ELECTROMAGNETIC RADIATION ++ DEVELOPMENT IN ANALYSIS OF BUBBLE CH
BER PHOTOGRAPHS BY SWEEPNIK AIDED BY SRC GRANT OF £40,473 ++ SUCCESSFUL LAUNCH O

council commentary

march

the future in nuclear physics

Prior to its consideration of the Forward Look in April the Council had a preliminary discussion of the Nuclear Physics Programme. Professor Gunn, the Board Chairman, explained that the intention was to give priority to the CERN programme and both the Rutherford and Daresbury Laboratories had an important part to play in its support. In the domestic programme he said the Board felt that work on the Nimrod and NINA accelerators was at its peak and of the highest scientific standard. Both accelerators should certainly run for another five years but thereafter the restrictions on manpower and money would make it almost impossible for both to continue. No decision on which should be closed could be taken on scientific grounds alone, but from staff management considerations the Board felt that the best solution might be for NINA to close down at the end of 1977, in phase with the likely build-up of the proposed Nuclear Structure Facility and the High Flux Beam Reactor, and the phasing in of the new CERN facilities. The Council noted that the Nuclear Physics Board had decided not to include construction of the NINA booster in its future programme.

more support for Cambridge computer group

The Council approved a grant of £109K over 3 years to Cambridge University to enable Professor M V Wilkes to continue research in computing science on machine organisation and programming systems. The Cambridge group was amongst the first to command support on a substantial scale from the Computing Science Committee and their research on machine organisation has achieved a high standard internationally. The group designed and implemented the successful multi-access system for the Titan computer and more recently work has included organisation processes within the computer, systems for solving algebraic equations and computer aided design. The work of the group is of industrial relevance and ICL are interested in its possible applications.

Approval was given for continuation of the programme of short courses, organised for the Council by the Careers Research Advisory Centre, aimed at giving university research students some knowledge of the challenges and problems that exist in industry and central and local government and some insight into the underlying

CRAC courses

the first ten years

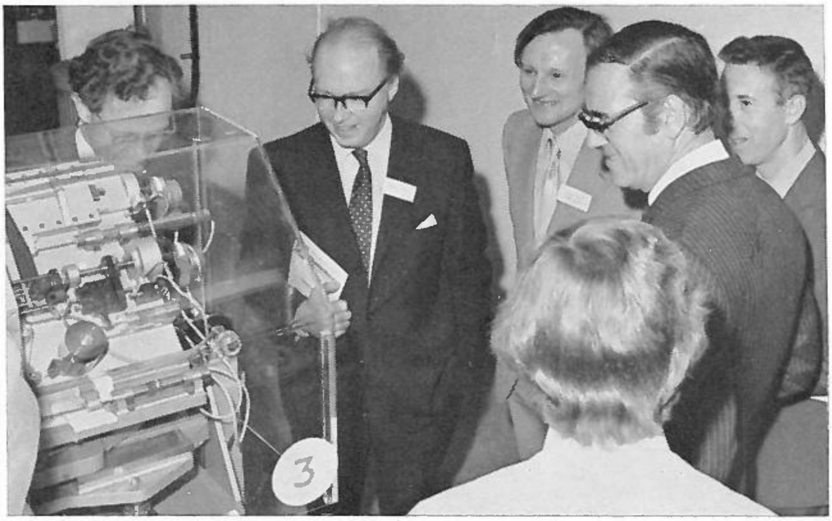
In May this year the Daresbury Laboratory held Open Days to mark the tenth anniversary of the date when the (then) Minister for Science gave approval to build a nuclear physics laboratory and a 5 GeV electron synchrotron at Daresbury in Cheshire. The Council and Council Secretariat were the first visitors, followed by a press day, a public day and a family day (see cover picture).

Construction of the laboratory began in 1963 and four years later it was officially opened by the Rt Hon Harold Wilson, then Prime Minister. An application to build a Synchrotron Radiation Facility

continued on p. 4

2. Dr Robin Marshall (DNPL) showing the LAMP (Large Aperture Magnet Project) experiment on-line data display to Professor H L Kornberg FRS (Chairman of Science Board).

3. The Diamond Target which contains a large single crystal diamond used to produce a polarised beam for photoproduction experiments. The exhibit showed the control mechanism and an explanatory display.
Interested onlookers (l to r) are: Mr Jolliffe (as 1), Professor Kornberg (as 2), Professor A Ashmore (Director DNPL), Sir Brian Flowers (as 1) and Dr B Zacharov (DNPL Group Leader, Computing and Electronics).



principles upon which work in these sectors are based. The courses are proving extremely popular with the students and there is every indication that they are useful in helping those attending to make more informed decisions about their future careers. Seven courses are being held in 1972 and there will be an increase of one each year over the next three years.

april

forward look to 1978

The main item discussed was the Forward Look for 1973-78. Council decided to prepare its future plans on the basis of the provisional allocations already notified for 1973-75, which allow an average growth rate of about $2\frac{1}{2}$% pa, and a 4% pa growth rate thereafter.

Within these overall figures, the Council proposes to keep the total funds devoted to nuclear physics approximately constant. Construction of the Nuclear Structure Facility is included, but plans are on the basis that one of the NP Laboratory accelerators will cease to operate at the end of the Forward Look period. At the March meeting, the NP Board recommended that NINA should not be used for high energy physics from 1977, but the Council has still to consider the matter in detail and take its decision. The present priority for university research in engineering will continue, but Council asked the Engineering Board to review the need for a high growth rate after 1976/77. There is substantial provision in the Forward Look for the neutron beam programme, which would create considerable in-house activity, and in astronomy future plans include the Mark VA radio telescope and the Northern Hemisphere Observatory. The Atlas Laboratory programme includes a new large computer. How far these plans can be implemented will depend on the funds actually made available and there is already an indication that the growth rate beyond 1974/75 is unlikely to exceed $3\frac{1}{2}$% pa. A further major uncertainty is that a Government decision has yet to be taken on whether, as the Council hopes, the High Flux Beam Reactor can be built.

new library for Rutherford

The Council approved construction of a new library building at

council commentary continued

the Rutherford Laboratory. When the Laboratory was opened it was planned that the library needs would primarily be met by the main AERE library, but this has never been satisfactory and the two libraries are now quite independant. There is a growing need for adequate space for the stock of books and pre-prints, and for reading and study by the Laboratory staff and the many university visitors. The new library will be in the form of a bridge connecting two of the Laboratory buildings. Approval was also given to expenditure by the Radio and Space Research Station for an increase in the core store of the 1906A computer by 32K and for an additional exchangeable disc transport to handle large data files. These additions are needed in connection with the control centre for the UK-5 satellite now being set up at RSRS – the first time a satellite in the Ariel series will be controlled from the UK.

The research grants approved included one of up to £105,000 over one year to Cambridge University for support of the Institute of Astronomy. The Institute has recently been formed by the university merging the Cambridge Observatories and the Institute of Theoretical Astronomy (IOTA). The grant is to cover a transition period until proposals are prepared for later years.

visit to Daresbury

The Council usually holds its May meeting at one of the Establishments and this year the visit was to the Daresbury Nuclear Physics Laboratory. The meeting was preceded by a tour of the Laboratory which included some of the exhibits prepared for the Open Day held immediately after the Council's visit. Council members have commented that they were impressed by the enthusiasm of the Laboratory staff, and the standard of the scientific programme, and said how enjoyable the visit was.

may

The Council received the report of the joint SRC/SSRC Committee on "broader" training. The Working Group on Manpower for Scientific Growth under Professor Swann, which reported in 1968, pointed to the need to encourage those studying science disciplines to continue their training in areas broader than are provided by the traditional PhD, and the joint SRC/SSRC Committee was set

continued on p 21

4. (l to r) Dr R G P Voss (Deputy Director DNPL), Professor J C Gunn (Chairman Nuclear Physics Board) and Professor A Donnachie (DNPL Group Leader, HE Physics and Synchrotron Radiation Facility).

5. (l to r) Mrs Pickavance, Mr M J Moore (as 1), Dr T G Pickavance CBE (Director Nuclear Physics) and Professor Rutherglen (Glasgow University).

ten years continued from p. 3

was the next big step forward, and this received approval two years ago *(as reported in Quest Vol 4 No 2 p 1).* The facility will become available later this year.

The latest project linked with the laboratory is the proposed very large tandem Van de Graff accelerator. This has been discussed for some years and a design study is now being carried out with a view to building it if the project is finally accepted, on the Daresbury site. One of the Open Day exhibits showed prototype and test equipment for the design study.

We offer congratulations to the staff of the Laboratory for a very well thought out exhibition, of both general and expert interest, and for their smooth organisation of tours of exhibits, lunches and buses. A special mention goes to the exhibitors who answered all sorts of questions at many different levels.

Pictures show moments during the Council's visit, all taken by Arthur Pickett, photographer at Daresbury Laboratory.

SRC INTERNATIONAL

A supplement that features some projects abroad and our collaboration with research teams from other European countries.

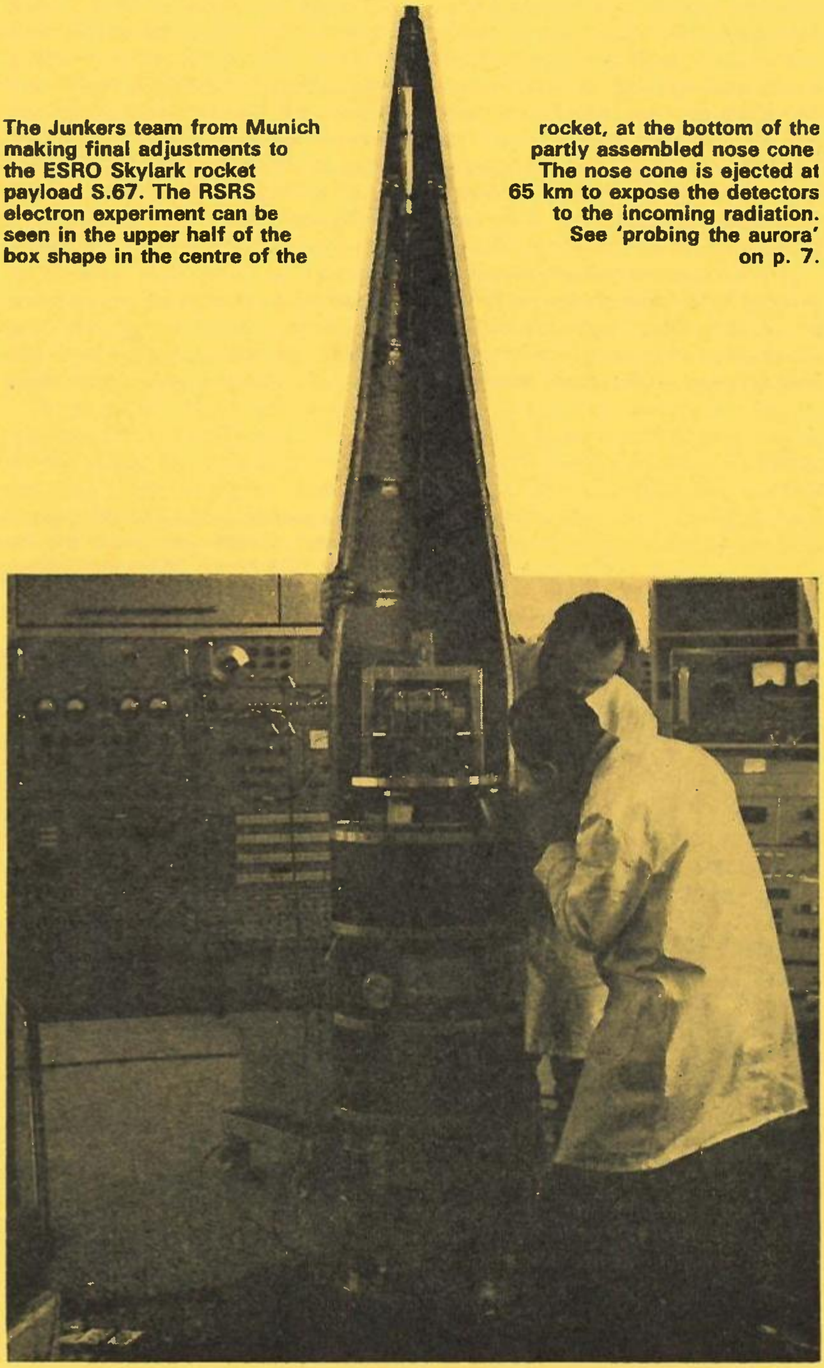
into Europe

Brian Flowers

Whatever the future brings it seems unlikely that the Treaty of Rome will prove simply to have been another scrap of paper. The most important issues are, of course, the economic and political ones on which scientists have nothing more to contribute than any other intelligent citizen. But science has received scant attention and even technology has only been touched on to bolster up economic argument. The likely effects of joining the EEC upon the advancement of science in this country and in Europe have as yet been scarcely considered.

The two basic elements of international science have always been the free exchange of information and movement of scientists across national frontiers. This has been so from Egyptian papyri to Gutenberg's press, to the modern international scientific journals. There would be little point in trying to explain the British climate using purely British data, or to control locusts and plague on a xenophobic basis. And so we have the World Weather Watch and the World Health Organisation.

Nations as well as universities and other institutions have already realised that they must coordinate their activities in order to share limited funds to the best advantage and to afford facilities to which they can no longer singly aspire. Cooperation already encompasses nuclear physics, CERN solid state physics (ILL Grenoble), space research (ELDO, ESRO), astronomy (ESO), molecular biology (EMBO), atomic energy (Euratom). Large new scientific projects will increas-



The Junkers team from Munich making final adjustments to the ESRO Skylark rocket payload S.67. The RSRS electron experiment can be seen in the upper half of the box shape in the centre of the rocket, at the bottom of the partly assembled nose cone The nose cone is ejected at 65 km to expose the detectors to the incoming radiation. **See 'probing the aurora' on p. 7.**

into Europe continued

ingly have to be judged and financed on a European, not a national basis, and we should welcome this even if it means that decisions may take a little longer and negotiations may be a little more difficult. At the same time, we shall have to beware of undertaking scientific or technological ventures for purely political reasons, merely in order to appear European. Building up a new Europe is indeed a worthy end in itself, and one that scientists just as others may be ready to accept. But we and our partners will be foolish to forget that however high our purpose bad science leads to bad politics, and bad technology to bad economics.

Of the science-based industries – those that depend especially upon automation, instrumentation, electronics chemistry, and materials science – the great majority have much to gain from the enlargement of the Common Market. If the heavy R & D overheads are to be covered, a home market of 50 million is insufficient as an export base; 250 million is nearer the mark.

There are thus strong practical reasons for international cooperation in science and technology, which reinforce the idealistic view that knowledge about the world belongs to mankind as a whole. But the EEC must be much more than a club in which rich nations can sell each other more and more consumer goods. Science is sedition at its best, and new discoveries can and should alter our concept of the world. The increasing complexity of technology and science provide added impetus to change as their side effects increasingly recognize no national frontiers. Pollution of air and water, excessive use of soil and sea, all make it more and more necessary – in our own self-interest – to cooperate internationally, when necessary beyond Europe, because in the end we prosper or suffer together. Already an international institute for the management of technology has been proposed, and the EEC intends to extend the work of the International Commission for Rhine Pollution Control to protect the North Sea as well as the whole of the Rhine basin.

Society demands satisfaction from its investments in science, and increasingly, a better quality of life. Technology no longer has licence to intrude in unwelcome ways. But to avoid and control the intrusion of noise, filth and poison we require more research, not less. To achieve this Europe will have to share the costs; to operate the subsequent controls, Europe will have to act in concert, and recognise its place in the world as a whole.

Picture below: an auroral arc seen from Kiruna in Sweden. The nearly vertical 'curtains' of light rays lie in the local direction of the earth's magnetic field. After a time waves begin to ripple along the curtains and they break up into a chaos of swirling and darting shafts of light that seem to fill the whole sky. See 'probing the aurora' opposite by Dr Duncan Bryant of RSRS.

probing the aurora

Sounding rocket experiments in Norway and Sweden by a group from the Radio and Space Research Station.

Duncan Bryant

No one who has the good fortune to see an auroral display in the heart of the auroral zone (in Europe this is the North of Norway and Sweden) can fail to be impressed by the sheer scale of the phenomenon and its highly varied nature. Usually an event begins with a bright band of light extending across the night sky from east to west. It appears first in the northern part of the sky and then begins to move south. After an hour or so, when it is directly overhead, one can see that it is composed of several thin curtains of light which are not quite vertical but are aligned along the local direction of the earth's magnetic field. After a time, waves begin to ripple along these curtains and the hitherto stable pattern breaks up into a chaos of swirling and darting shafts of light that seem to fill the whole sky. This settles down eventually to a widespread and fairly uniform glow, though even this can be patchy and its brightness often pulsates.

The immediate cause of the aurora is well understood. Streams of charged particles – mainly electrons with energies of a few keV – guided by the earth's magnetic field, enter the atmosphere from outside and make it glow like the gas in a fluorescent lamp. The light that is produced is somewhat incidental to the more important effects of ionization and heating of the upper atmosphere in the region 90 – 120 km.

The origin of the charged particles is still a mystery. It is clear that the energy which 'drives' the aurora comes ultimately from the sun, and it is carried to the earth by the constant stream of charged particles evaporating from the sun and forming what is known as the solar wind. It appears that some of this energy is captured and stored for a while in the magnetic fields and charged particles that surround the earth. The stored energy is redistributed every few hours in explosive events, one of the results of which is the aurora. It is not just the details of these processes that are unknown but even their very nature. One process that may play a large part in the redistribution of stored energy is the dissipation of magnetic energy, a process that occurs on the sun and probably on other stars. We have to resolve these questions both in order to understand the earth's environment, and in order to learn about basic physical processes that are as yet unknown in the laboratory.

A group at RSRS has studied the incoming auroral particles for some years by flying detectors on sounding rockets launched from Norway and Sweden. Most of the flights have been part of the ESRO rocket programme, some have been within the UK National programme and some in collaboration with the Norwegian Defence Research Establishment. So far we have used five different types of rocket, ranging from Petrel which reaches an altitude of 160 km, to Skylark which reaches 240 km. Each rocket carries several different but closely related experiments. A typical ESRO Skylark payload might carry experiments prepared by research groups from several different countries – to measure light intensity, ionization density, electric fields, and particle intensities. The preparation of such a payload requires a lot of co-operation between the experimenters, the authority responsible for the flight and (usually) a contractor appointed to assemble the various experiments into a working payload. In this way we have now worked with scientists and engineers from almost every country in Western Europe. We value this collaboration not only for the exchange of scientific and technical data and ideas, but also for the lessons to be learned from the different approaches to getting jobs done and completed on time.

The detectors we use are geiger counters and channel electron multipliers. The geiger counter detects a charged particle by amplifying the trail of ionization in gas. The channel electron multiplier amplifies the emission of secondary electrons from a surface. The geiger counter is easier to use but insensitive to the low-energy electrons that predominate and carry the bulk of the incoming energy. In order to isolate and compare particles of different energies, we deflect the incoming particles in an electric field before they reach the channel electron multiplier where they are detected. Several detectors are used in each payload depending on the exact purpose of the flight.

The launchings take place from Andenes, a fishing port on an island off the northern coast of Norway, and Kiruna, an iron-mining town in the heart of the Swedish part of Lapland. In spite of the extreme arctic cold our experiments have to be restricted to the winter months when the sky is dark enough for the aurora to be seen. Once everything has been checked and the rocket is ready to fire, there is usually a long wait through many nights before conditions are right. The wind must not be too strong, the sky must be clear, and the chosen type of aurora must lie in the flight path. The nominal trajectory of the rocket is predetermined: the rocket is set to be launched nearly vertically and, after about 8 minutes flight, to fall within a target area down range.

The decision to fire is the most critical moment of all because, although it is highly variable and unpredictable, the aurora can be studied systematically by

SRMU

The Space Research Management Unit (SRMU) was transferred to the Radio and Space Research Station on February 1, 1972. The unit originated in a small group on secondment to the Physics department at University College, London, under Sir Harry Massey, and was formed into a recognised Unit in 1963 when it became formally responsible for the Scientific space programmes carried out with rockets and satellites, acting on behalf of the Royal Society's British National Committee for Space Research.

In 1965 when the Science Research Council was formed, the Unit became part of the SRC's Astronomy Space and Radio Division (ASR) and also looked after Space Research grants and the Space Policy and Grants Committee (SPGC) and its working groups. When the Unit transferred to RSRS, the grants and committee secretariat duties remained behind with ASR.

SRMU contains three groups. The satellite project group is responsible for the overall management of the British space research programme carried out on the 'Ariel' series of satellites (Called 'UK' before launch). The satellites are launched by the United States National Aeronautics and Space Administration (NASA). Ariels I and II were American Satellites carrying British experiments, Ariel III was the first of the series built entirely in this country and Ariel IV launched last December, also contained an American experiment for the first time. The next one, UK 5, will be launched from the Italian San Marco platform off the coast of Kenya in 1973 (See John Smith's article in Quest Vol 5, No 2, p.11). The responsibilities of the Satellite group cover co-ordination of the requirements of experimenters, purchase of the spacecraft, through the Ministry of Defence Procurement Executive (MOD-PE), through to post-launch control and data processing, all in liaison with NASA.

The Skylark rocket group has similar responsibilities within the British national rocket programme. Skylark is a 17-inch sounding rocket which has been improved over several years for payload capacity, height and reliability. A sun-pointing attitude stabilised version has been available for some time and a star-pointing version is now being developed. Skylarks are mostly fired from Woomera, Australia, through the agency of the MOD-PE, but have also been launched in the ESRO programme from the Sardinia (Italy) and Kiruna (Sweden) ranges. A national campaign is now being planned for Andoya (Norway). The payloads carried study all aspects of space science – from, say, x-ray astronomy to upper atmosphere winds – and have contained experiments from several SRC establishments as well as many universities.

Recently the group has added balloon launched experiments to its activities, and it is planned to increase this programme. The solar experiments launched by balloon in New Mexico by the Queen's University Belfast and the Astrophysics Research Unit were described by G W Ackland in Quest Vol. 5, 1 p7.

The third group looks after the Petrel and Skua rocket projects and the Commonwealth Collaborative programmes. The Petrel rocket (7.5 inch diameter) has been developed from the Skua (5 inch diameter) meteorological rocket. Both are suitable for small, light and more quickly prepared payloads carried to lower altitudes of 150 km or so, compared with 250 km for Skylark. Most SRC experiments have been launched from the Royal Artillery range at South Uist in the Outer Hebrides. Some have been launched in collaborative programmes from the Sonmiani (Pakistan) and Thumba (India) ranges. High latitude experiments concerned with auroral phenomena have been sent up from the Kiruna range in Sweden and the first such campaign from Andoya in Norway following amalgamation of these ranges within the ESRO Special Project is to be held later in 1972. Nearly all of them have measured ionospheric or neutral atmosphere phenomena.

probing the aurora continued

careful selection of launch conditions. The decision is also of course irrevocable. Once the rocket is fired we can only hope that the data we want will begin to pour back from the transmitter it carries. By these methods we have so far been able to identify the process responsible for the glow-type aurora, locate the origin of the pulsating aurora, and we have begun to establish the origin of auroral bands or arcs.

International co-operation in this field of study has recently received a setback with the closing of the ESRO rocket programme. We hope though that much of this can be regained in the UK National programme. At present there are plans for a series of Petrel launchings from Andenes this autumn, and for combined Skylark and Petrel launchings, also from Andenes, in the autumn of 1973. These rockets will carry experiments provided by eight research groups in the UK.

ESRO's scientific satellites

ESRO-II/IRIS

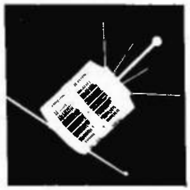
Study of solar and galactic cosmic rays and particles

ESRO-I/AURORAE

Study of polar ionosphere and auroral phenomena

HEOS-I

Study of interplanetary magnetic field and solar particles



ESRO-I/BOREAS

Study of polar ionosphere and auroral phenomena

ESRO and the SRC

From the early days of space research it was recognised that one of the dominant factors would be its cost. To share this, ten states in Europe joined together to form the European Space Research Organisation (ESRO), formally constituted in March 1964. The UK was a founder member and when the SRC was formed in 1965 we became responsible for UK participation in ESRO. We still have responsibility for the scientific side, but with the recent addition to ESRO's activities of a rapidly expanding 'Applications' programme, UK responsibility for this part has fallen to the Department of Trade and Industry.

In its early years ESRO launched a series of scientific satellites starting with modest size projects not dissimilar to SRC's own highly successful Ariel series. There was also a steadily expanding sounding rocket programme that provided European scientists with considerable opportunities in this field. Unfortunately this programme is now about to be terminated.

The satellite part of the programme was initiated with the launch of ESRO II in 1968 followed by another five satellites. The most recent and the largest of these was launched in March of this year. This latest satellite known as TD-1A weighs some half a ton and cost over £20 million sterling. It is clear that for the smaller countries of Europe the cost in finance and manpower of such a large project would be excessive, and even for the larger countries such as Germany, France and the United Kingdom it would be very expensive and could only be undertaken alone at rare intervals.

The six ESRO satellites have conducted a wide variety of extremely interesting experiments. The first two, ESRO I and ESRO II, were relatively small and entered orbit fairly close to the earth. The third, HEOS, entered a very different orbit, in fact it travelled to a distance of about a quarter of a million kilometers from the earth, or the greater part of the distance to the moon. Like the others it carried UK experiments, in this case to study particles occurring in deep space and the behaviour of the magnetic field which is found there. Experiments on board from other member states included a German one that released a large amount of barium deep in space which formed a cloud clearly visible from earth.

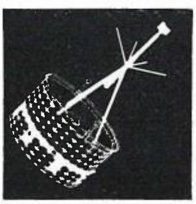
The TD-IA satellite launched early this year was put up to scan the sky in the ultra-violet, to study the radiation from the stars which we cannot see with our eyes. As this invisible radiation does not penetrate through the earth's atmosphere, these studies cannot be undertaken from the ground. Out in space where there is no atmosphere the satellite's telescope can see freely and can study large numbers of stars in the very interesting ultra-violet region. TD-1A has already produced a lot of fundamental information which our scientists are now analysing.

Of the seven experiments on board, the largest is the 12 inch ultra-violet reflecting telescope 'S2/68' with four photo-multiplier detector channels, constructed by the Science Research Council and the Liège Institute of Astrophysics to carry out multicolour celestial scanning in the range 1000 - 3000 Å. The experiment began as a joint project of the Royal Observatory Edinburgh and the Liège Institute, then three more of the SRC's seven research establishments became involved: ARU, ACL and RHEL.

The Centre D'Etudes Nucleaires de Saclay has two spectrometry experiments on TD 1A, studying primary charged particles and celestial x-rays in the 3 - 30KeV range; Utrecht University Observatory is studying UV stellar spectroscopy in three wavelength bands between 2000 and 3000 Å and solar x-rays in the 20 - 300 MeV range. Milan University are looking at solar gamma rays in the 50 - 300 MeV range and are taking part in a joint experiment with the Max Planck Institute, Garching, and the Saclay Centre to scan for celestial gamma rays in the 70 - 300 MeV range.

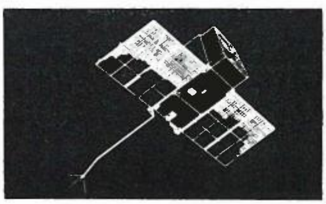
Future ESRO plans include a large satellite to study cosmic rays which will be launched either late in 1974 or early 1975. This is a very large and costly project, although simple in concept in that it contains only one experiment. This will consist of a very large

published by courtesy of the European Space Research Organisation



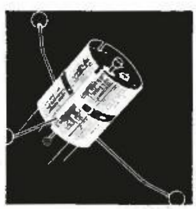
HEOS-A2

Study of interplanetary magnetic field and solar particles



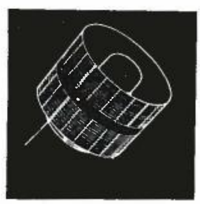
TDI-A

Astronomical, solar and cosmic ray research



ESRO-IV

Study of the ionosphere and solar particles



COS-B

Study of cosmic rays from the galaxy

GEOS

Investigation of particle fluxes, electric and magnetic fields

ESRO and the SRC continued

chamber and associated instruments, designed to study the very high energy gamma-rays which come from various parts of the universe. One hopes they will tell us much about the interior processes of stars or their creation or perhaps both.

Another project under active study that, if finally approved, would be launched in 1975 or 1976, is the large geostationary satellite known as GEOS. This would be placed in a geostationary orbit so as to rotate at the same speed as the earth and appear to remain stationary over a selected point on the equator. The satellite would send down to earth a continuous stream of information concerning particles and fields in space and these would be correlated with observations of high-latitude terrestrial phenomena made on the ground by a number of observatories scattered around or near the arctic circle. This is already a good example of the wide international collaboration which is one of ESRO's primary aims.

As mentioned before, the original ESRO programme consisted of both satellites and sounding rockets. Towards the end of last year the member states agreed that the organisation should no longer remain exclusively a scientific research organisation but should interest itself more in the applications satellites which promise so much benefit to mankind. Since funds are not unlimited some sacrifices were inevitable, and one of these was the termination of the sounding rocket programme. This programme provided opportunities for experimenters both here and on the continent to fly experiments on rockets which either did not justify the cost and effort of using a satellite, or were simply not suitable. The first one flown was a British Skylark rocket, launched in July 1964. This was followed by more Skylarks and the corresponding French rockets Centaure, until a total of 171 launches had taken place by the end of last year. This programme has been invaluable in assisting European laboratories to obtain data and develop their expertise in space techniques. Many of these laboratories have graduated from sounding rockets to complicated satellite payloads with great success. Indeed it may be said that the sounding rocket is the beginner's way into space.

Now that the sounding rockets programme is to end ESRO will concentrate on the scientific satellites on the one hand and on the applications satellites on the other.

What are 'applications' satellites? We have all sat and watched scenes from distant countries relayed to us on our television screens by means of satellites. This is one example, and the one most familiar to us, but behind the television broadcasts lies a complex network of ground stations and orbiting satellites built for telephone, telex and similar uses and they are the ones used, when required, for television purposes. Another familiar example is the use of satellites to photograph clouds and relay the photographs to the ground by means of radio transmissions. These help meteorologists to understand more about our atmosphere and the weather it inflicts upon us. Although the use of satellites for meteorology has only just begun it is already possible to detect and follow the progress of hurricanes as they near the coast and threaten cities and ports. Another type of satellite which is claimed to have great benefits for mankind is the 'Earth Resources Satellite'. This examines the earth and detects changes in vegetation and in geophysical properties, such as where areas of crops have been subject to blight or where warm water flows into a cold sea, or vice versa. Or it can assess which areas of a mountainside are covered by snow or how big is the real extent of a desert.

ESRO has firm plans for some of these activities and is conducting studies for others. A programme has been agreed for an European communications satellite which will last several years and which should lay the foundations for future communications services for the whole of our continent. Negotiations are being undertaken with the Americans for a satellite which will test a method proposed for control of air traffic over the North Atlantic. This method should enable aircraft to fly closer together but still more safely across the congested North Atlantic routes, and should enable traffic to grow and continue to grow over many years to come. Another programme on which decision is expected during 1972 is the European Meteorological programme which aims to place a single experimental satellite into a geostationary orbit and use it to test various types of instruments and to provide the basis for a more complex operational system which may be used in future years.

Responsibility within the UK for these new 'applications' activities which Europe is undertaking rests with DTI. SRC continues to be responsible on behalf of the UK for ESRO's scientific programme. Those of us who have been associated with this work over the years have found it stimulating and rewarding and the continuous contact with our European colleagues has demonstrated to us that, where there is a common will, there is usually a common way ahead to goals which none of us would willingly face alone.

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inside information

The rumour that London Office is to move to Swindon so that the staff can receive their copies of *Quest* on time have not yet been officially denied.

Staff at RGO have been given a firm promise by Management that they will be consulted before any further amendment is made to the Greenwich Time Signal.

the next telescope

By 1969 the Science Research Council found that applications for observing time on the Isaac Newton Telescope (INT) had increased to four times more than we could accommodate. The building of the British 48 inch Schmidt telescope and the 150 inch Anglo-Australian telescope in the southern hemisphere, due to become operational in 1973 and 1975 respectively were expected to cater for some of the increasing demand. Nevertheless it was clear that a new observatory would be needed in the northern hemisphere so design studies and site tests were put in hand.

Current financial resources for optical and radio astronomy were already assigned to several new projects, in addition to the continuing maintenance and improvement of existing facilities. So it was planned to have the northern hemisphere studies completed and ready to be considered as soon as resources became available.

The new projects, now all well advanced, include the two southern hemisphere optical telescopes mentioned above, the 5km radio telescope at Cambridge, modifications to the Jodrell Bank Mark I radio telescope, design work on the proposed 375 foot Mark VA Radio Telescope, construction of the 60 inch infra-red flux collector at Tenerife and the design study for a larger infra-red instrument.

In the first of the following articles, John Alexander of the Royal Greenwich Observatory describes some of the things an astronomer looks for in selecting a really good site for a telescope. He is a Senior Scientific Officer, engaged on problems of stellar spectroscopy and photometry. He was involved in the early stages of the NHO site testing.

The second article is an account by the project leader of the Site Testing now being carried out by the Royal Observatory Edinburgh for a new Northern Hemisphere Observatory. Bennett McInnes is a Senior Scientific Officer. He also leads the Satellite Tracking Section at Edinburgh and acts as Public Relations Officer. When the site testing project was added to his other duties he had to resign his position of Staff Side Secretary to the Local Whitley Committee.

where to look

John Alexander

The meteorological climate of the British Isles is not ideal for optical astronomy. The observations of John Goodricke, James Bradley, William Herschel, the Earl of Rosse and William Huggins were made very much in spite of the British weather, and although much serious astronomical research can still be done with an instrument of moderate size even in a poor climate, it is essential for many programmes to use a large telescope in a good climate. As more large telescopes are being built in the world, the incentive to find a really good site becomes that much greater. First one looks for a site with a large number of hours at night when there is little or no cloud,

Picture: La Palma Island in the Canaries showing the island's highest point, above the clouds, looking towards Tenerife, 80 miles away. Photo J Alexander.

preferably distributed evenly throughout the year. There is a general tendency for cloud to decrease as one moves from the latitude of Britain to that of southern Europe; and even less is found in parts of the trade wind belts — from high ground in the Canary Islands off North West Africa for instance. It is therefore to southerly latitudes that we look for sites for new large telescopes.

In spite of the vast amount of meteorological data available, an accurate assessment of the amount of clear sky to be expected at a possible observatory site is rarely obtainable, because the nearest meteorological station is often far from the site and at a much lower altitude. Moreover, meteorological records often do not refer to cloud cover at night. Although some of these difficulties can be partially overcome using data from weather satellites, there is no real substitute for observations made on the site itself.

Secondly, for many photometric programmes the sky above the site must not contain any large number of suspended particles of dust, water, salt, etc. Both man-made pollution and natural phenomena can cause problems. Dust blown from the deserts of North Africa, for instance, is sometimes seen in the skies of southern Europe, the Canary Islands and the Cape Verde Islands, and occasionally as far away as Britain.

Thirdly, it is extremely important that the so-called "seeing" is good. Because of small temperature irregularities in the earth's atmosphere, the amount by which the light from a star is refracted varies rapidly with time, and in a small telescope its image will dance around because of this. In a large telescope, the main effect is to blur the image into a fuzzy ball of light much larger than the minimum size imposed by the optical properties of the telescope. This ball of light is called the "seeing disc". Really good seeing usually occurs with great frequency only at certain mountain locations which are above many of the layers of air that cause optical turbulence. At Herstmonceux the diameter of the seeing disc is typically about three seconds of arc and very occasionally as good as one. On the other hand, on a really good mountain site, one second of arc will be quite common.

The advantage of having good seeing can be demonstrated, for example, where the seeing disc of a star is focussed on the slit of a spectrograph in order to analyse its light. It is not usually possible to design a conventional spectrograph for a large telescope that will give good resolution of the spectrum and also have a slit wide enough to admit the whole seeing disc of the star, and much of the light must therefore be wasted. However, when the seeing is good, and the light is therefore more concentrated at the slit, a greater proportion will pass through. Other things being equal, the time taken to obtain a spectrum of a star with a conventional spectrograph is proportional to the diameter of the seeing disc divided by the aperture of the telescope, so a 50-inch telescope taking a spectrum with a seeing disc of one second of arc is about as powerful as one of 150-inch aperture working with a seeing disc of three seconds of arc. Since the cost of a telescope varies roughly as the square of the aperture, finding a site with really good seeing is extremely important.

Fourthly, for some programmes the sky must be "dark". In addition to the natural sources of light from galaxies, stars and the upper atmosphere, any extra contribution from man-made sources can be a great hindrance when observing faint celestial objects. In a recent survey in California it was estimated that one had to be some 170 kilometres away from a city of 2½ million inhabitants to have a sky sufficiently dark for a large telescope. Much of Europe is too near cities and towns to have a really dark sky.

The four observing conditions mentioned above are the main ones to be considered but other factors such as wind velocity and the temperature range throughout the night are also important. Even when one has found a site with excellent observing conditions it may not be a practical one because of problems of access. The requirement of a dark sky means that any good site will be reasonably remote from towns, and the construction of a few miles of new road can be extremely expensive, espcially in rugged mountainous country.

In selecting possible sites for a new northern hemisphere telescope, British astronomers were

photo B McInnes

Pictures

(Left) Site testers in Italy . . . up early or late to bed?

(opposite) Frost on the Polaris Trail Telescope at Izaña in Tenerife. Pico del Teide in the background, is a 'still-warm' volcano – but not warm enough to keep the snow from its slopes.

able to consult the findings of other European astronomers who had already carried out site testing in the Mediterranean area and in the Canary Islands. After a study of their results and of meteorological and geographical conditions, it was possible to select three areas which appeared to be most promising for the British site testing programme – Italy, South-East Spain and the Canary Islands.

In the Spring of 1971, the writer and Alan Penny (also from RGO) visited two of the potential areas. During our observations on the snow-covered mountain of Calar Alto in Spain, standing in a 60 mph gale and a temperature of −7°C, we could not help recalling the farewell advice from Herstmonceux 'Southern Spain will be very warm. Don't forget your bathing costume!'

The 60 mph gale was but a breeze though compared with the 120 mph winds that have blown round the team on Tenerife this year. It is perhaps just as well that they did not take up the suggestion made by an economist in State House and sleep the team in tents.

There were other moments of exhilaration. When we were looking for possible sites on the mountains of La Palma in the Canaries, we walked up through the clouds and into the sunshine on the pine clad slopes of the Caldera. From the highest point on the island we had a magnificent view of the mountains and cloud below and, away to the south-east, we could clearly see the snow covered peaks of Tenerife, 80 miles away.

photo B McInnes

it's a matter of 'seeing'. . .

Bennet McInnes

The 'Northern Hemisphere Observatory Site Testing Project' — a name that evokes a variety of pictures, depending on the factor that springs most to mind.

money

SRC Projects depend first of all on money. In terms of pounds sterling our project originally meant 40K (as they put it) spread over two years. It is now beginning to look more like 45K spread over three years.

In 1970, when the project began to take shape, there seemed to be general agreement that the best astronomical site in the northern hemisphere occupied so far by an observatory was in California. There seemed to be widespread *dis*agreement about the likelihood of comparable sites nearer to Britain. The aim of the project was to study this question and, hopefully, to find a definite answer. Three general regions were suggested: southern Italy, south-eastern Spain, and the Canary Islands. The choice of sites within these regions was not yet decided.

Attention then turned to the instruments to be used. The Royal

it's a matter of seeing continued

Observatory, Edinburgh, was charged with the preparation of three sets of suitable equipment. For the measurement of 'stellar extinction' and of night sky brightness, the Instrumentation Division designed and built

instruments

a tripod-mounted photo-electric photometer. Stellar extinction is the dimming of starlight by the atmosphere and particularly by 'impurities' such as dust and moisture. Other things being equal, a high site will be better than a low one as regards extinction because it has less air above it. Dimming due to the natural brightness of the night sky is worse when the brightness is increased by artificial light scattered back from the atmosphere above the site. City lights are the worst offenders in this and the only satisfactory way to assess the effect of a nearby city on a site is to take measurements on the spot.

For many types of astronomical observation an important property of a site is the "seeing". The image of a star produced by a telescope moves and blurs as irregularities in the atmosphere pass through the light beam. The nature of the degradation depends on the instrument being used and, although the subject has been under discussion for many years, astronomers still disagree about the means of measuring it and many different instruments have been used to determine the seeing of potential sites.

For our project we decided to adopt the instrument used in the California Site Survey of 1965-1967, a Polaris Trail Telescope. This is a fixed telescope camera which takes an exposure (lasting ten minutes or so) at high magnification of the Pole Star. The resulting trail shows wobbling and blurring which can be measured and interpreted in terms of the quality of seeing as it would affect a large-aperture telescope. The design of the British PTT was based on the American one. Three PTT's and three sets of simple meteorological instruments were made or bought during the summer of 1970 and carefully calibrated against one another so that the results from the different sites would be strictly comparable.

people

Originally the project was to be a joint effort of the two Royal Observatories and the first reconnaissance work was done by John Alexander and Alan Penny of the Royal Greenwich Observatory, who visited Spain and the Canary Islands in March and April 1971. Shortly after that, the whole of the project became the responsibility of the Royal Observatory, Edinburgh, under the direction of the Astronomer Royal for Scotland, and the writer (or, more properly, a large fraction of him) became Project Leader. Not counting the many other fractions of people at the ROE who contribute to the project, the staff consists of four Scientific Officers from the complement of the ROE and six Assistant Scientific Officers recruited on a short-term basis.

Three of the SOs were allocated to the three regions as team leaders; the fourth was to assist with the reduction of observations in Edinburgh. In the summer of 1971 they were very busy visiting their regions, choosing the precise sites for the three Observing Stations, planning the ideal Station layout, working out the details of the observing schedule, and trying to extract from the Observatory Secretariat information about Foreign Service Allowance and other financial matters. Among the ideas considered and (fortunately) rejected was one that the team on each site should live in a caravan. Instead it was agreed that each station should be built around a prefabricated aluminium hut providing living quarters for the observers and storage space for the portable instruments. The Polaris Trail Telescope required a solidly built mounting, with walls for wind protection. For transport a Land Rover seemed to be the right vehicle.

More than fifty people applied for the six ASO posts. It had been decided that the special demands of the observing situation ruled out women and the advertisement was worded accordingly. But that did not deter some young ladies, including the one who said (I hope she will not mind if I quote her) "I believe in total equality of the sexes, and I think that my overland expedition to India has proved that I am just as hardy as any male (if not more so)."

Anyway by August the vacancies were filled (by men) and a Site Testing Training Course was held at Edinburgh, this included practice in driving a Land Rover and mixing and laying concrete! During the course the teams and the team leaders more or less chose one another (though some changes have been made since) and by the beginning of September one team was in the Canary Islands busy buying tools and clearing the ground for erection of the Station (hut).

places

The Canary Islands Station is in the island of Tenerife, on the Izaña mountain ridge, in the grounds of a Spanish observatory, Observatorio del Teide. The Station lies between the Imperial College London 60-inch infra-red flux collector (see Quest Vol. 5, 2 p. 6) and zodiacal light observing station. A vehicle accident and other difficulties made the setting up of our station into an arduous task but by the end of 1971 regular observing had started. For ROE people it was a resumption of earlier work begun in 1856 when the second Astronomer

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thankyou Atlas!

Quest is grateful to the people at the Atlas Laboratory who replied to a recent readers' survey and made some very good suggestions.

Royal for Scotland, Charles Piazzi Smyth, set up one of the earliest site testing stations ever on Tenerife. Instead of a Land Rover he had mules and manpower, his Station was a tent and his wife was the cook but he even managed to do some infra-red observations as well.

In Italy things moved very slowly. It took till October to find a suitable site and obtain permission to occupy it. Then bad weather made the access road impassable for vehicles. But the problems were overcome and regular observations began in February 1972. The Station is not far from an Italian site testing station, the probable site of the Italian National Astronomical Observatory. According to the British Consul-General at Napoli, the team there has "fitted into the bucolic Italian life with great success."

As far as Spain is concerned we are still waiting for permission to set up the station. We have selected our spot and we have our team raring to go; as soon as we get clearance things will begin to move.

results

The observations made at the site are sent to Edinburgh as quickly as possible and turned into lengths of punched paper tape which can be processed in the Observatory's computer to produce an answer to any (reasonable) question. A preliminary presentation of the observations is being made in a series of Reports which are being produced from duplicator stencils made on a tape-controlled typewriter.

Which Station is on the best astronomical site and how do these sites compare with California? So that we can answer the second question to everyone's satisfaction, the Tenerife team has one of the American Polaris Trail Telescopes on loan and they are making simultaneous observations with both instruments. It is not yet possible to give an answer, however: please ask us again in a few month's time.

magic squares solution

The puzzle appeared in the April issue on p. 24.

The 3 X 3 magic square is

2	9	4
7	5	3
6	1	8

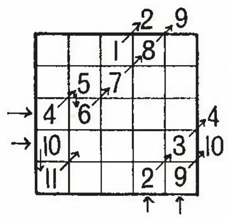
It can be derived logically if you note that the numbers add up to 15 in eight different ways (3 rows, 3 columns, 2 diagonals) and there are exactly eight ways of choosing three numbers from the integers 1 to 9 to produce this total. 9 appears in two of these (9 + 5 + 1 and 9 + 2 + 4) so it follows that 9 must be in the middle of one side of the square: if it were not it would get counted in more than twice. Continuing, 5 must be in the middle (so as to be counted four times) and so on. The fact that the number of ways of making 15 is exactly the same as the number needed for the square shows that the problem has a unique solution. One can in fact write the square in eight different ways (it can be turned upside down, changed left for right or rotated, to produce patterns which look different) but they are fundamentally equivalent.

In a 4 × 4 magic square the four middle squares and the four corner squares always add up to the magic number. The squares shown below, however, are 'Super-Magic' because *all* blocks of four numbers add to 34. If you imagine it curved round into a cylinder so that opposite sides touch this is still true. The two squares are 'complementary' meaning that the corresponding numbers always add to 17 (the fact that this is half the magic number is not significant).

1	12	7	14
8	13	2	11
10	3	16	5
15	6	9	4

16	5	10	3
9	4	15	6
7	14	1	12
2	11	8	13

There are a number of ways of drawing 'odd-order' magic squares (3 × 3, 5 × 5 and so on) without having to resort to trial and error. In one of these, the numbers are inserted in sequence, starting with 1 and moving upwards diagonally and to the right. When you come to the edge of the diagram you imagine it curved into a cylinder and continue on using the same rule. If at any time the next square is already filled, you put the next number in the square directly below the last number you inserted. The number 1 must be put in the middle of the top row. For a 5 × 5 square it works as follows:



and so on. The proper place for 16 takes a little finding but if you follow the rules precisely you'll see why it appears where it does.

If you would like to know more about magic squares write to Paul Dickinson at RSRS, who has published some notes on them in the *Station Newsletter*.

LO through the looking glass

'I'm glad we're not playing any more', said Christopher Robin. 'Every time the music stops, there are more chairs and fewer players.'

'I know 'said Father William,' and those two were not even in it a moment ago. I wish the Mad Hatter would stop playing "Flowers are bloomin' in Kensington".'

Sir March Hare drove off down the line in his shiny new telescope. 'Poop-poop' he murmured as he drew up beside Henry the Navigator, who had just dropped anchor in the harbour and was lowering Auntie Joan's new spinnaker, ably assisted by first mate Jimmy-the-one.

a new city state

a look at the European Centre for Nuclear Research — 'CERN' The part played in CERN by the Rutherford and Daresbury laboratories will be the subject of a further article

Peter Casey

CERN is not so much an organisation, more a city state. To appreciate its size you need to see it from a height – either coming in to land at Geneva Airport (if the wind is in the right direction), or from the viewing gallery of the new water tower – which recently earned its keep by cooling the accelerator magnets when a power cut stopped the electric pumps. The site covers nearly a third of a square mile, and has its own fire service, bank, travel agency, post office, two restaurants and several shops. When the land for the SPS (super proton synchrotron) is acquired, the site will extend to well over 2 square miles, and because the machine is to be built underground it will include a large tract of agricultural land.

The staff are also very much citizens of CERN. They do not pay income tax to any state, and they enjoy privileges very similar to those of visiting diplomats. They are recruited from all twelve member states, with a sprinkling of other nationalities, but it is said that when anyone has been there a while, his nationality becomes "Cernois". And the Cernois are a very welcoming people. The scientists and engineers all show a tremendous enthusiasm for their work, which is understandable since most of them have left their own countries to pursue it. They are always willing to explain what is going on, to any visitor – much more so, it appears, than our own laboratories.

Approaching from ground level, however, the impression of a city state is formed more slowly. From Geneva itself, you drive out along the St. Genis road, past the airport, still surrounded with barbed wire for protection from hijackers and saboteurs, but with the Swiss army now withdrawn.

Driving through the entrance, where you will not be stopped, you reach the main administration building, and enter it, passing between the bank and the travel agency. It is at this point that most people wonder whether they have arrived in a strange holiday camp, for in front and slightly to the right, past the newsagent and tobacconist, is the main canteen/restaurant, which, at whatever hour you visit it, always appears full.

Besides the main eating area, there are two lounges, in each of which groups of people can be seen drinking coffee or beer, chatting or arguing. One glass wall gives onto a small ornamental pool, with a few fragments of ancient columns beside it. At Christmas, a large tree is set up in the centre of the pool, with an illuminated revolving star. Passing through the restaurant, you reach an open area with tables, chairs, large coloured umbrellas, and a magnificent view of the mountains which enclose the Geneva valley. If the weather permits, more people will be eating, drinking and talking here. To one side is a strange piece of modern sculpture, which on closer examination turns out to be the body of an early bubble chamber.

I have dwelt on these early impressions of CERN because they are lasting ones and because they seem fundamentally true. The "feel" of CERN is of confidence and enthusiasm. CERN has worked, and the Cernois know it. They have built two big machines, the proton synchrotron (PS) and the intersecting storage rings (ISR), which have been great technological successes, and now work is under way on the SPS. Staff are represented by a Staff Association, and relations with them are good, because the administration, free from commercial pressures or concern for a national economy, can operate in a benevolent paternalistic style.

Nevertheless, CERN has its problems. Some of these arise from being controlled by 12 Member States. Inevitably there will be disagreements and pressures, usually financial. In particular, there is now a squeeze on Laboratory I, part of the price to be paid for the new SPS. Other problems arise from relations with the surrounding population. Although CERN may be a kind of city-state, it cannot be isolated from its neighbourhood. CERN personnel have to be housed — currently a great problem in Geneva. CERN is a great employer of local labour, and lorries delivering to its site must use French and Swiss roads. Fortunately, the great co-operation of the French and Swiss authorities has meant that most such problems have been solved relatively quickly.

You will gather from what I have written so far that I am pro-CERN. In the year and a half since I began attending meetings of its Finance Committee, I have become, and remained, impressed with its confidence, enthusiasm, and technical ability, occasionally with the ability of its administration to run rings round delegations, but above all with its openness.

I have not said much about the technical side of CERN, the big machines, the bubble chambers, and the experiments, and this is deliberate, because the information is there for anyone who wants it in CERN's many publications. Instead I have tried to give the "feel" of an extraordinary place and community — the city state of CERN.

SUMMER 1972

Oh! Where is the sun?
Obscured perhaps
By man's intransigence
The skies pour forth their tears,
Awaiting the sweet air of reason
To usher in a cloudless golden day.

Nona "Midsummer" Day, 1972

The Canadian National Research Council and the Radio and Space Research Station have got together over a radio astronomy project. The idea is to link the RSRS 25 metre aerial at Chilbolton with the Canadian 40 metre aerial in Algonquin Park, Ontario, to study Quasars at a wavelength of 2.8 cm. The two aerials are operated as one interferometer with a baseline (the distance between the two) of 5,700 km. This should enable observers to detect angular sizes down to 0.0001 arc seconds, which is equivalent to measuring a line 0.5 cm long (or about the size of a pea) 6000 km away.

links with Chilbolton

Another experiment in which Chilbolton is already taking part is a unique ionospheric study known as multistatic incoherent scatter. The experiment is centred on the Royal Radar Establishment (RRE) at Malvern and makes use of the Chilbolton aerial and the Mark III (36 x 25m) aerial at Manchester University's Jodrell Bank Laboratory at Wardle, Cheshire. A group from the University of Aberystwyth led by Phil Williams is also taking part with a set of 25 x 12m trough aerials (salvaged from a defunct Cambridge radio telescope) at Capel Dewi, near Aberystwyth. Peter McPherson of RSRS is at present working at Malvern on this project, with three RRE staff temporarily seconded to RSRS – Nick Taylor, Robin Rick and George King.

To observe ionospheric incoherent scatter, one must use a radio frequency sufficiently high to make ordinary, mirror-like "total reflection" from the atmosphere impossible and to cut out as much as possible of the "partial reflection" from irregularities in the atmosphere. The basic idea dates back to an article published in 1958 by W E Gordon of Cornell University. The first experiment was made by K L Bowles in the USA in 1959. There are now eight installations: in Peru, Puerto Rico, Maryland, Massachusetts, Alaska, France, Russia and England. The radio frequencies used range from 50 MHz (at Jicamarca, Peru) to 1300 MHz (at Millstone Hill, Mass. and Chatanika, Alaska).

Two of the systems, the French one at S. Santin-Nançay and ours, transmit continuous waves instead of pulses. This has advantages for measuring the spectrum of the scattered signal but it is necessary to use separate transmitting and receiving aerials. The transmitter at Malvern emits 40kW power at 400 MHz (using the same aerial as the pulsed system). The Chilbolton, Jodrell Bank and Capel Dewi aerials are receivers. The complete system was first used in March 1972 although observations at Chilbolton and Jodrell Bank started the previous summer. The object of our experiment is to determine temperatures and winds in the ionosphere at heights of 100-400km.

Henry Rishbeth of RSRS has written a more detailed description of the system for the station newsletter. (Copies available from Geoff Gardiner). We hope to hear something about the results later.

RC's meet and talk

W L Francis

In November 1969 I accompanied the Chairman and Mr Jolliffe on a visit to the Centre National de la Recherche Scientifique (CNRS) in Paris. CNRS is the nearest French equivalent of the Science Research Council, but is mainly concerned with pure science – with most Government support for engineering, applied science and technology coming through the Delegation Generale de la Recherche Technologique (DGRST).

We were received by Monsieur Curien, the Director-General of CNRS, and other senior staff. At this first meeting we mainly exchanged information about our respective organisations. CNRS were particularly interested in the various SRC schemes to achieve closer liaison between universities and industry. We discussed the possibility of collaboration between SRC and CNRS and it was generally agreed that a greater interchange of information between the two organisations was desirable, and that we should make a start by each seconding staff to the other for 2-3 weeks at a time. Mr Walsh of SRC's central training section subsequently spent three weeks at CNRS in June 1970 and a further week in December 1970 and Monsieur Zahn of CNRS came to SRC for two weeks in January 1971. Both visits were most successful and useful. *(John Walsh wrote about his visit in Quest, Vol. 4, 2 p7).*

In June of the following year the Director-General and other representatives of CNRS visited this country. In addition to talks at State House, they visited the Physics and Engineering Departments at Imperial College, London, the Astrophysics Research Unit, Culham, and the Nuclear Physics and Clarendon Laboratories at Oxford. One outcome of our talks was an agreement to encourage collaboration between research workers in British and French universities supported respectively by SRC and CNRS. The visitors were also interested in the discussions SRC were having with the French-German neutron beam team at Grenoble.

In July 1971 the Chairman, Mr Walker and Mr Jolliffe visited CNRS at Toulouse and amongst the subjects discussed were

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Dr Francis retires from the post of Secretary to the Council this year — see page 1.

the encouragement of collaborative research, common research themes, neutron beam research and astronomical research, They also visited the three CNRS Laboratories at Toulouse: the Laboratory for Automation and its applications in Space, the Electronic Optics Laboratory and the Solar Furnace at Odeillo.

These contacts were followed in November 1971 by a visit made by the Chairman, Mr Jolliffe and myself to West Germany to see how that country organised scientific research. The States of the German Federal Republic are largely responsible for education, but responsibility for the support of research is shared between the States and Federal Government with the latter carrying the greater responsibility for finance and coordination. A great deal of research is carried out in research institutes, especially those of the Max Planck Gessellschaft which has fifty five, many in the Munich area. These institutions receive substantial support from the States and Federal Government. Although we heard a great deal about them, we were only able to visit one, the Radio Astronomy Institute of Bonn, where we saw their new 100 metre radio telescope. This was not yet fully operational, but the instrument and surrounding buildings looked most impressive. Further visits to the research institutes of the Max Planck Gessellschaft are planned for late 1972 or early 1973.

We also met Professor Speer, the President, and Dr Schiel, the Director-General of the Deutsche Forschungsgemeinschaft (DFG). This is a body largely financed by government funds, but independent of the government, which provides 10-20% of the cost of university research in the physical and life sciences, medicine, engineering, social science and the humanities.

The DFG works closely with the Max Planck Gessellschaft, holding three or four joint meetings a year to discuss plans. The general programme and priorities of the DFG are decided by a Senate of thirty three scientists who receive proposals from specialist groups and then from bodies with a wider scope (comparable with the SRC Council, Committees and Boards). But priorities are not decided purely on scientific grounds: political and social factors must of course be taken into account.

interest in the high flux beam reactor

In April M. Aude (Director External Relations), Professor Chabal (a Scientific Director) and M. Creyssel (Director Administration and Finance) of CNRS visited London to discuss techniques of establishing collaborative projects with SRC. Talks will be held later in the year with DFG. Discussions continue with the French and German authorities on possible collaboration in neutron beam research and this country's taking a share in use of the Institut Laue Langevin reactor at Grenoble. Later France and Germany might make use of the High Flux Beam Reactor which the SRC are hoping to build.

In February of this year I was one of the UK delegates to a Conference of West European Councils held in Denmark. The other UK delegates from the SRC were the Chairman and Professor Kornberg (a member of Council and Chairman of the Science Board). All the main West European countries were represented, with the exception of Greece, Portugal and Luxembourg, and a late entrant was Yugoslavia.

On the first day the conference analysed the activities of research councils or equivalent bodies and we were questioned on the Green Paper on R & D and the Rothschild and Dainton Reports. The Scandinavian countries who admire the UK research council system and had modelled their own on it, were puzzled that it was apparently under attack. Sir Brian explained the origin and scope of the exercise and led the discussion back to the relations between Government Departments, industry, the scientific community and universities.

The next day delegates from Germany, France and the UK (Professor Kornberg) described their national methods of supporting university research. Then the Conference discussed research councils and the community and spoke of the difficulty in getting universities and research councils to do applied research.

The most important session of the Conference took place on the last day when the subject discussed was "Collaboration among West European Research Councils". To promote such collaboration, the Conference agreed that each Research Council should nominate a Foreign Liaison Officer (FLO), who would be a focus for the exchange of information on proposals for, or problems which would benefit from, international collaboration. There will be a meeting of FLOs in the autumn of 1972 to consider what actions should be taken. These might include a further Conference of West European Research Councils. If it is held, the UK has offered to act as host.

Quest Quarterly Quote

Apollo 12 dust shows a higher overall albedo than *Apollo 11* dust due to its higher plagioclase and lower ilmenite content. The observed lunar albedo is lower than either and could be approached but not reached by mechanical roughening of the dust layer before measurement. This emphasises that the lunar surface must have in general a 'fairy castle' structure.

from the 1969/70 Space Research report

Non-scientists do appreciate any attempt to explain things on a more credible level but this time the scientific mortals seem to have overshot their mark and wandered off into other realms which many of us are not altogether sure about.

to South Africa with the SRC

Sandy Powell

My trip on the boat was very nice, it was called the SA Vaal. I think I am very lucky to travel on a boat like that one. It was very easy to get lost on such a very big boat. When we landed at the Cape me and my parents went into a Café, much to my surprise we were served by a black person. I then bought a packet of mint imperials. I turned it over and saw a different name on the other side, little did I know it was Afrikaans. But I found out later on.

I am sad about leaving my brother in England as my parents think he will be better educated in England. I miss the snow and television and my friends at school, my grandparents, aunts, uncles and cousins. These are some of the facts why I don't like South Africa. I did not like changing schools and having all new teachers and friends.

The school I go to is DSG, it is a very posh school and is private and you wear uniform and it is a girls' school. The school in England was not very posh and was a government school and we did not wear uniform and it was a mixed school. I think school work is much harder in Africa than in England.

I don't think the Afrikaans children who only speak Afrikaans are very nice to the English. They call us names and throw stones at us when we come past them.

I think the Bantu are made to work too hard and they should be cared after more. I have seen them being badly treated. They should have big houses and schools and be treated just like the white people.

Most of the people at the Observatory nearby are friendly and are willing to help you. The Observatory pool is great and lots of people enjoy it very much as well as me and my friends.

There are lots of lovely sights to see in South Africa. We have seen the Drakensberg Mountains, the Golden Gates, Table Mountain and many other mountains. We have also seen Ostrich Farms, Caves, Waterfalls, game reserves and camping sites. The sea is very dangerous and the waves are very big and I was nearly drowned at Port Elizabeth. The sand is soft and silver on the beaches, and they are not very crowded. They go for miles and miles.

The towns are not very big and they are not very clean either. There are lots of miles between towns in South Africa but in England they are nearly all together. The picnic spots have papers and milk cartons and food all thrown down and it is very filthy. My dad is always making fires in South Africa to clean up all the rubbish.

The pictures here are very different. They have a big screen at the front and the cars drive in and park, you sit in your cars all the time but everyone can see because the screen is very big. If it rains everybody has to go back home because the screen goes all funny. We don't have drive-in cinemas in England because it is too cold.

We have a maid, who is Anna, and a gardener who is Ben which is very useful but makes us very lazy. They are very good at cleaning things and Anna has a special interest in the oven. She irons very nicely too. I think my parents are kind to them.

photos Alan Powell

Sandy is the 9 year old daughter of Dr Alan Powell who is at the Radcliffe Observatory. As far as we know he is employed to look through telescopes, not as a fire raiser.

nutcracker suite

We cannot please everybody all of the time it seems, though goodness knows we do try. To put it right for one group, the nutcrackers, who sometimes tell us the posers are too simple and, occasionally, too hard, here are three new ones graded easy, middling and *very* difficult.

Your local correspondent has the answers.

7 top draw

It is a well known fact in London Office that no one ever hears anything officially. So when the six future Heads of Divisions sat down to lunch, they had a fine collection of rumours about the impending moves. "I hear you're going to Science", said Hourmetal to Cotton. "I didn't know" Cotton replied, "but I have heard that Edgar is definitely not going to NP or ASR". "Yes, I've heard I'm for Finance", said Edgar. At this point Overton joined in "My CO tells me that Jones won't be getting an operating division", he said. "Well, all I've heard is that Hourmetal's taking ASR," said Jones. "And for what it's worth, I hear that Overton's getting Engineering," added Morley.

In fact, only four of these rumours were correct. The two people destined for Establishments and Finance had picked up false information, probably through being too close to a powerful source of interference. So who goes where?

Note: E and F are not operating divisions.

8 - sin et lumiere

middling

The Roman Ludi Florales, in honour of the goddess Flora, were celebrated on April 28 with indecent plays. When the custom was revived in London Office this year, six Divisions competed for the three prizes offered in each of five categories. As it happens, each won a different number of prizes, but none took more than one 1st prize.

The first prize for Best Actress went to Miss Colonne, of Engineering, which won more prizes overall than Science Division, but less than ASR. Cary Steepe of Nuclear Physics came second in the Best Actor competition, for his energetic portrayal of a worker in 'Up the Linac'. This was the only second prize won by NP. Establishments were very disappointed not to win first prize in this category for Wat Stanton's performance as a train ticket to Swindon in 'All Quiet on the Y Front'. First prize in the Best Satirical Attack on the Chairman category went to Dr Quill of Finance Division, but the Division failed to win any acting prizes, and could only manage 3rd place in the Walker Trophy for Most Convincing Reason for a Production Overspend. Needless to say, this Trophy was won by ASR.

The Division which came second in the Walker Trophy also took 3rd place in the Best Satirical Attack on the Chairman competition, and the Division which came 3rd in the Most Obscene Script competition came second in Best Actress.

Given that no Division can win more than one prize in any category, who came second in the Most Obscene Script Competition?

9 - musical chairs

good luck!

There are precisely five chairs of Environmental Chemistry in Britain, currently occupied by Professors Bison, Gabriel, Paten, Trout, and Wilbur-Didymus. Every three years they exchange chairs, each moving to a chair he has not previously occupied. They are now about to make their second such exchange.

Trout is moving to the chair held by the man whose previous chair Wilbur-Didymus now holds. Paten now holds the chair to which the man who holds Bison's previous chair is moving. Gabriel is moving to the chair now held by the man to whose old chair the previous holder of Bison's chair is moving. Paten is not moving to the chair previously held by Wilbur-Didymus, and no two professors are swapping chairs.

So who previously held the chair now occupied by Gabriel?

Hint. Whose old chair does Wilbur-Didymus now hold?

Peter Casey

Competition

Not so long ago it seemed that a well-educated man always had a phrase from one of the dead languages to impress (or confuse) the hoi polloi. Alas, this is no longer so. In an attempt to halt this decline of traditional values we invite readers to devise suitably learned mottoes for the various constituent parts of SRC. (The alternative—of sending more scientists to Oxford for their education—is far too dreadful to contemplate.)

Some examples which we have devised ourselves (and think tremendously good) are:

Fiat lux[1]—Synchrotron Radiation Facility

Errare humanum est[2]—LO Administration

De minimus curamus[3]—NP Division, Finance Division or any Establishment canteen.

On second thoughts we will also (in accordance with the Zeitgeist) accept entries in modern European languages including those spoken (or at least uttered) in our northern outposts.

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1. *Let there be light.*
2. *To err is human.*
3. *We are concerned with trifles.*

Headlines we missed seeing (p 22)

FLOWERS SEEKS FRESH FIELDS

BRANCHES OUT

IC Takeover Bid

Sir Brian to head IMPCOL

TOP MAN GOES WEST

promotion

Mr Robert Dalziel is promoted to Deputy Chief Scientific Officer and takes up the newly created post at the Radio and Space Research Station.

Mr Dalziel joined RSRS in 1961 as leader (SPSO) of the division now known as Space Science (A) and Space Management Services, which is concerned with a wide range of investigations carried out by experiments flown on rockets and satellites. He is the project scientist for the Aeriel IV satellite experiments, launched last December.

His career began with a first-class honours degree at the University of Glasgow in 1941. Then, like many others, he was influenced by the war to turn from the theoretical to the practical and joined the Signals Research and Development Establishment. His work there (until 1961) included the application of electronic techniques to means of defence and, later on, to highly specialised military communications systems.

Dr Henry Rishbeth also of RSRS is promoted to Senior Principal Scientific Officer on individual merit. Born in 1931 into a family that has many associations with Cambridge, he entered Christ's College in 1951 after two years' service with the Royal Air Force. Postgraduate research into ionospheric phenomena at the Cavendish Laboratory under Mr Ratcliffe was followed by radio-astronomical studies at the Radiophysics Laboratory, Sydney, then a return to work at Cambridge.

Dr Rishbeth joined RSRS in 1960 as a Senior Research Fellow, spent two years at the Central Radio Propagation Laboratory at Boulder, USA, as a consultant and returned to RSRS in 1965.

He has an international reputation as an expert in the theory of

continued on p. 22

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council commentary continued from p. 4

up in 1968 to advise on the provision of postgraduate training in cross-discipline areas. Each year both Councils set aside a number of studentships for this purpose. The joint Committee's report, which was introduced by the Chairman, Professor Kay, describes the innovations in postgraduate training already underway and recommends a five year programme in broader based education in a small number of selected universities. The recommendations were endorsed by the SRC and the Committee's report will be published shortly.

boost for rocket telemetry and tracking systems

Two major items approved will help to increase the scientific return from the national sounding rocket programme. The telemetry system (type 465) used in Skylark, and subsequently in Petrel and Skua rockets, since the start of the national programme in 1957 falls short of the experimenters' present and future requirements and a new pulse code modulated system is to be introduced. This will be considerably more adaptable and increase the information rate some sixfold over the present system. Prototype flight units will be prepared for trials in 1973 before full production is started. The second item approved was for tracking of Petrel and Skua rockets. At the South Uist range, tracking relies on radar provided by the Meteorological Office, which is not fully satisfactory for our purposes, and a new slant range measurement system is to be introduced. This is based on comparison of the phase of a 39K Hz signal generated in the rocket with that of a signal of the same frequency generated on the ground, the slant range being deduced from the change in phase difference as the rocket ascends.

better committee structure for engineering

On a recommendation from the Engineering Board, the Council agreed that from October 1972, the existing Committees dealing with Mechanical and Production Engineering, Aeronautical and Civil Engineering and Transport should be replaced by three new Committees covering Aeronautical and Mechanical Engineering, Manufacturing Technology and Civil Engineering and Transport. The aim is to fit the Committee structure more closely to areas where special emphasis is required, to even out the Committee work load and to reduce the number of research grant applications referred to more than one Committee.

improved superannuation

The Council also agreed to proposals for substantial improvements in the SRC's superannuation scheme. These follow the changes to the Civil Service superannuation arrangements and the effect will be to bring the Council's scheme up to modern standards, with better family protection. The Council is also to adopt the revised arrangements being introduced into the Civil Service for early retirement of employees in appropriate circumstances.

the ionospheric F region and is currently working on the multistatic incoherent scatter experiment described on page 17. He has written many papers on the subject and is co-author with Professor Owen Garriott of the book "Introduction to Ionospheric Physics". In 1971 his work gained him the ScD of the University of Cambridge.

Dr Erwin Gabathuler of Daresbury Laboratory is promoted to Senior Principal Scientific Officer. He is team leader of a resident group who carry out experiments on quantum electrodynamics, rare decay of vector mesons and rhoomega interference. At present he is investigating the possibility of a T violation in electromagnetic interactions and is looking at the possibilities of studying electromagnetic interactions at CERN Laboratory II.

Dr Gabathuler graduated at Queens University Belfast, then gained his PhD working on the 300 MeV synchrotron at Glasgow. After a post doctoral fellowship at Cornell University he joined Daresbury to work on the NINA experimental physics programme.

Dr Philip Duke from Rutherford Laboratory is promoted to Senior Principal Scientific Officer to fill the second vacancy in the High Energy Physics Group at Daresbury (see also Dr Gabathuler). Dr Duke has been a high energy physicist at Rutherford since the early 1960's, and has spent much of his time studying the Pi-nucleon interaction using a polarised proton target. He was one of the first members of the Rutherford Laboratory and one of those seconded to Brookhaven to gain US accelerator experience. In 1965 he spent six months at the Moscow Institute of Experimental and Theoretical Studies on an exchange visit.

Dr Duke has also worked on experiments at CERN and at present, in his Daresbury appointment, he is engaged in a joint Daresbury — Liverpool — Queen Mary College — Rutherford experiment studying anti-proton-proton interaction off a polarised target. One disappointment due to the move is that he had to give up his joint appointment as a Lecturer at Warwick University. He enjoys giving lectures and had previously given some at Bristol and Reading. Last winter at the Laboratory he gave a very successful course of lectures on elementary particles for non-specialists.

The Chairman, Sir Brian Flowers FRS has accepted the appointment of Rector of the Imperial College of Science and Technology, University of London, from October 1973 following the retirement of Lord Penney OM KBE FRS. The Secretary of State for Education and Science, Mrs Thatcher, had offered Sir Brian a further term of office from September 1972, at the end of his five year appointment. In accepting this he had resigned his chair at Manchester, where he was Langworthy Professor of Physics (on unpaid leave while with SRC), but said at the time that he hoped to return to academic life eventually.

Sir Brian's earlier career was spent with the Anglo-Canadian Montreal and Chalk River Atomic Energy project (1944-6) and the Harwell Atomic Energy Research Establishment, where he became Chief Scientist. He joined Manchester University in 1958.

Rollo Swively and the great Quest theft

(with apologies to Michael Frayn)

'You know, Mike,' said top P R man Rollo Swively as he stared morosely into his Lo-Cal gin and tonic, 'I think I'm beginning to lose my grip. You remember my telling you about the job I was taking on for a little magazine called Quest*? Well, frankly, things haven't been going too well for them lately—circulation dropping and people cancelling their subscriptions: that's pretty bad when it's given away free anyway.*

'Well, Mike, I decided to use ploy number five in the PR man's handbook. I'm sure you must have heard of it in one form or another. Letting the golden eagle escape when attendances fall off at the Zoo is one of my own variations. That's right, Mike, you've got it. In the right hands "Zoo loses Bird" can produce more column inches in certain Sundays than "Boy loses Girl". Then I follow up with "Zoo finds Bird", "Zoo can't catch Bird", and "Call of the wild" and before you can say Snowdon they're trooping through the aviary in their thousands.

'Frankly, Mike, you can take it from me that this one is almost unbeatable. In this case, the Quest *one I mean, I arranged for one of the batches of the magazine to get delayed en route, and then spread rumours about the supposedly seditious nature of the contents. Now normally I'd have expected an incredible demand to have built up within 48 hours, but absolutely nothing happened. So next I let it be delivered but removed it again before it could be distributed. Get the picture? Great mystery! Where is the missing mag? Who is the mystery Miss X? No luck again. So finally I threw the lot in. THEY had suppressed the edition. The Establishment strikes again. Now that one, Mike, is guaranteed to produce a sit-down, sit-in or walk-out at any school, university, or factory anywhere in the country. And what happened here? Absolutely nothing, Mike. I've come to the conclusion that either I'm slipping or these people just aren't interested in* Quest *whatever happens to it. Still, there's a chance yet. I'm just off to have lunch with Rupert Murdoch's PR man. Cheers, Mike.'*

timetable of 1972/73 training courses

The Central Training Section runs courses for all grades of staff from clerical officer to senior principal scientific officer, and equivalent grades. Brief descriptions of the courses and future dates are given below; some are residential. Managers who are considering the courses for their staff can get further information from local training officers or Central Training Section, London office.

Course	Description	Scheduled Dates 1972	Scheduled Dates 1973
Induction Course *for all new staff.*	The course gives information on the formation and organisation of SRC and its work in the various scientific fields, and on conditions of service and staff associations.	October 10-11 12-13	March 6-7 8-9 May 15-16 17-18
Course A *for clerical officers with at least one year's experience in the grade.*	The course covers basic statistics, estimates and accounts, basic organisation and methods, communications and effective writing.	November 7-10	February 20-23
Course I *for scientific officers, executive officers, and equivalent grades, under age 28.*	The course looks at communications, work-team relationships, basic managerial responsibilities, O & M, networking for projects and decision analysis.		Jan 30 - Feb 2 June 12-15
Course II *for senior scientific officers, executive/higher executive officers, and equivalent grades, over age 28.*	The course explores delegation, motivation, leadership, planning and forecasting techniques, staff reporting and interviewing.		April 3 - 6
Course III *for principal scientific officers, senior executive officers and equivalent grades.*	The course will consider the analytical and sociological approaches to management.		March 19 - 23
Course IV *for senior principal scientific officers and equivalent grades.*	The course will look at leadership, communications and interviewing.	September 26 - 28	

Remember ! **If you wish to undertake an external course of serious study, you may be eligible for a training concession. Ask your local Training Officer for details.**

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after Chaucer

Did you know that the annual Civil Service Poetry Competition is open to members of SRC. The publishers of the *Anthology of Civil Service Poetry* (20p) offer a prize of £25 and this year the Post Office Corporation are also offering £10. The standard is usually high. Many entrants get published regularly in magazines and literary journals.

Perhaps you could beat them. If so remember that poems entered must be your own work, not published or about to be published, and not previously winners in this or any other competition, not longer than 24 lines, typed on A5 paper — each entry on a separate sheet. Give your full name, private address and official address (section and establishment) and post to the Civil Service Council for Further Education 11 Belgrave Road, London SW1V 1RB **before December 31.** The CSCFE will send you a copy of the rules, on request.

newsfront

from observatory sources

Mrs E Margaret Burbidge FRS the new Director of the Royal Greenwich Observatory took up the appointment on July 12 1972.

Professor D. Lynden-Bell of the Royal Greenwich Observatory has been elected Professor of Astrophysics at the University of Cambridge. He will succeed R. O. Redman who retires on September 30, 1972. The Observatories at Cambridge are going to be merged with the Institute of Theoretical Astronomy into a new Institute of Astronomy. This will be directed by the Professors of the Institute in rotation.

Professor Sir Martin Ryle FRS a member of the Astronomy, Space and Radio Board and Chairman of the Royal Greenwich Observatory Committee is appointed Astronomer Royal. He is Professor of Radio Astronomy at Cambridge University, in charge of the new 5km radio telescope now being built at Lord's Bridge.

Professor H A Brück CBE, Astronomer Royal for Scotland has received an honorary Degree of DSc from the National University of Ireland. Professor Brück spent ten years in Dublin (1947-57) when he re-established Dunsink Observatory as an astrophysical research centre under the Dublin Institute for Advanced Studies. (Dunsink was once the Observatory of Trinity College Dublin but closed in 1922.) In 1957 he took up his present post as Director of ROE and Regius Professor of Astronomy of the University of Edinburgh, Department of Astronomy (both are under one roof at ROE). He is also a member of the Board of Governors of the Armagh Observatory in Northern Ireland.

Dr S V M Clube of the Royal Greenwich Observatory has been appointed Senior Principal Scientific Officer in Charge of the Astrophysics Division at the Royal Observatory Edinburgh. He will take up the post on his return from the Lick Observatory where he holds the Alexander F. Morrison Research Fellowship, from May 1 to July 31.

The subject of this year's Herstmonceux Conference was Cosmic X-ray sources, by Dr K. A. Pounds on Dr F. Pancini on pulsar models of X-ray sources, by Dr K. A. Pounds on recent work at Leicester on X-ray astronomy and by Dr D. W. Sciama on X-ray emission from the neighbourhood of galaxies.

birthday honour

We congratulate **Mr J F Hosie** OBE who receives a CBE. Formerly Director of Astronomy, Space and Radio, Mr Hosie succeeds Mr Walker as Director Administration. See above.

changed at the top

The retirement of the Secretary to the Council *(see p. 1)* and the appointment of Mr R St J Walker as his successor is closely followed by the retirement of Mr C Jolliffe CBE, Director of Science, Mr J Clemow, Division Head — Nuclear Physics, and Dr B G Pressey, Section Head — Space and Radio. As a result there will be a number of changes at the top level in London office and at the same time some changes in the structure of the organisation.

Up to July 31 London Office had five Directors who worked with the Chairman and Secretary at the top administration level (in addition to the Directors of the seven SRC establishments) representing these main branches of the work:
Administration (of SRC)
Astronomy, Space and Radio
Engineering
Nuclear Physics
Science

Following reorganisation, from August 1, the top 'Cabinet' level now consists of three Directors with a second level comprising six Heads of Division. The table below shows the new organisation and the people who will fill the posts. Some new names appear and the three who retire during the next two months are not shown. The new names are not new to SRC – Mr M O Robins was in SRMU *(see p. 8)* in 1965-8, Mr R Edmonds has been on secondment to the Department of Education and Science from Science Division, Dr H H Atkinson was seconded to the Cabinet Office from Rutherford Laboratory and Mr A J Egginton comes from Daresbury Laboratory. Details of the appointments are in Circular 41/72.

Chairman	Directors	Heads of Division
Sir Brian Flowers FRS		
Secretary	**Director**	**Astronomy, Space and Radio**
R St J Walker CBE	M O Robins	Dr H H Atkinson
		Science
		Mrs J O Paton
	Director	**Engineering**
	Dr A W Lines	A J Eggington
		Nuclear Physics
		I A Learmouth
	Director	**Establishments**
	J F Hosie CBE	R Edmonds
		Finance
		L S Smith

will they have to go?

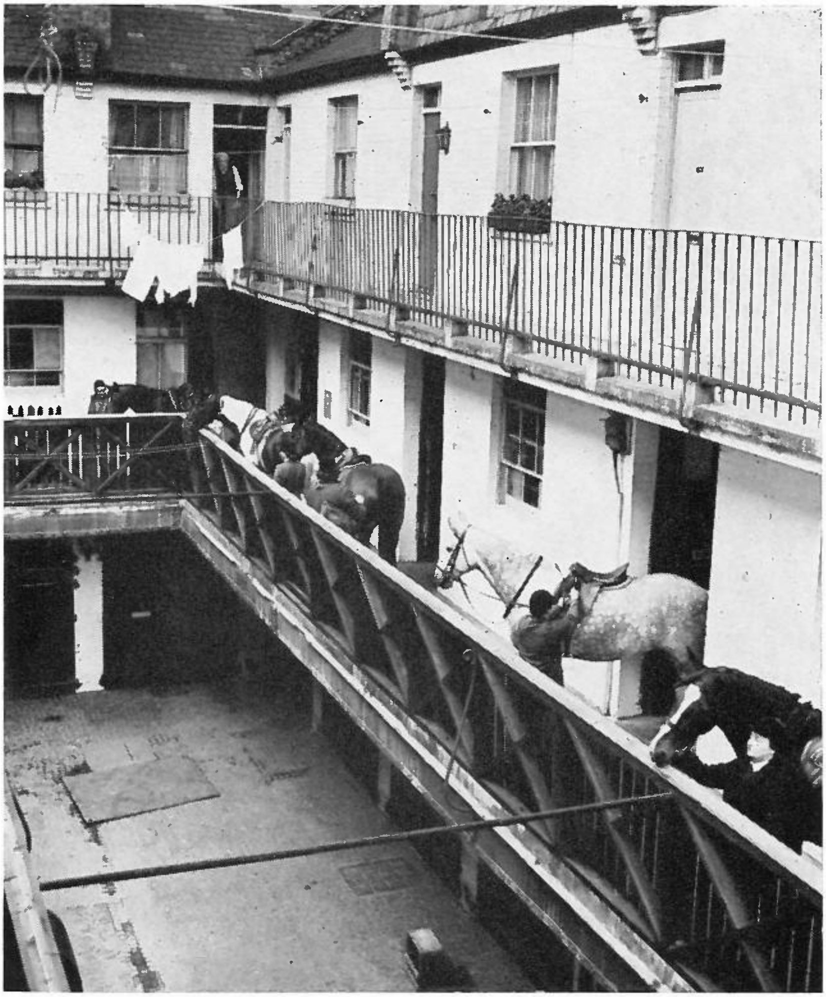

photo BIPS Ltd

A unique building now threatened with demolition is the home of the Civil Service Riding Club. This is one of the very few riding stables that remain in central London and the only one where the horses are stabled on the first floor.

De Vere Mews was built in 1877 to house the horses, carriages and staff of the large houses in De Vere Gardens. The Civil Service Riding Club started there twenty-five years ago. There are flats on the second floor, as you can see in the picture, and the former coach house at ground level, where the mounting block is standing, is now used for cars.

How do they get up? Well, the horses don't, thank goodness, have to be taught to climb stairs. There is a winding ramp that they manage quite easily.

The Mews is in Canning Place just off Gloucester Road. Members are civil servants and members of recognised public institutions and their families. Rosemary Lyster of the SRC Press Office is one of the instructors.

Riding instruction is given on four nights a week in the new indoor school of the Knightsbridge Barracks, by kind permission of the Commanding Officer. At weekends and early on weekdays, members ride out in Rotten Row and they can enter on club horses for horse shows and gymkhanas. The club also holds its own and inter-club events in the paddock in Kensington Gardens. Beginners are welcome and there are BHS and BSJA tests and demonstrations for more experienced riders.

To preserve the club, and an amenity that is unlikely to be replaced, and to save this interesting building from destruction, club members and local residents have petitioned for a preservation order. This has received some strong support from local MPs, Borough officials and the press, and is now being considered at a higher level.

BIG PRIZE

A bottle of scotch* is offered for the best article that appears in the next two issues of Quest. The winning article will be selected by the Editorial Board for its impact, interest, presentation of content and whatever else makes it in their opinion especially good.

Any length over 100 words and less than 1000 will qualify but since space is precious we suggest you keep it under 500 to make sure of getting in. The prize will also be open to the best story caption to a picture, of between 100 and 250 words.

You can write about anything you like or may we suggest one of the special topics we hope to cover: Edinburgh Observatory's 150th anniversary, people from Daresbury and Rutherford at CERN and at home, Computer use and misuse, Sports Day 1972, Ideas for Sports Day 1973.

*** **Glen fiddich** it is . . . the Quest Board member who offers it can speak for its value and we regret that board members cannot compete.

Quest *April issue.* Extra copies are now available for anyone who missed getting one. Ask your local correspondent.

move with the times

Radio 1 pop fans and other observers who kept the midnight watch on June 30 shared the experience of hearing the first performance of the Leap Second. Well folks, it's good to hear that Universal Co-ordinated Time is in step again with GMT. No they aren't pop groups — see Quest April issue p 23.

QUEST

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QUEST

House Journal of the Science Research Council

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Vol. 5 No. 4
1972

contents

Getting it straight from space

Cover picture shows one of the eight 42 foot dishes of the new radio telescope at Cambridge. Placed along a straight east-west 5 km line, the eight dishes give the effect of one enormous dish with a diameter of 5 km (3 miles).

The design was pioneered by the Cambridge Radio Astronomy group under the guidance of Sir Martin Ryle, FRS, now Astronomer Royal. It was built with a SRC grant of £2 million and the help of the UK Atomic Energy Authority, British Insulated Callenders Cables Ltd (who designed and laid the cables) Marconi Company Ltd (the aerials and the Myriad computer) and Mitchell Construction (civil works and the control building). The extremely accurate survey was carried out by the Ordnance Survey and the construction firm reckon that it is "probably the longest and most accurately defined straight line ever set out".

Four of the dishes are fixed and four move on bogies along a 28-foot gauge rail track. As it happens the piece of land bought for the telescope used to be a section of the old Cambridge-Bedford railway that ran due east-west at this point. But the telescope's baseline had to be straight 'in space' and could not even be allowed to follow the curve of the earth.

The telescope was inaugurated on October 17 by Sir Alan Hodgkin, President of the Royal Society.

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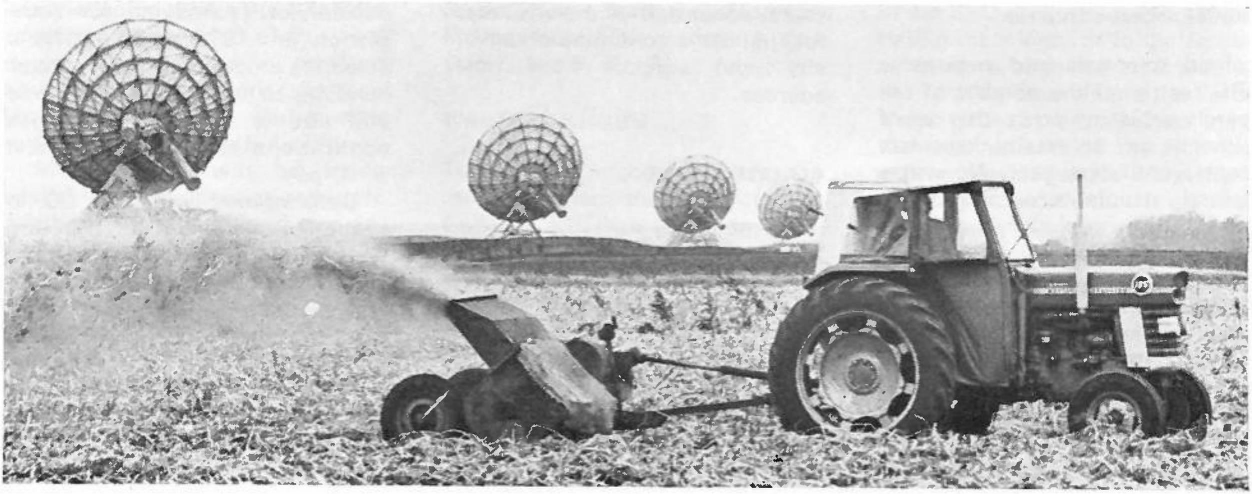


Two products of applied research

One helps the astronomer to glean clues from the sky on the history of the universe while the other helps the earthward-looking farmer to a better harvest. The one on the skyline is four of the eight radio telescope dishes that make up the 5km radio telescope at Lords Bridge Cambridge. *See cover caption on facing page.*

1971-2 annual report

looking back —and forward

The SRC's seventh report for its seventh year was published in September and presented at a press conference held by the Chairman and four Council Members: Dr Eastwood, Professor Ford, Professor Kornberg and Professor Matthews.

Since the cloud thrown by the 'R & D' report on SRC's future rôle has been lifted, the auspices seem to be good for continued progress. However, there are indications in the report that SRC is not altogether happy about its future fund expectations compared with the likely rate of expansion in universities and polytechnics.

The three main themes of the report are SRC's views on the organisation of Government support of research and development; SRC's policy for support of research and postgraduate training; and the facilities and services provided by the SRC establishments for university research.

SRC and R & D

Addressing the conference, Chairman said that the report had been written before the appearance of the White Paper on Government support of applied research and development (R & D), but the views expressed in the report were much the same as the Government later decided after 'the great debate'. SRC was particularly pleased that the White Paper had defined SRC's primary function as the support of research and postgraduate education in the universities.

The Council gave evidence to the Select Committee on Science and Technology (as summarised in *Quest 5, 2, pl*) and, says the report, it welcomes the Government's decision that the Research Councils – subject to applied research being commissioned on a customer-contractor principle – shall remain under the sponsorship of the Department of Education and Science.

Although SRC is only marginally involved in support of applied R & D, we have begun joint reviews with the Departments of the Environment and of Trade and Industry, to see whether we can improve present collaboration in R & D programmes and the use of results. The fields under review are control engineering, transport, mechanical and production engineering and civil engineering. Computing science will also be looked into.

In the report we say that applied R & D undertaken with a particular application in mind is often more expensive than basic research. Only when enough basic research has been done, so that an objective and the research route to it can be identified, is there a sound basis for an applied R & D programme. On the other hand, R & D often reveals gaps in basic knowledge which are seldom made good on an R & D programme, forced through lack of time to expensive *ad hoc* solutions. The gaps are filled most effectively and economically by further basic research.

grants - stop and grow

SRC awarded £1M more for university research grants than in the previous year – a total of £15M. We continued to give priority to engineering, to give special support to areas of science selected for their special significance or promise and to concentrate support in certain areas to a limited number of university departments.

Because of industry's need of

trained scientists and engineers, SRC restricted the number of research assistant posts that were allowed on university research grants, until last year. Now that trained people are no longer scarce the restriction is lifted, except in the case of nuclear physics.

The same number of postgraduate awards was offered in 1972 as in 1971 and there will only be a small increase in 1973. Thereafter the number available will depend on the extent of university expansion over the next five years and increases in SRC funds.

More studentships were taken up in 1971 than in 1970 and fewer eligible candidates were turned down. As in previous years, about half of the unsuccessful applicants continued at university with support from other sources.

co-operation

On the subject of international collaboration, the report mentions the moves to promote co-operation in all areas. (A progress report appeared in Quest 5, 3, p17).

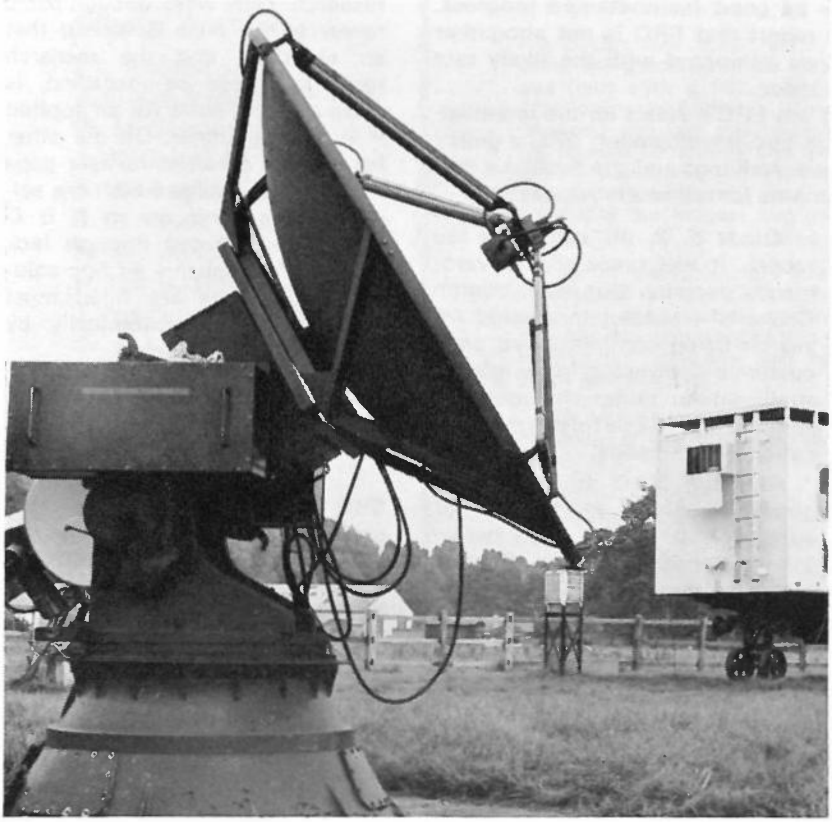
Existing collaboration over the joint funding of large facilities is going well in the fields of nuclear physics (CERN) and scientific satellites (ESRO). The CERN programme is currently expanding, with the addition of new large facilities, such as the Intersecting Storage Rings (already in use) and the 300 GeV proton accelerator (scheduled for completion in 1979). But ESRO's scientific programme, on the other hand, is to be reduced in scope and size to allow expansion in applications satellites *(see Quest 5, 3, p9)*.

Collaboration with the US in space science was marked by the launch of the Ariel IV satellite last December. Meanwhile preparations go ahead on UK5 and on plans for the future UK/US programme.

The five UK research councils are co-operating in the field of pollution. They have published the report "Pollution Research and the Research Councils" and set up an inter-Research Council Committee, under Professor Neuburger FRS. SRC and SSRC together have commissioned the University of Manchester to identify areas for environmental research in their own fields of interest.

Another inter-Council review is looking into the use of computers, future needs and possible centralisation of facilities.

An aerial and trailer-laboratory for monitoring microwave radiation from the sun at the Radio and Space Research Station. The picture comes from the film 'Talking of Science' made by the Central Office of Information. The film takes a wide look at work in the natural sciences supported by four of the Research Councils. (It can be borrowed from the COI Central Film Library).



our prospects

For the first time for several years SRC has been given a provisional allocation of funds for two years ahead (1974-5). Though less than our needs, this nevertheless makes it possible for us to plan with more assurance. On the other hand, the level of allocations, which are expected to increase by only 2½% a year to 1975, increases our fear (expressed in last year's report) that the gap will grow between SRC resources and the rate of expansion in universities and polytechnics.

Within the budget, the report says, we hope to keep nuclear physics allocations constant in 'real' terms and, while giving priority to the growing CERN programme, to build the electrostatic generator for nuclear structure work now being designed at Daresbury. (For up to date discussions on the future of the NP Laboratories, see *Council Commentary* in *Quest 5, 3, p2)*.

In astronomy – a priority field

– plans include the Mark VA radio telescope (the subject of a current design study), a new northern hemisphere observatory (site testing is in progress) and a new millimetre wavelength facility.

More money will be made available for engineering research, another priority field, and associated applied sciences.

In space research, the Astronomy, Space and Radio Board is planning alternatives to fill the gap left by the reduction in ESRO's scientific programme. It has also decided, following the (published) review of the role of the Radio and Space Research Station, that the services and support for the whole of the UK space science programme should be centred at RSRS. The Station already provides services for university groups, has its own space programme and has recently taken the Space Research Management Unit under its roof (see *Quest 5, 3, p8)*.

internal affairs

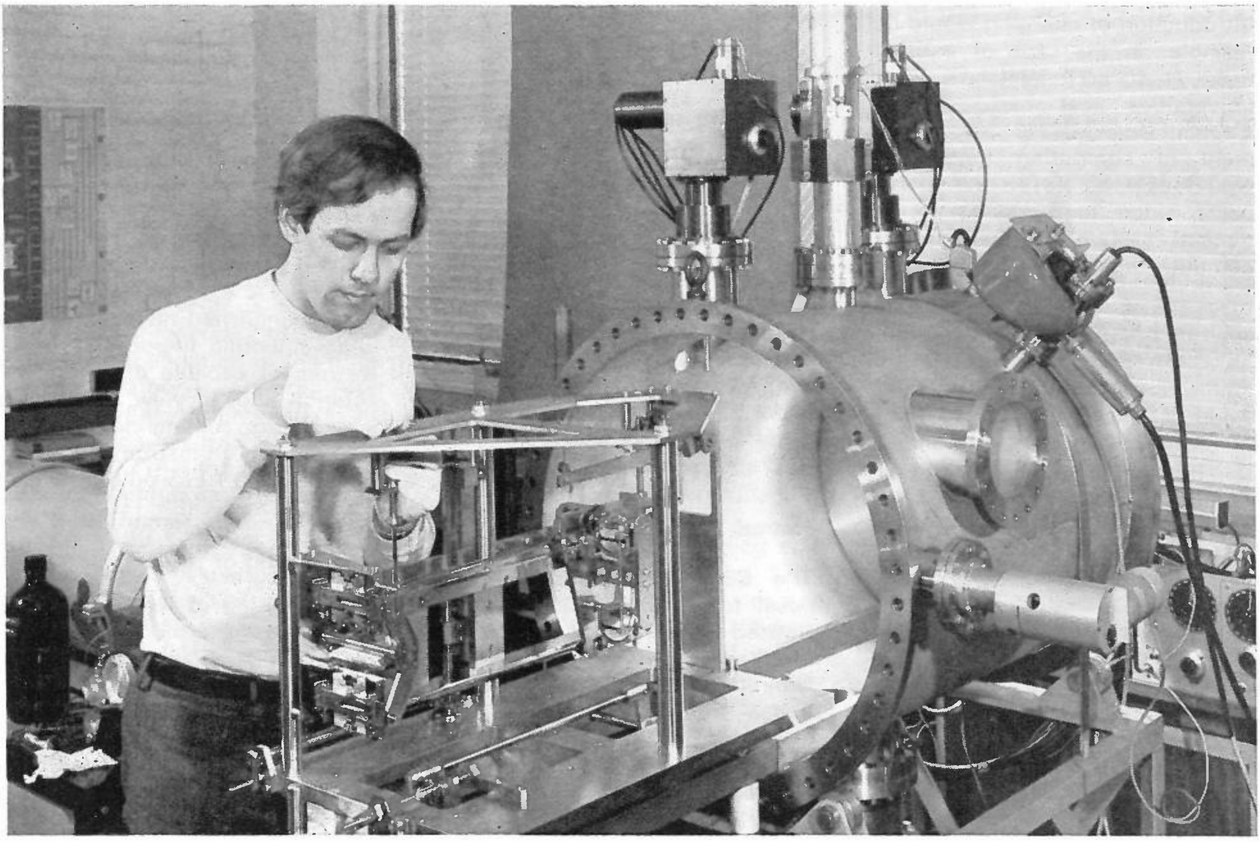
Turning to personal matters the report mentions that, like the Civil Service, SRC has begun to introduce staffing changes based on the recommendations of the Fulton Committee. The main change has been the merger of most of the classes into three main groups – 'Administration', 'Professional & Technology' and 'Science'. As at March 31, 1972, there were 949 people in the Science Group and 545 in P & T, out of a total staff of 2,893.

The Industrial Relations Act was studied by the Whitley Council and the Joint Negotiating Committee. It was not found necessary to make any changes in the SRC consultative and negotiating machinery or in the formal agreements with the staff side of the Whitley Council and the Trade Union side of the JNC to meet the requirements of the Act. But a few minor changes were made to some conditions of employment and some procedures.

About twenty-five members of SRC served with other organisations during the year, on secondment or special leave, as a result of SRC's policy to encourage people to gain wider experience. We hope, the report says, that mobility of staff will be helped by the improved superannuation arrangements that were introduced to bring the SRC scheme up to modern standards.

If you want to read the report, look for it in the Station Library or your local administration section.

Dr John West of Reading University adjusting one of the precision drives on the grazing incidence grating monochromator designed for Daresbury Laboratory's Synchrotron Radiation Facility by the University. This instrument works in the far ultra-violet region of the spectrum and is able to select particular wavelengths out of the continuous radiation from the synchrotron. It is used to study the absorption of ultra-violet light by metal vapours.



june

computer review

Council considered the first report of the SRC Computer Review Panel which had been set up to rationalise the Council's computer requirements as whole. Apart from the new DNPL computer, already approved, and the plans for the Atlas Laboratory, the immediate and additional needs of the Boards, Establishments and London Office were found to be small. It was clear, however, that the requirements were constantly growing and changing and Council felt that the Panel had carried out a useful review and agreed that it should continue in existence, reporting annually in relation to the Forward Look.

The Panel had been requested by Council to look at the feasibility of charging for computer use and a subsidiary panel had been set up to consider the problem in more detail. Council accepted the recommendation that the introduction of charging would be feasible; in the case of entitled users (such as Establishments or universities that had received Council approval to an entitlement of computing time) this would have to be on a notional basis, since there was as yet no general system of charging for computer use in the universities.

collaboration with Europe

Council discussed a note of a meeting with the Centre Nationale de Recherche Scientifique (the French equivalent of SRC) and approved the proposal to set up a standing SRC/CNRS committee to advise both bodies in Anglo-French collaboration. Also approved was the initial allocation of £10,000 for a short-visit scheme to encourage European and British scientists to visit each other to discuss possible collaborative research programmes.

Council considered an application from Leicester University for a supplementary grant for the preparation of 2 experiments for the UK-5 satellite. In view of the high priority of the UK 5 satellite pro-

extra grant for UK 5

gramme Council approved a supplementary grant of up to £64,700. Because of escalation of costs due to the special circumstances of grants for satellite work, Finance and ASR Divisions were asked to review the arrangements under which experiments were prepared and expenditure estimated and controlled. Reference was made to the possibility of closer involvement of RSRS in all experiments prepared for large space projects.

july

retirements

The Chairman paid tribute to three Chairmen of Boards – Professor Ford (Engineering), Professor Gunn (Nuclear Physics), and Professor Kornberg (Science) – and to Professor Hoyle and Dr Menter, who were all retiring from Council. The Council also thanked three retiring members of London Office, Dr Francis, Mr Jolliffe and Mr Clemow for the vitally important contributions they had made to the work and progress of SRC and of its predecessor DSIR.

nimrod injector

The Council considered a proposal for a new injector for the Nimrod accelerator at the Rutherford Laboratory which would keep Nimrod comparable with other major proton synchrotrons at a total cost of £2.180M. It planned to replace the present injector with a new 70 MeV linear accelerator consisting of some components of the old 50 MeV proton linear accelerator and some newly purchased components. The construction programme would be timed to coincide with lengthened shut-down periods of the machine. During this period the running time on Nimrod would be reduced by 25% and the resources provided for high energy physics research on the accelerator reduced by a similar amount. The equipment cost of the project would be met from savings arising from the reduction in the accelerator programme and the freed manpower used intensively on construction and installation of the new injector. Council agreed that, pending a decision on which of the two major nuclear physics machines should be closed down, only the preliminary planning work required in connection with the scheme should proceed: it is expected that such a decision will be taken by November 1972.

1 A electron microscope

Amongst the grants approved by Council in July was one of up to £260,000 to Dr V E Cosslett at Cambridge University for the design and construction of an experimental 1Å electron microscope. The Council had no doubt of the wide scientific importance of an instrument capable of atomic resolution and, in view of the possible future commercial exploitation of such an instrument, hoped that DTI and AEI would also contribute towards it.

exploitation of research

Mr D N King of NRDC was present when the commercial exploitation of results arising from SRC grants was discussed. Some universities had criticised the guidance and regulations on patents published in 1971, and the role of NRDC. This had stemmed partly from a lack of understanding: appropriate changes have now been made to the grant regulations to take account of the views expressed. The future role of NRDC is being considered by DTI and the arrangements for collaboration between SRC and NRDC in ensuring exploitation of research results may have to be reviewed when this has been established.

framework for R & D

Copies of the White Paper 'Framework for Government Research and Development' (CMND 5046) were tabled and the Council discussed the implications for SRC; these were less immediate for SRC than the other Research Councils, but the Council foresaw that there would be considerable long-term implications for the funding of SRC activities.

computer facilities

Council welcomed the proposal that the Atlas Laboratory should provide a substantial part of the Natural Environment Research Council's (NERC) future computing needs, initially estimated at one hour a week on the IBM 360/195 and five on the ICL 1906A. A small NERC group will be located at ACL and to co-ordinate computer policy between SRC and NERC, the latter will be represented on the ACL Committee. The initial minimum annual cost to NERC will be about £50,000.

Proposals from the Nuclear Physics and Science Boards for the purchase of thirteen terminals — twelve British universities and one at CERN — to be linked to the ICL 1906A and the IBM 370/195 at the Atlas and Rutherford Laboratories were approved by Council. This experimental scheme will allow university scientists and engineers to have access to these powerful computing facilities.

A request from The Atlas Laboratory for additional office accommodation and conference facilities was also approved by Council.

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astronomical years

In 1972 two of our observatories celebrate important anniversaries. The Radcliffe Observatory reached 200 years in June and the Royal Observatory Edinburgh is 150 years old in October.
An outline of the Radcliffe's history follows (a fuller account appeared in Nature Vol 239 No 5371). ROE will be featured in the next edition of Quest.

the Radcliffe Observatory

200 years in two hemispheres

A D Thackeray

On June 27 1972 the Radcliffe Observatory in Pretoria celebrated the 200th anniversary of the laying of the foundation of the original observatory in Oxford. After the Radcliffe Infirmary was built out of funds left by Dr John Radcliffe (d. 1714), the Savilian Professor of Astronomy at Oxford — the Rev Thomas Hornsby (1733-1810) — persuaded the Trustees to found an observatory for use by the University astronomers.

The Radcliffe Observatory was the second established in the British Isles as a permanent institution. As at the Royal Greenwich Observatory (established in 1675), most observations were made to assist navigation and related to the position of the sun, moon, planets and stars. But the real interests of the astronomers then and later lay in the study of the refined aspects of planetary motions – to test Newton's gravitational predictions – and in the proper motions of 'fixed stars', first detected by Halley in 1718. As it turned out these results also were of use to navigators.

The Observatory building was complete in essentials by 1774 but the octagonal tower, copied from the Temple of the Winds in Athens (see picture), and the interior finishing were not completed until 1793. The Observatory was generally recognised to be one of the best equipped, if not the best, in the world. The original instruments were an 8-foot transit, two 8-foot mural quadrants, a 12-foot zenith sector (actually little used) and an equatorial sector.

Hornsby himself was a remarkable observer. From 1774 to 1803, when he had to stop due to ill health at the age of seventy, he recorded — single-handed — 80,000 transits and 20,000 zenith distances. It is recognised now that the accuracy of his observations was exceptionally high. In Right Ascension his measures had

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Dr Thackeray is the present Radcliffe Observer, the Director of the Observatory. In 1969 he gained a special promotion to Deputy Chief Scientific officer. His own work was outlined in Quest Vol 2, 4 p7.

less than half the errors of Bradley's: a previous Savilian Professor and the pioneer of accuracy in astronomical observation. He even achieved somewhat better measurements than RGO in 1852 under Sir George Airy.

As an example of Hornsby's accuracy he derived a solar parallax of 8".78 (now measured as 8".79415) from transits of Venus in 1824, even though Encke's value of 8".57 continued to be accepted for many years. It also came to light very recently that Hornsby's observations of Sirius showed the orbital motion due to the pull of a white dwarf companion that was not announced till 40 years later, by Bessel. Hornsby narrowly missed discovering Castor's binary motion when he pointed out the proper motion of the two components.

Because of the advantage of comparisons over a long time span, such early observations continue to be of value even though modern measurements may be much more precise. From Hornsby's death in 1810 until 1839 the Radcliffe observatory continued to observe positions under Abraham Robertson (1751-1826) and Stephen Rigaud (1774-1839), who recorded 53,000 transits and 40,000 zenith distances between them, but with employed assistance. Their observations have never yet been reduced or published and might be worth studying.

an unfortunate split . . . got a practical man

Unfortunately a split occurred in 1839 between the University and the Observatory Trustees over the choice of Rigaud's successor. As a result the University appointed the Rev G H S Johnson as Savilian Professor of Astronomy, and the Trustees, under the chairmanship of Sir Robert Peel, gave the Radcliffe Observer appointment to a much more practical astronomer, Manuel Johnson. So the Savilian Professor was left without an observatory until the University built one 25 years later.

Manuel Johnson had become well known while at St Helena, where he had compiled a catalogue of 606 star positions for the East India Company. These are the earliest records of southern systems of proper motion still in use today. He also detected the large proper motion of α Centauri and told Henderson at the Cape Observatory who examined his own measurements and gained the credit for having made one of the first measurements of a stellar parallax.

At Oxford Johnson started regular annual publication of observations and began the first of six Radcliffe catalogues of star positions. After Bessel had used a heliometer to measure the parallax of 61 Cygni, the Observatory acquired the only heliometer ever to be used in England. Johnson used it to study variable stars and attempted to measure trigonomical parallaxes until it was realised how few bright stars were within its range.

The Observatory's traditional work continued under Robert Main (1859-1878) and E W Stone (1879-1897). Stone was particularly interested in the solar parallax and used the heliometer to observe minor planets in an attempt to improve the knowledge of this fundamental quantity. When Stone was succeeded by A A Rambaut in 1897, stellar photography was just beginning. To introduce this Rambaut persuaded the Trustees to buy two refracting telescopes – a twin 24 inch photographic and an 18 inch visual refractor – and as a result the Observatory abandoned the meridian work that had occupied it for 130 years.

At first the observers concentrated on photographic studies of stellar parallaxes but later, more profitably, they turned to the study of proper motions and also took part in Kapteyn's international plan of selected areas, a star count in which several observatories covered areas of sky, selected at random, to gain an overall idea of the size and shape of the galaxy.

First-epoch plates were taken and stored by Rambaut, second-epoch plates were taken by Harold Knox-Shaw who succeeded him in 1924. Knox-Shaw and his assistants had to struggle hard to complete the observing during ten years in deteriorating conditions and they measured and reduced 32,000 stars down to a faintness of 15 magnitude. The Radcliffe catalogue of proper motions published in 1934 was unique in its coverage of the sky down to such a faint limit. Observations have since been repeated in a few of the selected areas with the same telescope (now at the University of London Observatory) and reductions are in progress at the Royal Greenwich Observatory and the Kapteyn Laboratory, Gronïngen.

decided to move . . . to Klapperkop

Another outcome of Knox-Shaw's directorship was the publication of "Hornsby's Meridian Observations, 1774-1798". It was this reduction of Hornsby's work that proved its high accuracy, as mentioned earlier.

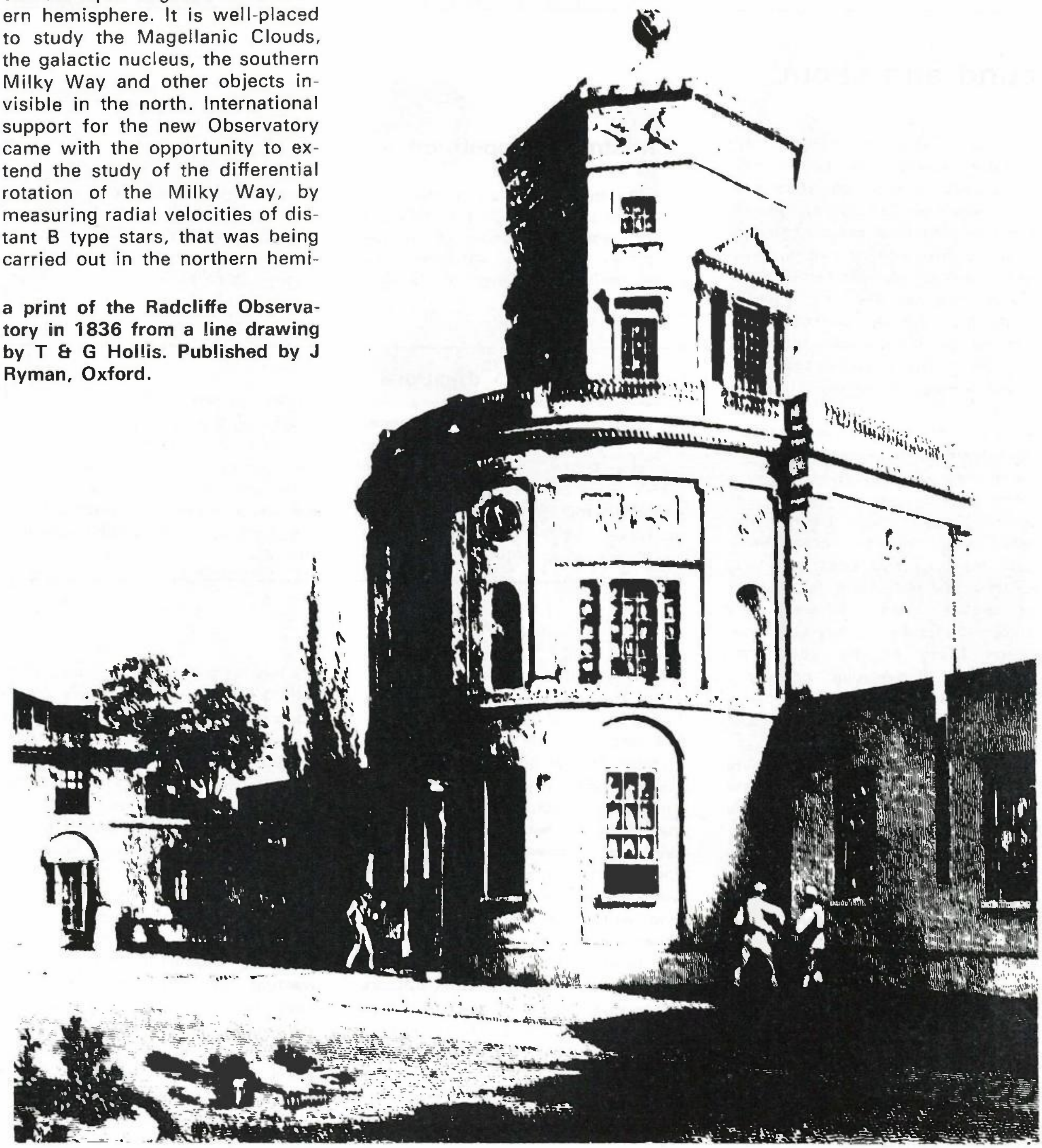
The biggest event of Knox-Shaw's term of office was the decision to move the Observatory to the southern hemisphere. Due to the poor climate and for want of large telescopes, the United Kingdom had, by the 1920's, fallen far behind the United States in observational astronomy. As it happened, the Oxford Medical School in the Infirmary next door were ready to expand with the help of Lord Nuffield's donations to medical research. So the Trustees sold the building and the land and set aside £65,000 for a new Observatory in South Africa with a 74 inch (1.88m) reflecting telescope. The Municipality of Pretoria donated a site on the Klapperkop ridge, 4½ miles south east of the city, and laid on water and electricity.

So far so good. Unfortunately the University raised a legal objection to spending so much

Trust money outside the court's jurisdiction. The Trustees won the case but this delay and others due to casting failures of the 74 inch disc (in USA) and the intervention of war held up the move and the Observatory was not commissioned until 1948.

From 1948 to 1968 the Radcliffe reflector was the largest British optical telescope and it is still the equal largest in the southern hemisphere. It is well-placed to study the Magellanic Clouds, the galactic nucleus, the southern Milky Way and other objects invisible in the north. International support for the new Observatory came with the opportunity to extend the study of the differential rotation of the Milky Way, by measuring radial velocities of distant B type stars, that was being carried out in the northern hemisphere at the Dominion Astrophysical Observatory in Victoria, British Columbia.

In 1951 the Trustees came to an arrangement with the Admiralty who controlled the Royal Observatory at the Cape, whereby two Cape observers were allotted one night in three in return for an Admiralty grant, and the staff was increased so that observations could be made through all available dark hours. In 1958 the instruments were improved with the help of a grant from the Department of Scientific and Industrial Research and many UK astronomers visited the Observatory with the help of DSIR grants. In 1967 SRC made a 7-year agreement



a print of the Radcliffe Observatory in 1836 from a line drawing by T & G Hollis. Published by J Ryman, Oxford.

200 years continued

with the Trustees whereby it took over administrative and financial control while the Trustees continued to contribute from their Astronomy Fund.

Since 1948 the Radcliffe reflector has been used by nearly a hundred astronomers, mostly from Britain but also from the Commonwealth, Europe and the USA. With an average observing time of more than 2400 hours a year (more than the Californian telescopes), it has probably been used more in 24 years than the telescopes at Oxford during 160.

With SRC assistance, the Observatory has now installed an image-tube spectrograph, constructed at RGO, and other advanced modern equipment. The spectrograph which is about ten times faster than conventional photography, is opening up the field of extra galactic spectrocopy and results are beginning to emerge about faint stars in the nucleus of our galaxy and beyond.

(An account of the present work of the Observatory appeared in Quest Vol 2, 2, p7).

round and about

Did you know that Rutherford Laboratory spends over half a million pounds a year on electricity and no less than £85,000 on steam? I find that difficult to grasp. Actually, I have no idea what it means. How much steam do you get for a pound anyway? It's not the sort of commodity the man in the street has much to do with. Could someone out there in QUESTLAND provide a homely analogy in terms of boiling kettles or filling the dome of St. Paul's or distances between oranges and billiard balls to enable us to quantify the elusive vapour?

And what do they *do* with all that steam? I would have thought the place was already comfortably warm from all that electricity. But no, they use the steam for heating and cooling. I don't suppose their canteen Committee, if they have one, spends hours arguing about the temperature of the soup, unless it's because the clientele are complaining about burnt mouths. I wonder what their water bill is?

Talking of heating, a funny thing happened on the 13th floor of State House a couple of years ago. One of the west-facing rooms was L-shaped with windows running the length of the longest side, so that on a sunny afternoon in summer the temperature would rise unpleasantly, particularly in the top part of the L where the ratio of window to cubic content was exceptionally high. Now it came to pass that during one of the half-yearly re-organisations which we have in LO this room changed hands, and the new occupants were regaled with stories of how healthy COs had suffered heatstroke in the oven-like atmosphere and how, therefore, this unaccommodating space was declared unfit for human habitation and filled with filing cabinets.

Now one of the new occupants was an SSO, who felt that he was entitled to a little privacy from the two SOs he was forced to share with, so somewhat foolhardily he decided that he would put his desk you-know-where. Came the spring and with it a few of those days when the sun turns itself on before the powers that be have turned the central heating off. Temperatures rose, and our hero saw what the future, in the way of a warmish summer, might have in store for him. Rather than abandon his territory, however, he called on Office Services with a request for improved ventilation. Soon after, a couple of OS men turned up with a third from MPBW. This should have been warning enough, because the latter species was very rare and has, indeed, since become extinct. An attempt was made to explain the situation, but the man from the Ministry cut straight through to the heart of the problem. 'Why are these people working in shirt-sleeves with all the windows open,' he asked. Explanations began to flow again but he cut them off. 'The place is overheated and you are wasting fuel,' he said. 'We shall have to turn down the heating.' Whereupon, having found a problem he could solve, he left and was never seen again. Certainly he did nothing about the problem of overheating in summer. There's a lesson to be learnt from that.

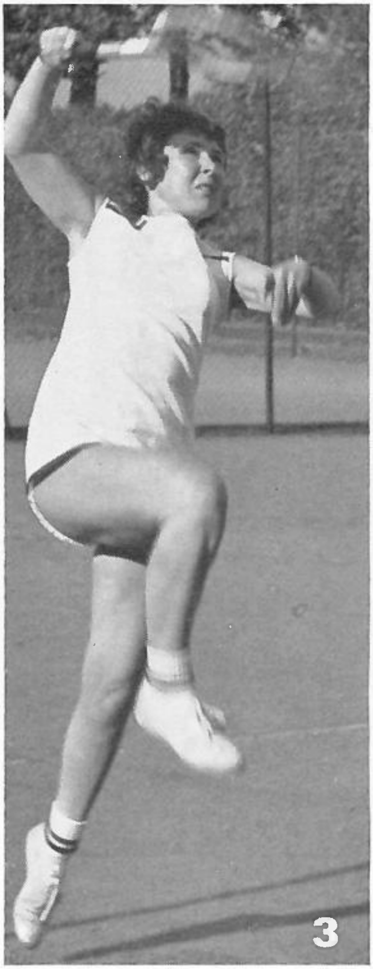
Christmas competition

Seeing that Daresbury is the birthplace of Lewis Carroll and the home of a machine that looks at invisible particles, we think someone must have written a sequel to *"Alic* in Wonderland." Competitors are asked to write a 200 word review of the book and say why they will give or be given it at Christmas. Results of mottoes competition are held over

nutcracker 10 - diaspora

In an attempt to eliminate unnecessary meetings and reduce rental, London Office, which has a staff of 350, is to be moved to the Isle of Mull. Of the 280 junior staff 115 are willing to move but a total of 215 staff, including 105 women, are determined to stay in London. The majority of the staff of course are men and this position is worst among senior staff, only 20 of whom are women. Furthermore, only 5 of these senior women are prepared to move. So how many senior men will go to Mull?

Sports day 1972



We always hope for good weather on Sports Day, whatever the forecast, but this year the Met. man's safe bet of a little bit of everything on June 19 turned out to be true. The doubt kept some spectators away but there were more players than before: the number has risen each year.

The sun was there and play was not stopped by the 'occasional showers', it merely paused for ten minutes while we all sheltered happily in the pavilion bar. The indoor games of chess and table tennis went on but did not have much spare room for people to sit and watch.

Pictures

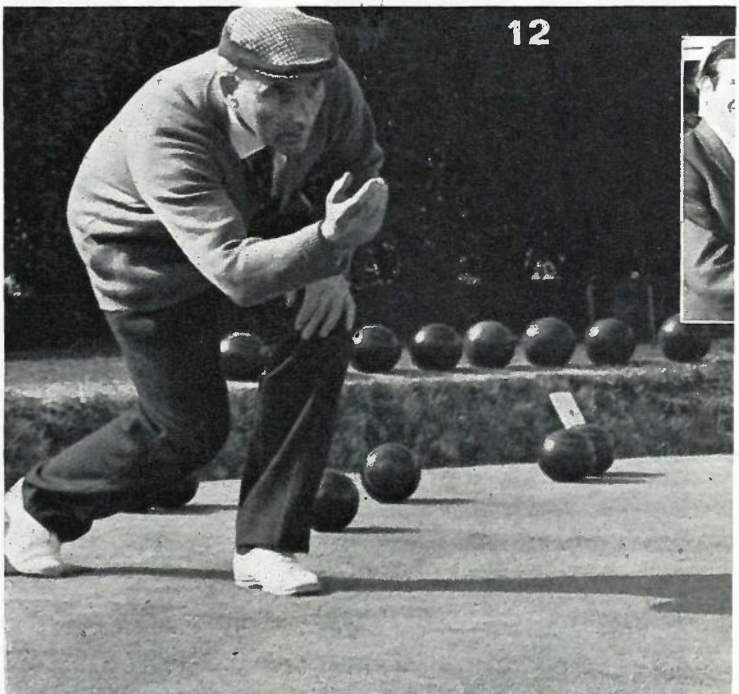
1. Dr. Francis presides and . . . 2. Mrs Margaret Francis presents the Bowls Rinks Shield to the RHEL team. The four in the team were J A Goode, E Gray, L Holder and C Grindrod.

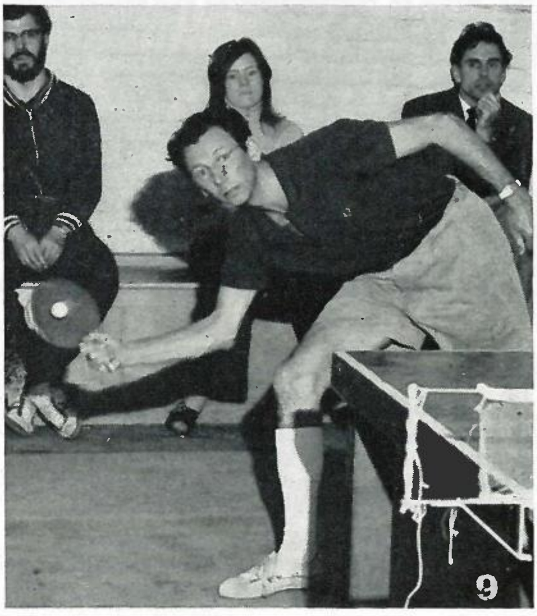
3. Mrs Pat Martin RSRS who won one of the mixed doubles sections with R Smith, but lost the final. *(see p. 10-11).*

4. & 5. A Chilvers RHEL wins the table tennis.

6. The 6-a-side football final between RHEL and DNPL *(see p. 10-11).*

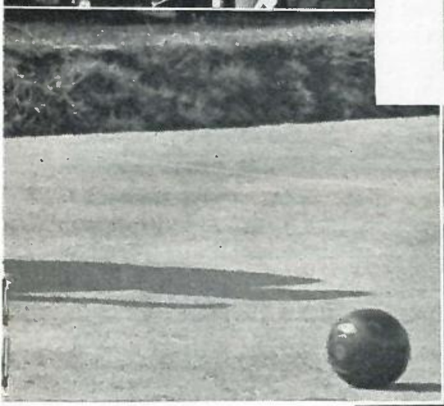
photos P Hicks RSRS





Sports Day was organised by the SRC Sports Association, Chairm retary Mrs Yvonne Windsor LO. Dr W Francis CBE, then Council Margaret Francis presented the prizes. The Civil Service Sports Gr vided the pitches, greens and pavilion facilities. Bill Butler of RH and LO provided the extra helpers who looked after the events and

Seen at Sports Day 7. Sports Association Secretary Yvonne Winds Francis. 8. A bit of cricket outside and . . . 9. table tennis in the shine. 11. "Only two can play" in the lightning chess tournament RSRS, won it again this year. 12. C Hayes, DNPL, bowls in winning Pairs Cup with partner G Robinson. 14. G Gordon-Smith and A R tennis doubles again and kept the title and . . . 15. J More and Ma les by beating R Smith and Pat Martin RSRS in the final. 16. In in the 6-a-side soccer final between DNPL (in darker shirts) and
Photos by P Hicks RSRS, except 12, 17, 19 by J C Beech DNPL an



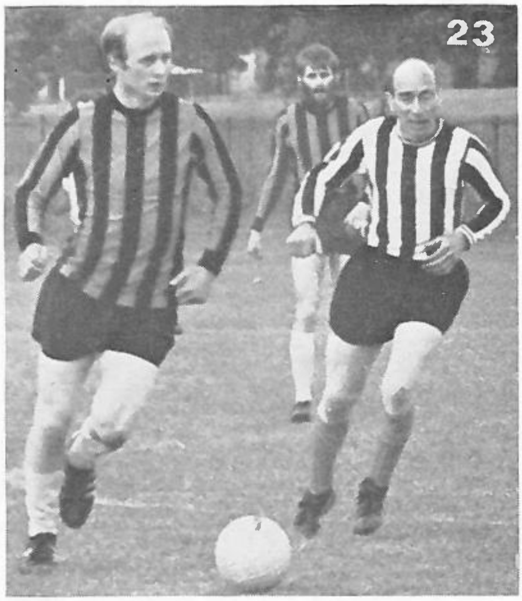
ı Dr F Horner RSRS and Sec-
ecretary, presided and his wife
und did the catering and pro-
. led the first aid team. RSRS
ıld the lunches.

r (r) presents flowers to Mrs avilion. 10. Netball in the sun- The onlooker, Dr E Bramley style and . . . 13. receives the berts, RSRS, won the men's e Huggins won the mixed doub- etball style. 17, 18, 19 Players HEL 'B' team. DNPL won 4-1.
8, 18 (Quest).

More from Sports day

The organisers made everything run smoothly although some games were held up because people were signed up for several events. This seems a bit hard on the players. It might be better to concentrate on fewer, stronger teams and getting some events finished earlier. Some impromptu competitions have been suggested for next year, to give more players and spectators a chance to meet earlier in the day. This year the social evening provided the meeting ground and the party was a great success thanks to the RSRS 'disco' team and their music.

Pictures
20. Chess winner (l) Dr E Bramley, RSRS, ponders. 21. Well placed! and . . . 22. some jump! 23. Meanwhile, back at the football and . . . 24. in netball fashion.
25. Bad light never stops cricket at Sports Day. The winning team RHEL, seen in the gloaming on their way back to the party in the pavilion. RHEL beat LO in the final by 68 for 1 against 64 for 9.
Photos P Hicks RSRS, except 23, 25 (Quest).



another chapter in the

great site testing saga

by one who never did

$\frac{d\ seeing}{dt}$ *is negative*

This is Greenman's Law, and he knows about these things, having invented astronomical "seeing" in 1913 after a series of experiments on the roof of the local piano factory. In plain terms it is another version of the Universal Law of Cussedness *(Quest Vol 5 No 2 p18)*: as soon as you have chosen an excellent remote site with good seeing for a telescope, its advantages for tourism, an iron smelting works and a cement factory are also noticed. Floodlit sports arenas and motorways quickly follow. It is nice to think of the fortune to be made selling for development the site you bought for £5 per acre, but that doesn't help astronomy.

"site testing is impossible"

Finkelstein propounded this hypothesis after four years of site testing at Lido di Jessolo (August 1968), Torremellinos (July 1969) Zermatt (January 1970) and Nassau (August 1970). In practice this is true: the most eminent scientist available may collaborate with the finest administrator to assemble a hand picked team of men of undoubted resource and skill, and still there is trouble. For example once there came messages from afar: the site testing anemometer had broken, please get another one from M's urgently. The lady at M's despatch was charming: Mr M himself was helpful: BOAC were on their mettle: we got it there: they installed it. Within a month the mast was struck by lightning. After overcoming this and other setbacks, results began to flow in: site 3a and site 7a (why not sites 1 and 2? but that kind of thing happens in site testing). Then instrument 1 at site 3a did not read the same as instrument 9b at site 7 or was it 9 at 7a...... and one of them was calibrated in cm/sec and the other in mph, but we did not know which. Anyway the operator had not read 3a on alternate Wednesdays or 7a on every 3rd Friday. He didn't read either on Thursdays, or even Tuesdays. Of course there was no question of weekend work and anyway what was the use of an electric recorder up there?

'voracious appetites . . .'

You may feel this is a bit far fetched, but I must remind you that (a) it is true (more or less, for I fear they didn't tell us about the termites till later) and (b) so far we have only got as far as wind, which any schoolboy worth his salt knows how to measure.

"I think God is trying to tell us something"

(Quote from a discussion on disasters following site testing attempts).

If at last you get down to comparative astronomical tests between two sites, your problems really begin. Apart from hostile factions in the local community, animals with voracious appetites for scientific apparatus, sun stroke, flood, avalanche and blizzard, the apparatus will not work. When it does, the two will not be the same. One day you may find all systems are 'go' at both sites. Torrential rain will set in and a letter from SRC will remind you all the grant has been used up. When you have gained most of the results, a dictum will come from on high, to the effect that reports of excellent work by D in America (and we know who brings those reports) make it essential that your apparatus should be calibrated to match D's. On investigation, you find D's apparatus is (i) on a Carribean island in the middle of a revolution (ii) made of old car parts and string (iii) unlikely to work. Anyway D is now working on fertility rites among aboriginal tribes (or was it "solar spectroscopy"?)

a practical approach

For these reasons, seasoned astronomers conduct site testing in a more empirical way. They get up before dawn (on any convenient day) and visit the possible site. Points are awarded for pleasant aspect and freshness of the morning. A recommendation in the Guide Michelin counts double points. There is a bonus if they see the green flash (a phenomenon at point of sunrise in exceptionally clear sky). This system works and is inexpensive.

PS Anybody who is sceptical about all this is reminded of the remarkable junketings now going on in London Office under the guise of relocation. People in establishments will be forgiven, we hope, for believing that this is site testing in its most rampant form. (It is reliably reported that they had smoked salmon at Milton Keynes!).

radiation and man

John Coleman M.Sc is the Radiation Protection Officer (SSO) at Daresbury Laboratory and Head of the Health Physics Section.

John Coleman

The word 'radiation' often conjures up horrifying visions of catastrophic proportions in the minds of many people – an emotional response that probably originates from the destruction of the Japanese cities Hiroshima and Nagasaki by atomic bombs in the Second World War. The idea that radiation almost always spells total disaster is often perpetuated by those television and film script writers who invent physical and biological properties unknown to science in order to create an exciting story.

Sensational press coverage is also responsible for exaggerating and at times erroneously reporting situations concerning radioactivity. The result is a misinformed frightened public, unable to arrive at a balanced judgement of the real problems regarding radiation, its uses and its effect on man.

At the risk of over-simplification, this article attempts to explain the health hazards arising from radiation, the problems of protection facing man in our modern technological space age and at the same time considers some of the benefits.

Radiation simply means the emission and diffusion of rays. Light, heat, television and radio signals can all correctly be called radiation, so the first thing to realise is that we are concerned with a particular type of radiation known as ionising radiation.

This special type of radiation, when impinging on materials, forces orbiting electrons away from the parent atoms of the substance leaving them with an excess of positive electrical charge. The isolated electrons also have an equal but opposite (negative) charge. This condition exists for only a very short period of time and eventually recombination takes place, the atoms regain the lost electrons and once more become stable. Th process is known as ionisation and the constituent parts are termed positive and negative ions.

How this affects our bodies is that atoms join together into various chemical combinations by virtue of their outer orbiting electrons and the molecules so formed, in our case, build up into living cells. The atoms of our living body tissue were never meant to suffer ionisation so when it occurs the complex chemical bonds are broken and on regaining stability new chemical bonds may have been created which can be detrimental to the cell. Depending on the intensity of the incoming ionising radiation, these chemical changes in the cell can produce local damage which can ultimately affect the body's well-being and even its future offspring.

Rays of ionising radiation can best be visualised as streams of tiny projectile-like particles directed at the atoms of material which consist of a central nucleus made up of positively-charged particles known as protons and uncharged particles called neutrons. Around this nucleus of protons and neutrons orbit the negatively-charged electrons: the positive charges balance the negative charges, producing a neutrally-charged atom. The ionising radiation projectiles are simply bits of basic atom and can be divided into two categories; those that are electrically-charged and those that are uncharged. Charged particles consist of three main types—the positively charged proton with a mass of 1, the alpha particle with its two protons and two neutrons (therefore having a double positive charge and mass of 4) and the negatively-charged electron with a mass 1800 times smaller than the proton.

Charged particles have such a strong electrical force that their energy is quickly spent pushing and pulling the protons and electrons near the surface of the material – rather like a strong ball magnet rolled into a pile of steel marbles. So while a relatively large number of target atoms are ionised, ionisation takes place in a small area very near the surface. Therefore charged particle radiations, while densely ionising, are not deeply penetrating.

Uncharged particles are the neutron, with the same mass as the proton, and the photon, a name given to electromagnetic radiation such as x-rays and gamma rays when being considered as a stream of small particle-like packages of energy. Ionisation of target atoms by uncharged particles is only brought about by direct collision and since the atoms making up the molecules of the material are relatively as far apart as stars in the universe, uncharged particles miss more often than they hit, so unlike charged particles, they penetrate deep into the material before collision, and hence ionisation, occurs.

Although the basic effects are penetration and ionisation, each radiation particle type (i.e. proton, neutron, alpha, beta and photon) has its own characteristic property and this can vary with energy. To give an example of the difference in penetration properties of the main particles (all having a similar energy of a few MeV) alphas would be stopped by a sheet of paper, most of the betas would be stopped by a plate glass window, but it would take about 1 cm of lead to decrease the photons by 50% and the same thickness of lead would stop only a few neutrons.

Each particle also has its characteristic biological effect and in practice is designated by a number known as a Quality Factor (QF). The QF varies from 1 to 20, the higher the number the greater the biological effect. This factor like the penetration property can also vary with energy, but generally the alpha has a QF of 10, the beta a maximum QF of 1.7, and the photon a QF of 1. The neutron depending on energy can have a QF between 2 and 10 and recoiling nuclei have the highest QF of 20.

The energy deposited by each type of radiation can be physically measured, the unit of measurement being the rad (equivalent to 100 ergs per gram). This unit does not always give a measurement of the biological damage so the Health Physicist also needs to know the type and energy of the radiation producing the rad dose in order to assess the 'quality'. By using various other methods of measurement it is possible to deduce an average effective QF. Multiplying the rad dose by the QF gives the rem (Rontgen Equivalent Man) dose which is a unit meaningful in terms of both radiation intensity, type, and resulting biological damage. The old unit, the Rontgen so often quoted in press reports, is quite meaningless when talking of mixed types of radiation producing varying biological damage to human tissue.

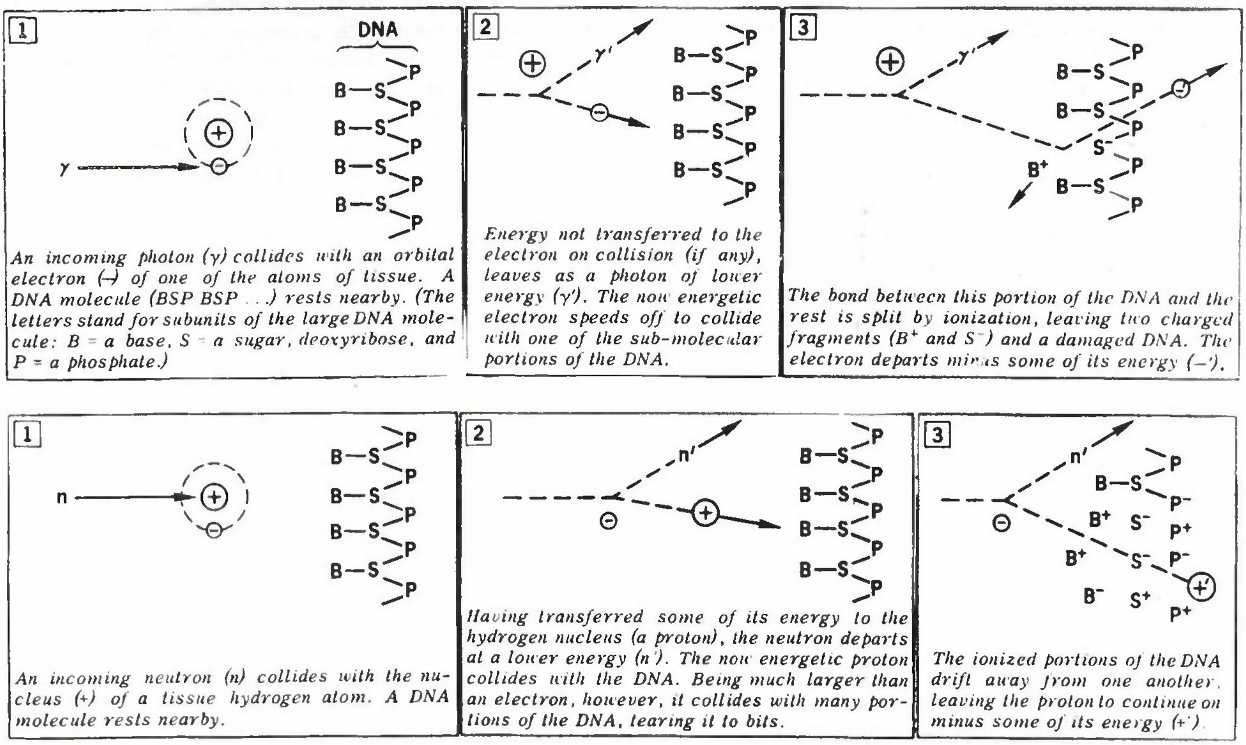
damage to man

Radiation damage to man is brought about either by external penetrating radiation, such as photons and neutrons passing through the outer layers of tissue and ionising cell atoms deep in the body, or by internal radiation. In the later case densely ionising alphas and betas must actually be transported into the body via the nose or mouth and while the outer dead layers of skin of the body would absorb alpha particles without much damage, this is certainly not the case when the absorbing layer of tissue is the wall of the intestine or lung. So the basic hazards are from either external penetrating radiation, usually photons and neutrons, or contamination radiation, usually alphas, betas and photons, and of course both problems can occur together.

There are two kinds of molecular damage; the direct effect where a biologically important molecule is directly smashed by an incoming radiation particle producing useless fragments, and the indirect effect where the water molecules of which as much as 80% of the cell is built, are split into reactive ions or radi-

the direct action of photons and neutrons on tissue

(reproduced by kind permission of the US Atomic Energy Commission)



An incoming photon (γ) collides with an orbital electron (−) of one of the atoms of tissue. A DNA molecule (BSP BSP ...) rests nearby. (The letters stand for subunits of the large DNA molecule: B = a base, S = a sugar, deoxyribose, and P = a phosphate.)

Energy not transferred to the electron on collision (if any), leaves as a photon of lower energy (γ′). The now energetic electron speeds off to collide with one of the sub-molecular portions of the DNA.

The bond between this portion of the DNA and the rest is split by ionization, leaving two charged fragments (B^+ and S^-) and a damaged DNA. The electron departs minus some of its energy (−′).

An incoming neutron (n) collides with the nucleus (+) of a tissue hydrogen atom. A DNA molecule rests nearby.

Having transferred some of its energy to the hydrogen nucleus (a proton), the neutron departs at a lower energy (n′). The now energetic proton collides with the DNA. Being much larger than an electron, however, it collides with many portions of the DNA, tearing it to bits.

The ionized portions of the DNA drift away from one another, leaving the proton to continue on minus some of its energy (+′).

cals, and may form, for example, poisonous hydrogen peroxide. Subsequent cell injury can be divided into 'somatic' damage where the cell's function is impaired and 'genetic damage' where the cell's reproductive ability is impaired.

In somatic damage the body is affected. This is also the case if genetic damage has occurred in a cell other than the human egg and sperm cells – for example, if genetic changes have occurred converting a healthy liver cell into a cancerous one. When genetic damage has occurred in the egg or sperm cell the offspring can be lethally affected, possibly without affecting the parent at all.

In general discussion of the subject, somatic damage means personal body injury and the term genetic damage is usually limited to the egg and sperm cell which ultimately affects future generations.

The biologically important molecules are the DNA (deoxyribonucleic acid) molecules of the cell nucleus. These build up into genes which are contained in microscopic thread-like units called chromosomes. The whole assembly is a complicated chemical structure containing the 'blue-prints' necessary for the cell to reproduce itself. It does not require much imagination to visualise the havoc caused when the electrons binding the whole system together are suddenly torn away by ionisation produced by incoming particles of radiation. Not only can the cell be killed outright but in some cases subtle changes produced in the genetic material can produce cancerous cells, and in the egg or sperm cell can produce a mutated offspring.

Man has always been subjected to radiation both from cosmic rays coming in from space and naturally-occurring radioactivity in the air, water and earth of the environment. Cosmic rays consist mainly of protons and alpha particles of great energy. On striking the atoms of air at the top of the atmosphere they produce secondary showers of penetrating particles which eventually reach the ground. The dose rate to man is about 0.1 mrem a day (1 millirem is 1/1000 of a rem). Naturally-occurring radioactivity in the ground stems mainly from uranium, thorium and their products in various rocks and soils. The dose rate depending on geographical location varies between 0.1 mrem per day to 0.3 mrem per day, but in a few isolated places, notably in Brazil, the dose rate can reach as high as 4.4 mrem per day.

It is only since the turn of this century that man has been subjected to radiation dose rates in excess of the background radiation. The first victims were the early scientific experimenters and medical doctors machine. Becqueral's discovery of radioactivity in who used Rontgen's marvellous invention, the x-ray material also led to injury. This was not immediately recognised, even though Becqueral himself is reported to have sustained a serious slow-healing skin ulcer from handling the material. Further cases of injury resulted from the demand in World War I for instruments that could be seen in the dark. This effect was achieved in those days by using luminescent paint mixed with radium salts, a concentrated naturally-occurring radioactive substance. The girls employed in painting these dials developed the bad habit of most artists who produce fine work, of sharpening the point of the brush with the mouth. The resulting tragic sickness and death of some of these girls together with the high incidence of lung cancer observed in pitchblend miners (the ore from which the Curies obtained their radium) led to the forming in 1925 of what was to become the International Commission on Radiological Protection. This organisation, consisting of learned people from all parts of the world, was established to define safe working limits for persons coming into contact with this new hazard.

The 'maximum permissible level' whole body dose to produce negligible somatic or genetic damage has gradually decreased over the years as more information has become available. At the present time this is set at 5 rems per year for a radiation worker, 1.5 rem per year for a non-radiation worker, and 0.5 rem per year for individual members of the public.

In Part II I shall describe the radiation received by man in space, medicine and industry and look at the reasons given for the continued controversy over the maximum permissible levels of radiation.

Crossword

Maxim

Across

1. Special lessor re-accommodated in temporary black-outs (5, 8)
7. Tin is poison, I'd made up a reason for sick leave (13)
8. Disorganised as an American organisation (4)
9. One way to knock holes in a computer program (5)
13. Happy story printed backwards by the editor (6)
14. Many stars are bright outside, soft inside (6)
16. When there are 1 across, it's not! (5)
17. A soft song for two (4)
19. Strange alien moon ring in a country north of China (5, 8)
20. E for engineers and elasticity (6, 7)

Down

1. Insurance against Rothschild? (7, 6)
2. Explodes target, revealing Polaris (8)
3. Réaumur equals Kelvin? It's a possibility (4)
4. Anchor used to give unity (6)
5. A frequency to play on (5)

It cost just under £$\frac{1}{4}$ million.

Is it (1) a South Bank Concert Hall? (2) SRC's new bunker? (3) . . . or what?

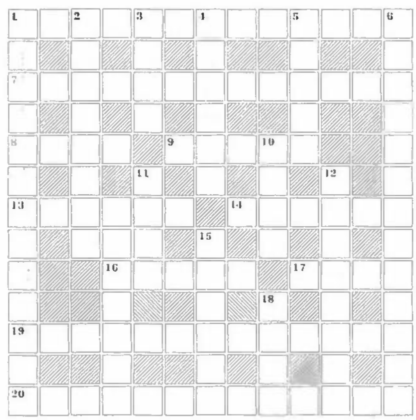
Answer: Picture shows the landscaped approach to the three million volt Van de Graaf Generator at the University of Sussex. The machine and the new Laboratory building cost £228,000 to build and most of it was met by an SRC grant of £200,000. It was opened on July 10 1972 by Sir Alan Cottrell, FRS, Chief Scientific Adviser to the Government, and is directed by Professor M W Thompson of the School of Mathematical and Physical Sciences. The use of small accelerators in research into solid state physics has increased in the last ten years following important developments in the study of particle-solid interactions. This machine will continue fundemental studies in this and related fields, such as in changing the properties of materials by ion bombardment and investigating the nature of impurities in solids and the various constituents of alloys.

PS We understand, by the way, that the resemblance to that concert hall is only superficial. The Van de Graaf Generator inside is well-tuned but hardly tuneful. *(— is that how the pop group got its name then?).*

6. If sorry nose nags badly, consult an expert in these (7, 6)
10. Family of isotopic lanthanides (4)
11. Nash is heard before bells (4)
12. Like Inter-City lines, affording infinite get-togethers (8)
15. At peak performance, magazines aim to do this (6)
16. Back in monster nebulae (5)
18. Managed to get rid of one employee, ready for retirement (4)

reward

The first correct answer opened gains a £1 book token. Send entries to *Quest* at London Office not later than December 8 marked "CROSSWORD"



London decides to move

"While we at headquarters are being distracted by reorganisation, you must run the railway"
G F Fiennes, BR Eastern Region (c. 1966)

'It's nice to get out for a change . . .'. LO staff and their families at Basingstoke.
P. Culba.

Swindon gets most votes

On October 18 1972 the Council decided that London Office should move and that Swindon, the location most favoured by the Working Party and by the staff who were prepared to move, would be the first choice. But the decision would depend on financial arrangements being made with DES and CSD/Treasury and on confirmation from the staff that, in the light of the decision to disperse, Swindon was the location preferred by most of the people who were prepared to move. In the first opinion poll 148 staff put it down as first, second, third or open choice and 97 put it first. It was selected by the working party because it is far enough from London to qualify as a 'dispersal area', it is not too far from four SRC establishments and has a good train service back to London (65/80 minutes), London airport and to other parts of the country.

The working party found that there were less cultural and business amenities than in larger towns. There are few professional entertainments and, as yet, no 'west-end' style shops. But they got an assurance from the planners that these will come with Swindon's expansion over the next ten years. The population, now 125,000, is planned to rise to 200,000 in the late 1970's and to 300,000 by the year 2000.

The present amenities are the surrounding countryside and excellent facilities for outdoor sports, amateur theatricals and many other leisure pursuits. Also housing, cheaper than in London, is available to rent or buy. Bristol, Oxford and London are within reach with their wider choice of shopping and evening entertainments.

New offices, shops and a large hotel (l) in Fleming Way, Swindon. The Parade shopping centre lies behind them *Published by courtesy of Swindon Corporation*

A long sift to find a short shift

as seen by a Town mouse

London Office has been driving round in coach loads to surprise out-of-town dwellers in their natural surroundings. We have looked critically at the way they live, where they put their washing and other amenities and have swept off again to talk it over.

It's all part of the LO dispersal/disposal exercise. The three towns we visited were Basingstoke, Milton Keynes (Bletchley) and Swindon: each seen in fair and alphabetical order, and previously vetted and short-listed by the working party elected to do this complicated business.

In spite of recommendations to consider the places, many of us said "What they've done to Basingstoke is *disgraceful*", "Milton Keynes sounds marvellous but . . . where is it?" "Some parts of Wiltshire are beautiful . . . but Swindon isn't." And some people did not want to move to any of them — 134 out of a total of 336 in the first poll.

Perhaps some of us who voted 'no' are just unenterprising. On the other hand, when looking for a 'good' place to work one does not usually first choose where to live. If the prospects of promotion and further experience are good, the 'quality of life' bit will follow.

wider prospects

Leaving out specialist jobs, there are not many higher administrative posts in SRC. So, to quote this year's annual report: 'the Council has continued to encourage staff to secure wider experience . . . Members served during the year with other organisations on secondment or special leave.' And some of them came back with the LO reorganisation.

Where are the wider prospects? Most must still be in London we believe (have always been told so), but what about other important towns like Bristol, Manchester, Oxford, Newcastle? Well Newcastle was not on but they did look at Bristol and found it attractively situated with a good range of houses (old and new) to buy, good cultural, recreational and shopping facilities, good local employment apportunities and 'excellent' transport links with SRC's business contacts. But the Hardman Committee said it was too far from London where, it has been decided, the Council, Boards and Committees are to meet.

New school in old 'farmhouse' style at Milton Keynes

What or who is a 'Wendy'?

A 'Wendy' is someone who refuses to grow up and face life – "Wendies" choose to live in a Never Never Land, preferably of their own making and seldom, if ever, venture into the world of reality; never of their own volition. Alternatively a "Wendy" is someone who chooses to live and/or work in London when the choice of dispersal is offered . . .
Oh why bother, it's exactly the same thing isn't it?
(With apologies to William Cobbett and Sir James Barrie).

The outside of the new shopping centre dwarfs old Basingstoke.

There are not many people to move. There are less than 400 jobs and, according to the first poll, less than half the people in them want to leave town. So our transit is unlikely to cause much excitement.

what goes on

What do we do in London Office? According to the LO directory ('an excellent book'*) we have two sorts of staff. One half (under the four Boards) spends £19M on grants, sifts the applications for them, and attends or arranges committees to consider who should get how much. The other half (two of the Boards plus E & F) spends £20M on running SRC, and a few see to things like who should spend what on travelling to committees, being off sick or just visiting. This half also spends another £20M on national and multi-national facilities used by SRC and universities alike.

The first half want to be within reach of every committee member from any university, industry or government body in the British Isles. Now we have noticed, even here in the south east, that universities happen as far north as Nottingham or Coventry, so why don't the committees pick up their papers and go north . . . to Crewe? "No," they say, "it's easier for everyone to come to London and the papers are too — — heavy to carry anyway."

The other half work in close alliance with SRC's 'outer seven' – who will even find a way here via Woomera, CERN and Tenerife in Winter. Could this 'internal' affairs half have pitched a campus site with one of their well-endowed customers? or would it have caused a dilemma like that chap Paris had when he tried to decide who most deserved the golden apple?

. . . Which brings me back to where I began.

* *the author is on the working party.*

the new Council

Four new Council members are appointed from October 1 1972:

Professor H G Callan FRS	Head of Department of Zoology, St Andrews University
Mr J M Ferguson	Director of Engineering, GEC Power Engineering Ltd
Dr R W Pringle OBE	Chairman and Managing Director, Nuclear Enterprises Ltd
Professor D W N Stibbs	Napier Professor of Astronomy and Director of the University Observatory, St Andrews

The retiring members were Professor H Ford FRS, Professor J C Gunn, Professor Sir Fred Hoyle FRS, Professor H L Kornberg FRS and Dr J W Menter FRS. Mr R St J Walker CBE has succeeded Dr W L Francis CBE as Secretary to the Council. *(see Quest Vol 5, 3 p1).*

Except for the Chairman and Secretary, who hold full-time appointments, the members of the Council are appointed on a part-time basis, usually for a term of three to four years. The names and full-time appointments of the existing Council members are:

Sir Brian Flowers FRS	Chairman, Science Research Council
Dr A H Chilver	Vice-Chancellor, Cranfield Institute of Technology
Dr D S Davies	General Manager Research and Development, ICI Ltd
Dr E Eastwood CBE FRS	Director of Research, GEC Ltd
Professor H Elliot	Professor of Physics, Imperial College of Science and Technology, London
Professor R Mason	Professor of Chemistry, School of Molecular Sciences, University of Sussex
Professor P T Matthews FRS	Professor of Theoretical Physics and Head of the Physics Department, Imperial College of Science and Technology
Professor E W J Mitchell	Professor of Physical Properties of Materials, University of Reading
Dr E J Richards OBE	Vice-Chancellor, Loughborough University of Technology
Professor Sir Michael Swann FRS	Principal and Vice-Chancellor, University of Edinburgh
Mr R St J Walker CBE	Secretary, Science Research Council

Chairman on pollution: Royal Commission

Sir Brian Flowers FRS has been appointed to succeed Sir Eric Ashby as Chairman of the Royal Commission on Environmental Pollution. His term of office is for three years from February 1973. Sir Brian has just become President of the Institute of Physics and he recently received an Honorary degree from the University of Wales, Aberystwyth.

research scientist builds safer scaffolding

An investigation into design improvements for steel scaffolding is being sponsored by the Science Research Council and the Construction Industry Research and Information Association (CIRIA).

There are two linked projects. One is Dr Edgar Lightfoot's mathematical and experimental study of the instability behaviour of scaffolding. The Osney Mead Laboratory (of Oxford University), where he works was once the Oxford Power Station so he has room to build full scale scaffolds under cover. Dr Lightfoot has an SRC grant of £17,442. He will study models and carry out failure tests on the full size version.

The second project is on-site surveys of the loads applied to scaffolding, load effects on parts of the structure and site erection standards. This project will be carried out by John Laing Research and Development Ltd. It is supported by CIRIA funds and by special contributions from the Department of the Environment, Kwikform Ltd, John Laing and Son Ltd, Peter Lind and Co Ltd, Sir Alfred McAlpine & Son Ltd and Rapid Metal Developments Ltd.

our own students get grants

Three people have been given the chance to do a year's full time study, with the help of SRC bursaries. Mr H J Jones and Mr D J Watson of Rutherford Laboratory are at the Oxford Polytechnic studying for the Council of Engineering Institutions (CEI) Part II exam. And Mr D K Yeomans of Daresbury is studying for an MSc in Thermodynamics at the Manchester University Institute of Science and Technology (UMIST). Anyone who is interested in taking up serious study may be able to get help of some kind. Your local Training Officer will advise you.

a career with accelerators

Mr A E Pyrah retired from Rutherford Laboratory in June. He entered the 'accelerator business' in 1947 (after war service) when he started work on the 5 MeV Van de Graaf machine, was promoted to Chief Experimental officer (1955) and went to help construct the Tandem Generator at Harwell, then the Oxford University machine (1960-66). For the last six years Mr Pyrah has been working on cyclotron ion sources at the Rutherford Laboratory.

above: Mr A E Pyrah (l) and Professor W D Allen (who made the presentation on behalf of RHEL staff) *–see report left.*

better frames for high rise buildings

Strength, elastic deflection, stiffness and safety against yielding are important things to know when you design a steel frame for a multi-storey building. There has been a lot of theoretical research over the last ten years and now a group of scientists at the Simon Engineering Laboratories have come up with a practical idea in the form of a computer program. They were helped with an SRC grant of £11,000.

The group, led by Professor M R Horne, have developed the program and tested it and have demonstrated that it gives more efficient and economic designs than existing methods.

The program first produced a trial design which is modified to take account of vertical forces that destablise a structure. The group have had to explore the relationships between the stiffness of frames and their ultimate collapse loads. Existing computer programs showed behaviour up to collapse but cost a lot in computer time when applied to large frames.

Above: Mr & Mrs W H J Hayes and (r) Dr J Howlett Director of ACL who made the presentation from the staff *(see below)*

Mr W J Parmenter, ACL *(see below)*

Atlas loses two

The first two people to retire from the Atlas Computer Laboratory left this year. Mr W H J Hayes and Mr W J Parmenter have been with ACL since it opened in 1963.

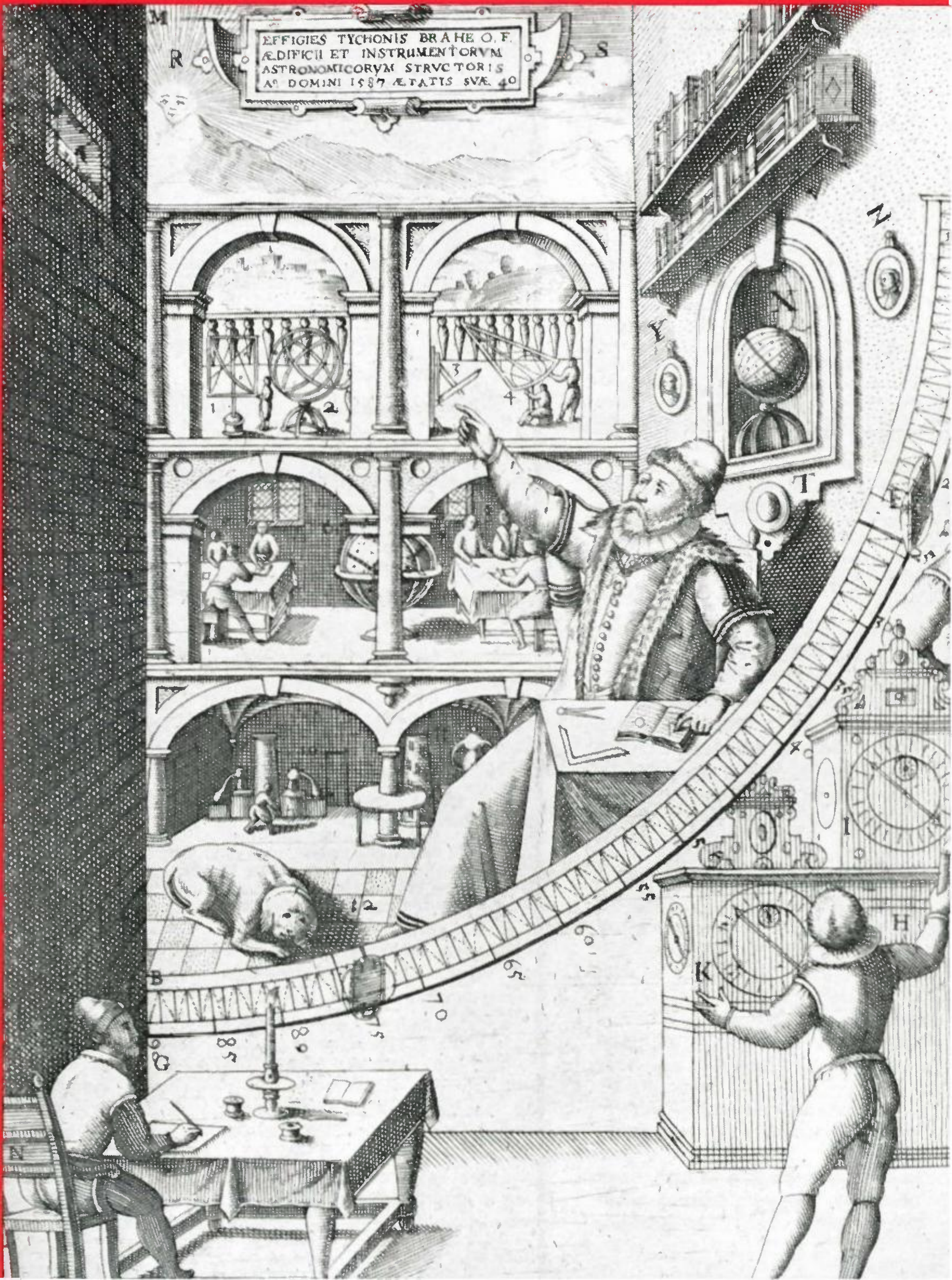
Mr Hayes was the chargehand responsible for all industrial staff and the Laboratory Shop Steward for nine years. At a dinner, held at the Bear Hotel Wantage, attended by seventy people, Mr Hayes was presented with an inscribed tankard from the Atlas and Rutherford shop stewards. The staff of ACL gave him a carriage clock, an appropriate memento of his earlier career as a driver. He drove for MRU, RAF Milton in the 39-45 war, the Lambourn volunteer ambulance crew for 20 years and the Rutherford Laboratory (1960-63). For thirty years he was Police Sergeant Hayes of the Berkshire, later Thames Valley, Special Constabulary.

Mr Parmenter, Senior clerk of works, was the second to retire. At a presentation ceremony he was thanked for his contribution to the present high standards of the building services at ACL.

we apologise . . .

There was not enough space here to include all the recent retirements and senior appointments. More will appear in the next issue.

QUEST



EFFIGIES TYCHONIS BRAHE O.F.
ÆDIFICII ET INSTRUMENTORVM
ASTRONOMICORVM STRVCTORIS
Aº DOMINI 1587 ÆTATIS SVÆ 40

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QUEST

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Vol. 6 No. 1
1973

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our inheritance

Cover picture shows a sixteenth century research instrument used for measuring star positions.

It is an illustration of Tycho Brahe's Mural Quadrant from his book 'Astronomiae Instauratae Mechanica' published in 1602, which is just one of the rare and valuable books in the Crawford collection at the Royal Observatory, Edinburgh, *see article on p. 2.*

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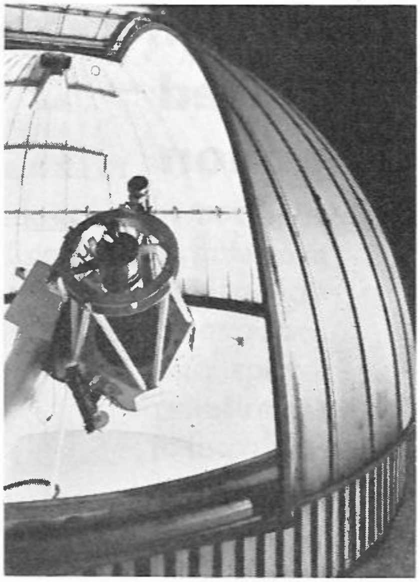


Edinburgh looks up to a bright future

Pictures: left, the Hewitt Schmidt camera at Earlyburn, Peeblesshire, used for optical tracking of satellites. The camera has an aperture of one metre and a timing mechanism accurate to a thousandth of a second that is used to determine satellite positions.

Above, the 20-inch reflecting telescope at Edinburgh that can be used photographically or photoelectrically. Beneath the dome is a Coudé room into which starlight can be projected for examination under laboratory conditions.

The Royal Observatory Edinburgh celebrated its 150th anniversary on November 3 by opening a new library for its unique and priceless collection of great astronomical literature ***(see p.2)*** **and by holding a symposium on Infrared Astronomy, one of the newest, fast-growing fields of research. 'In the next few years this will grow into one of the major activities at Edinburgh' said the Director, Professor H A Brück CBE, Astronomer Royal for Scotland, writing in** ***The Times*** **about the first century and a half** ***(3.11.72).***

The Observatory is perhaps best known in the field of pure research for its work on the physics and chemistry of the diffuse material that floats in space in clouds between the stars; the 'interstellar matter' that stars are made of. It is also known for its development of instruments that make use of current technical developments, such as automatic guidance systems for telescopes, and the automatic measuring machine GALAXY that can locate 10,000 stars an hour on the star-field photographs taken with Schmidt cameras, and can measure their position and brightness with close to absolute accuracy.

GALAXY was designed by the Instrumentation Division of astronomers and engineers. Their job is to bridge technical gaps like the one between the Observatory's 16/24 Schmidt cameras that photograph tens of thousands of stars and the slowness of measuring them by non-mechanical means.

When I visited the Observatory Dr Neil Pratt, who wrote about GALAXY for *Quest*, was busy on the Mark 2 version that is being developed to match the power of the new 48-inch Schmidt camera in Australia *(p.21)*.

Dr Reddish of the Observatory is Project Manager for the 48-inch and responsible for the team who will run the telescope, take plates and rush them to Edinburgh to be measured and sent to university astronomers in a very short time.

The Observatory is also helping with other national projects: the site testing for a new Northern Hemisphere observatory and the 60-inch Infrared flux collector in Tenerife. Dr Reddish described it as 'a move from research into management; a cost dear to pay,' although the Observatory does also use the 60-inch for research. (His own research has contributed to Edinburgh's studies of interstellar matter.) But he added 'with the 48-inch and GALAXY we [the UK] should end up ahead of California and the European Space Observatory. We will probably scoop the pool'.

Dr Stoy, the Deputy Director, told me he worked mostly with the 16-inch twin telescope, studying the structure of the Milky Way and intergalactic matter. Dr Clube, Head of the Astrophysics Division, is using the GALAXY machine to measure plates that he took at the Cape in 1967-70 to study star positions, their motions and galactic structure.

The Observatory has a 16/24 Schmidt under the clearer skies of Italy at Monte Porzio. It develops experimental equipment for ultraviolet and infrared radiation observations from rockets and

Edinburgh's unrivalled collection

On right is a page from Copernicus' 'De Revolutionibus Orbium Coelestium' with notes added by Erasmus Reinhold who was Professor of Mathematics and Astronomy in Martin Luther's University at Wittenberg from 1536 to 1553. It is one of the rare books that can be found in ROE's library, see articles below, also Quest's cover picture.

Copernicus was born 500 years ago. To celebrate the aniversary there is an exhibition at the British Museum until May and Macmillan are publishing 'On the Revolutions' in English (at £25).

Vivienne Ainsworth

In 1888 the future of astronomy in Scotland hung in the balance. The government were toying with the idea of abandoning the Royal Observatory, Edinburgh, since its site, originally built outside the city, was now surrounded by buildings, lights and other city interference that made observational astronomy practically impossible; and the building itself needed repair.

James Ludovic Lindsay, 26th Earl of Crawford and ninth Earl of Balcarres, came to the rescue by offering to donate to the nation his magnificent private collection of books and instruments on condition that a new observatory be built to house them. The government accepted his offer and as a result the Observatory's present premises were built to the south of Edinburgh, high up on Blackford Hill, and officially opened in 1896.

The collection of books or the 'Crawford Collection', as it is now called, is one of the finest in the world. It has been described as being second only in astronomical literature to the library of Poulkovo Observatory, USSR. I have also heard it said (on more than one occasion by specialists in this field) that it is in fact *the* finest. This claim might well be justified since the collection includes first editions of all the most important works that have influenced the development of astronomy, with only one exception. (We don't have Galileo's 'Dialogo . . . sopra i due massimi sistemi del mondo', 1632.)

the first and the few

We have a unique and unrivalled collection of cometary literature, the largest of its kind – Lord Crawford was specially interested in the subject. There is a first rare edition of Newton's 'Principia Mathematica'; a unique set of Babbage's arithmetical tables printed in a variety of coloured inks on coloured papers; some very early and beautifully illuminated manuscripts and calendars; specimens of printers' marks and title pages. Among nearly thirty editions of Euclid there are the first Arabic, Greek and Latin editions. We have Kepler's 'Harmonices Mundi'; a first edition of 'Tabulae Rudolphinae'; a beautiful and well preserved copy of Copernicus' 'De Revolutionibus' personally annotated by Erasmus Reinhold, and many other items too numerous to mention here. I have named but a few of the "gems". Some of the wonderful bindings of leather and vellum represent the highest art of the book-binder in the late 19th century; they were specially commissioned by Lord Crawford.

The collection has recently been re-housed in a specially-designed room with up-to-date fire and burglar alarm systems and special air-conditioning with room temperature and humidity control. The observatory's computer was used to compile a new catalogue according to authors and dates, which is very useful in this sort of collection. It was also used to calculate the amount of shelving required. The room was officially opened in November 1972 by the present Lord Crawford, grandson of the 26th Earl to whom we are so much indebted.

Mrs Ainsworth is the Librarian of the Royal Observatory, Edinburgh.

Edinburgh continued

satellites such as TD-1A. It has a satellite tracking station at Earlyburn, Peeblesshire.

During the Observatory's early years, technical developments led to big advances in theoretical astronomy. It looks as if this is going to happen again. Professor Brück thinks 'the future of all British astronomy looks distinctly bright'.

Sol redit ad eandem stellam fixam diebus 365 · 15 · 24 · 5 · 53 · 55

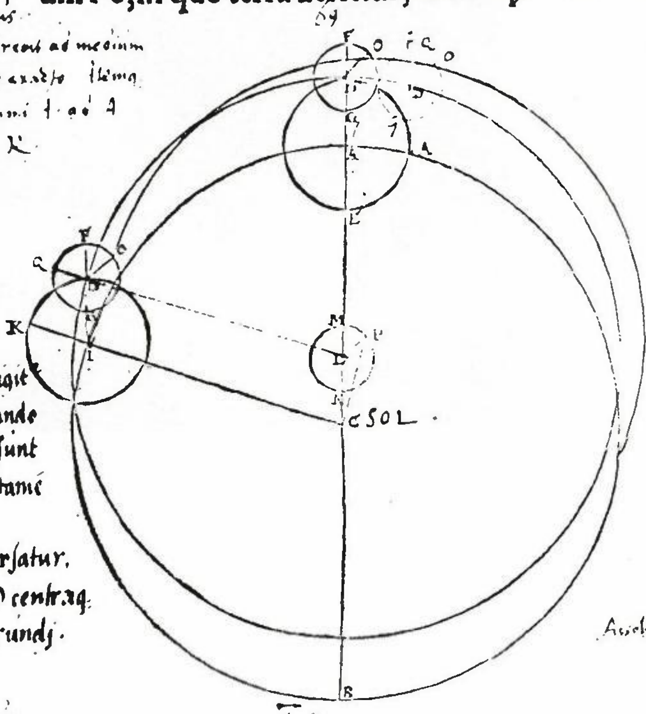
Sed ad ἀπόγειον ... 365 · 15 · 50 · 4 · 13 · 31 · ... apogeum ... paululum ... procedit in consequentia.

ad lineam A C

Primus epicyclus

quoq; epicyclum hoc modo. Sit mundo ac Soli homocentrus A B, & A C B diameter, in qua summa absis contingat. Et facto in A centro epicyclus describatur D E, ac rursus in D centro epicyclium F G, in quo terra uersetur, omniaq; in eodem plano zodiaci.

... autem C A E diameter in consequentia ... progressus ... paulo tardius ... ad medium apogeum ... annuo spacio ... tam centrum epicycli primi ... ad A quam secundi D ad E.



Sitq; epicycli primi motus in succedētia, ac annuus ferè, secūdi quoq; hoc est D, similiter annuus, sed in præcedentia, ambo rumq; ad A C lineam pares sint reuolutiones. Rursus cētrum terræ ex F in præcedentia addat parumper ipsi D. Ex hoc manifestū est, quòd cum terra fuerit in F, maximum efficiet Solis apogeum, in G minimum: in medijs autem circumferentijs ipsius F G epicyclij faciet ipsum apogeum præcedere uel sequi, auctum diminutumúe, maius aut minus, & sic motum apparere diuersum, ut antea de epicyclo & eccentro demōstratum est. Capiatur autem A I circumferentia, & in I centro resumatur epicyclus, & cōnexa C I extendatur in rectam lineam C I K, eritq; K I D angulus æqualis ipsi A C I, propter reuolutionum paritatem. Igitur ut superius demonstrauimus, D signum describet eccentrum circulū homocentro A B coæqualem in L centro, ac distantia C L, quæ ipsi D I fuerit æqualis, F quoq; suum eccentrum secundum distantiam C L M æqualem ipsi I D F, & G similiter secundum I G, & C N distantias æquales. Interea si centrū terræ iam emensum fuerit

u tcunq;

2

In secundo modo ☉ intelligit esse ἀπογειότατος tunc, quando terra centrumq; primi epic. et ☉ sunt in eadem recta linea, medio tamē centro primi epicycli.

In medio uero apogeo Sol uersatur, quando ἐπ' εὐθείας sunt ☉ centraq; utriusq; circuli primi et secundi.

Si in hoc secundo modo hypothesium intelligitur apogeon secundi Epicycli in linea I D F ducta ex centro primi epicycli per centrum secundi, tunc terra ... circumferentiam secundi Epicycli absoluit integram periodum annis ægyptijs 3434. Sed si apogeon secundi Epicycli intelligatur in linea, quæ per centrum secundi Epicycli parallela existit rectæ C K ductæ ex centro Uniuersi per centrum primi Epicycli, ut in ... L D E, tunc erit

pag. 85 primo modo

... C D F æqualis angulo K I D et A C K. accedit autem ... F D C ... integra periodus annis 3434 ægyptijs ... hic motus terrae ... angulum E D F ... (3) ... primus ... motus puncti E ab

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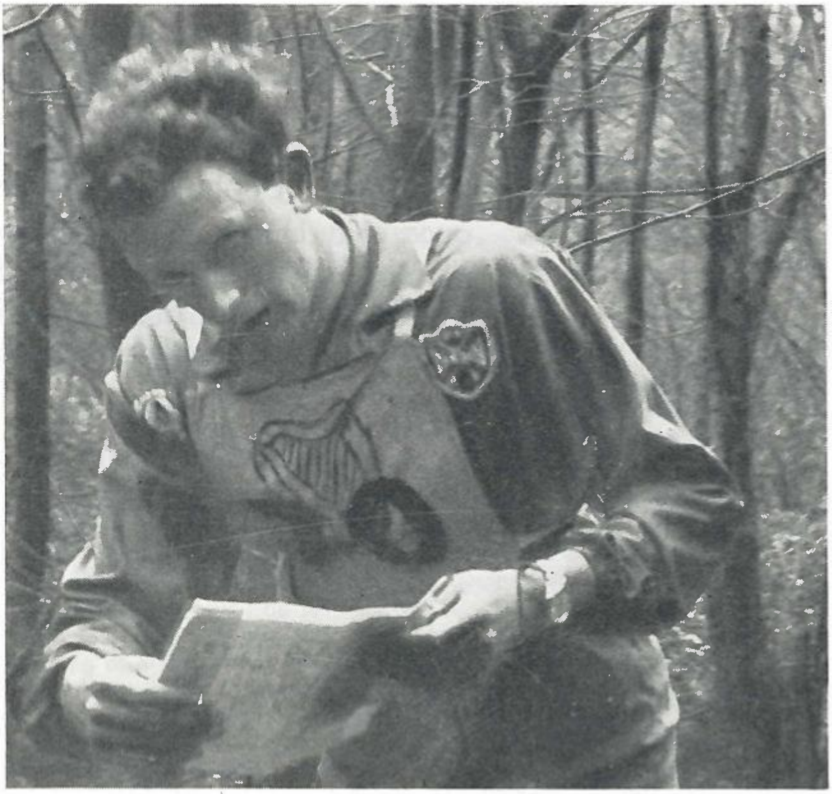
He represents Scotland in a different way

hooked for life



John Barrow, a bit disorientated – see story below. He is wearing the club colours of Edinburgh University in the Southern Orienteering Championships held in 1969 in Worth Forest, Sussex.

John is a Scientific Officer at the Royal Observatory Edinburgh. He has been working on the Northern Hemisphere Observatory Site Testing Project and is now engaged on work involving the two Iris Photometers and the Schmidt telescope at the Observatory.

John Barrow

One day in the middle of a large wood you might suddenly see a man coming out of the undergrowth. If he's wearing a light tracksuit, holds a compass and stands there rotating a map, scratching his head and muttering '* * * ! Where's this * * * control' – don't worry! It might be me *(see picture)* and I won't have time to explain.

Why do I disappear into a forest every Sunday, run round for an hour and a half looking frantically for red and white flags, and emerge completely wrecked and unable to speak for ten minutes? Well, in one word, I'm an 'orienteer'.

To begin at the beginning. The skill of orienteering was developed in Norway and Sweden in the 1914-18 war by resistance members who learnt to elude pursuers by navigating through the dense forests. Later someone thought of making the skill competitive, and set a course consisting of a series of locations on a map, called checkpoints or controls, each to be visited in order with no laid down route in between, using only the map, a compass, and a reasonably fit pair of legs.

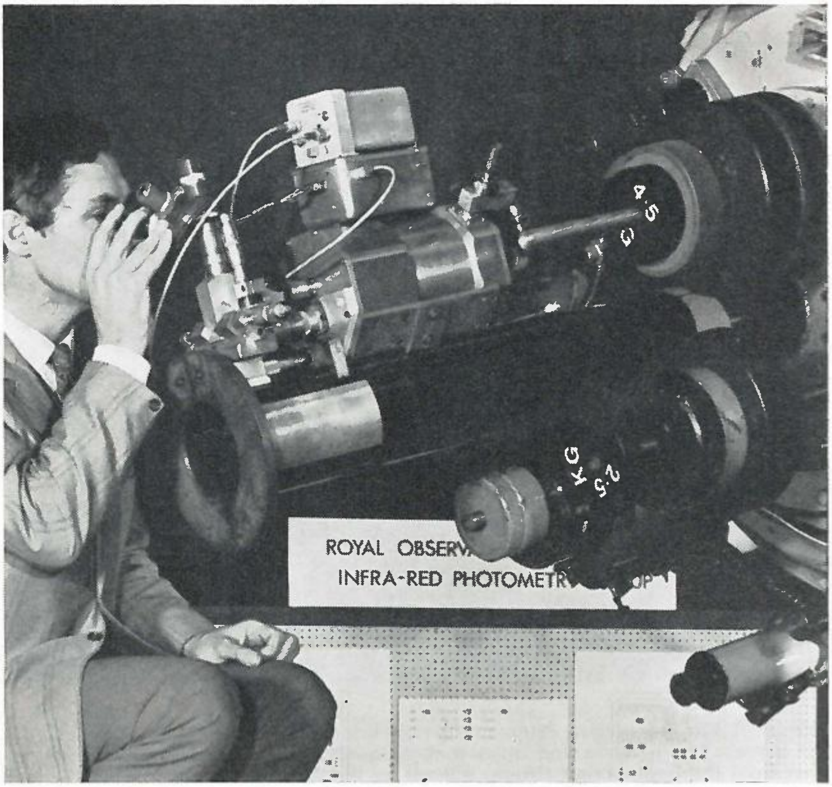
That is what orienteering is and, with many refinements, is the way the sport is practised throughout Europe and North America. In Britain it is still fairly new. We have held eleven Annual Scottish Championships but the British Orienteering Federation, the governing body in Great Britain, was not formed until 1967.

keeping fit and going places

Orienteers are still struggling for recognition but already a National Standard Event may have 400 competitors, and an international standard event in Staffordshire last Easter had nearly 1000. An annual five day meeting held in Sweden attracted 9500 competitors last year and was said to be the largest gathering of competitors at any single-sport meeting. With their vast areas of forest it is easy for the Scandinavians to choose good areas for competitions.

'What's the great attraction', you may well ask. To me orienteering is the most satisfying sport I've ever taken part in. When I emerge triumphantly with the control card stamped with the right code at each control and find that someone has done it a few seconds faster, that makes me – and many others – determined to try again and win. I also think it is one of the healthiest of leisure activities.

For five consecutive summers I spent my holiday in Scandinavia. My first visit was in 1967 when the Scottish Association was looking for people to represent Edinburgh in Euro-Meeting, a competition held every two years between European cities. That year it was in central Sweden and



. . . while at the controls

star trek

Left: Jim Campbell of the Royal Observatory, Edinburgh, is using the 36 inch optical telescope to measure infra-red light emitted by stars. The telescope has been converted by fitting the photometer that is normally used by ROE's Infra-red Research Group on the 60-inch flux collector in Tenerife.

Jim is in charge of the Infra-red Group and of the Instrumentation Group at the Observatory. He is also local correspondent for *Quest.*

I was in my second year at Edinburgh University. After a swift reckoning I decided I could afford to go: and had a great holiday. The orienteering was of a much higher standard than I had ever experienced, but I got my first chance to see Sweden.

meeting friendly people

The following summer, I went to the Swedish Five Day Event mentioned earlier. The main centre was at Boras, east of Göteborg, and easily accessible from Britain (regular ferries from Immingham by Tor Line) and the five races were all within easy reach of Boras. One of the reasons I've returned to Norway and Sweden so often is that there one can get well off the beaten track and really see these countries that are so healthy and clean. The Norwegians are the friendliest I have ever met abroad; and in the forests on the south east coast of Norway, between Oslo and Kristiansand, some of the scenery is simply breathtaking.

Nowadays, as a recognised competitor in international teams, my travel is subsidised by the Sports Council. I have been selected for every international event in which Scotland has so far competed and have represented Great Britain (twice). I have competed in events abroad in Sweden, Denmark, the Netherlands, Belgium, France and even England!

looking for jungles

As it's a new sport, competitors often have to double as administrators: and orienteering seems to need twice as much organising as other sports. Take a simple competition. There are three main officials. The Planner chooses controls from a map and makes them up into a course scaled according to the age, sex and ability of the competitors. The Controller vets the courses, both in theory and in practice, by testing whether one has to cross a 40 foot crag, or a lake, or a piece of dense jungle in order to get from one control to the next. Finally the Organiser arranges things like start and finish, refreshments, first aid teams, and, possibly, radio links between control points.

In addition, a new area will need a new map. Recently orienteers have begun to resurvey competition areas and redraw maps (based on the Ordnance Survey 6 inch series), to show as much detail as possible without unnecessary obscuring detail like tree symbols. Orienteering maps are at 1: 20000 (about 3 inch to a mile), and the International Orienteering Federation has drawn up its own list of map symbols so that competitors will be sure to find maps they can understand wherever they go in Europe.

The more one helps to organise it, the more the sport threatens to become a full time occupation. It is easy to become hooked on orienteering as I was, and I don't think I'm going to get off for a long time yet. If this hastily written screed has encouraged you to try it, I will be only too happy to tell you how and where to begin.

photo A Pickett, DNPL

The DNPL Fire Auxiliaries demonstrate how dry powder fire extinguishers can put out a fire of both wood and inflammable liquids. The auxiliaries are ten craftsmen from the Engineering Group, trained by the Assistant Safety Officer George Robertson *(seen right)*. **The glamour of the speeding fire engine is absent but they are well provided with hand equipment, including two-way radios and breathing apparatus. They are ready to answer any fire call during working hours and to rescue people and contain even the worst fires until the County Fire Brigade arrives.**

In the picture (l to r) are: Eric Wilkinson, Les Davies, John Towers, David Bouch and George Robertson.

our own fire-fighters

DOILY cartoons

The staff of the Atlas Computer Laboratory hold an open day nearly every year on a Saturday. Visitors are shown how the Laboratory is run, the different sorts of problems that the computers can tackle and how the work fits into the whole research programme of the Science Research Council.

This year the Graphics Section ran a number of programs using the interactive display on the PDP15. In one program, aptly named DOILY, the user can define a simple line drawing and then elaborate it by superimposing copies of the original, which are rotated and expanded to give an elegant kaleidoscope effect. By outputting the completed picture to the SD4020, visitors were able to collect their works of art later in the afternoon. Probably the most successful one was Dr Howlett's well-known signature which turned into a most interesting composition.

The other program which collected a crowd was a simulated Fruit Machine which paid out winnings – in lengths of paper tape!

The Graphics Section also showed computer generated films made in various parts of the world. These included animation of a frog jumping, from the Massachusetts Institute of Technology, a Navajo folk story from Colorado and the *Tomorrow's World* program made at the Laboratory last year.

The Safety Group from the Rutherford Laboratory crossed the road to take part and gave a demonstration of kiss-of-life revival for operators who have come into contact with an electrically 'live' computer.

About 300 people came, many were families and friends, and they showed great interest.

answers to puzzles

see pages **14** *and* **16**

nutcracker 11: Hartree

(the detailed membership are:

	Old Cttee.	*New Cttee.*
Chairman	*Gideon*	*Coutts*
Treasurer	*Hartree*	*Gideon*
Secretary	*Ferguson*	*Hartree*
Whitley Rep.	*Redbreast*	*Ferguson*
Cttee. Member	*Coutts*	*Redbreast*

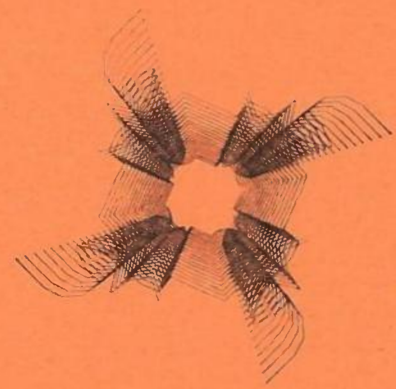
blow that: 6. If John then blows out N, Peter follows with 7-N. John cannot influence the result if Peter plays perfectly.

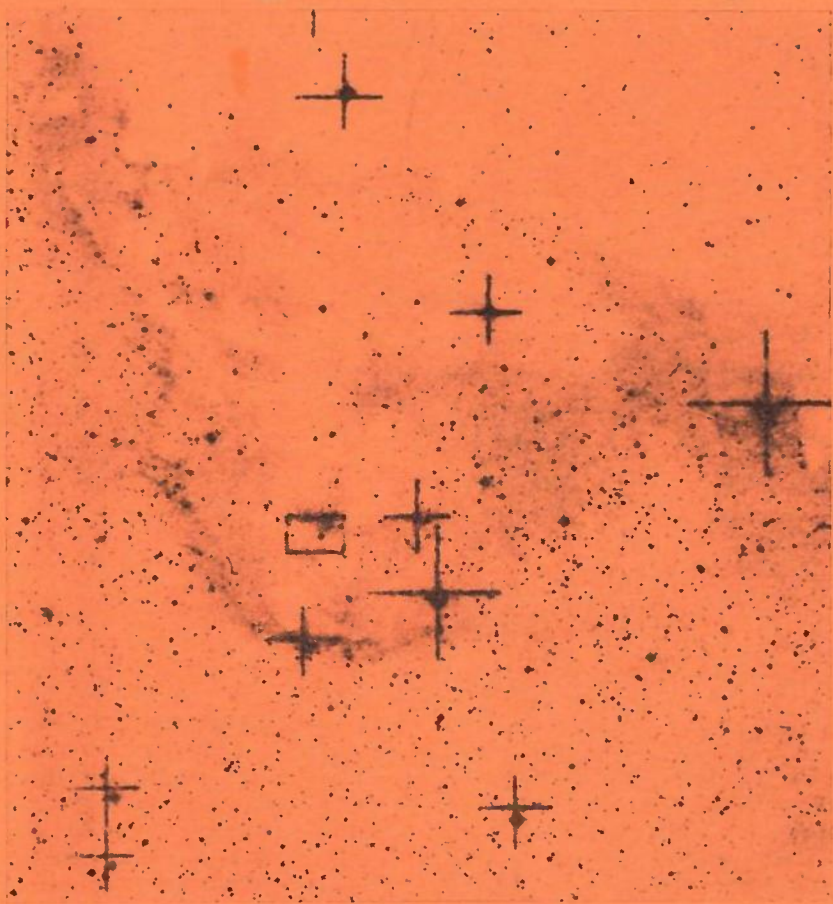
Thinking Mechanically

For this supplement Quest has collected news of computers and computer uses in the Science Research Council.

The picture below was produced on the SD 4020 at the Atlas Computer Laboratory.

On the left is a star chart plotted with the help of the computer at the Royal Greenwich Observatory – *see below*.





The picture above shows part of a photographic star chart (light and dark reversed) which has been copied through a 'finding' chart made on transparent paper by a graph plotter linked to a computer. The 'finding' chart shows nine bright stars as crosses and the position of a tenth, marked with a rectangle, which is the one to be studied. The sizes of the crosses indicate the degree of brightness. The plotted crosses have been placed as closely as possible to the nine bright stars on the star chart (produced by the Palomar Sky Survey). Used in this way a computer provides a quick method for locating objects in crowded areas of sky.

how does the computer see stars?

Roger Wood explains

The computer is housed in the Nautical Almanac Office at the Royal Greenwich Observatory and holds a specially prepared catalogue of star positions and brightness on magnetic tape. When positions of faint stars or galaxies are read into a search programme, the catalogue is scanned and the positions of nearby reference stars are stored in the computer memory. The reference stars are then ready to be plotted on to a chart, to the scale desired, and compared with photographs of the region around the object.

The star or galaxy that the chart refers to will lie in the centre of the rectangle if its position is known accurately. If not, the size of the box may be altered according to the accuracy with which it is known. For example, it is not possible to measure the position of x-ray sources (from rocket observations) as precisely as for normal stars. So the box on the chart may surround a number of stars which might all have to be investigated to find which, if any, is identical to the x-ray source.

From charts such as these an observer at the telescope can find the correct field from the disposition of the bright stars and then centre on his fainter object. When the object is too faint to be visible, even through a large telescope, the computer programme can be used to determine the position of the faint object in relation to a nearby visible star. The observer positions the visible star on a grid in the eyepiece of the telescope so that the faint object is centred in a detecting instrument such as a spectrograph, which may reveal the spectrum of the object only after several hours' exposure.

Photo copyright: National Geographic Society, Palomar Observatory Sky Survey.

6 ἀει

BA	0650	PE	τις; τους λογους γαρ ἐσφερεις καινους ἀει.
BA	0807	PE	ξυνεθεσθε κοινῃ ταδ' ἵνα βακχευητ' ἀει.
BA	0881	CO	ὁ τι καλον φιλον ἀει.
BA	0896	CO	ἀει φυσει τε πεφυκος.
BA	0901	CO	ὁ τι καλον φιλον ἀει.
BA	1261	KA	ἐν τῳδ' ἀει μενειτ' ἐν ᾧ καθεστατε.

1 ἀελλαις

BA	0873	CO	μοχθοις τ' ὠκυδρομοις τ' ἀελλαις θρῴσκει πεδιον

the Atlas computer writes greek

Susan Hockey

Among the more unusual uses of the computers at the Atlas Laboratory has been the development of programs to analyse literary text. One of the earliest was the COCOA program, which was developed for the Atlas computer in 1967 and has now been rewritten for the 1906A. It can be used to count up the number of words in a literary text and print out concordances listing each word in the text, surrounded by its context, with a reference to its location in the text. So far we have processed texts in all the main European languages as well as Arabic, Persian, Sanskrit and Armenian.

Because the computer can only recognise 64 characters which consist of the English ('Roman') alphabet, numerals and a few mathematical symbols, languages that are not written in our alphabet have to be transliterated into 'computer' characters. Even languages written in the same alphabet sometimes need extra characters to mark diacritics such as French accents and German umlauts.

Greek is fairly straightforward since it has only 24 letters in the alphabet which means that each can be matched to a roman letter, eg B for beta and W for omega, and we only have to resort to mathematical symbols to mark capitals and diacritics. But for Persian and Arabic which have alphabets longer than ours, we have to use some non-alphabetic characters for the alphabet itself. The alphabet used for Persian text looks like this:

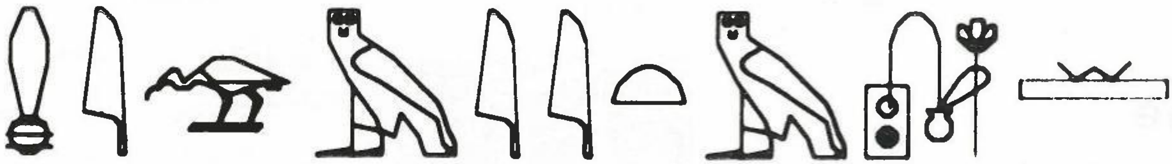
A B P T=J C H X D * R Z) S $!
@ V & E U F Q K G L M N W (O
Y'

However getting the text into the computer is only a small part of the problem. How can we get it out again in the original script? The normal output from COCOA is on the lineprinter which can only print the characters which went into the machine and is therefore not suitable for scripts that have been transliterated. To get over this problem we have devised a way of converting the computerised text back into the original script by using the laboratory's visual display system. We draw the characters of non-roman alphabets on a grid on the VT15 display of the PDP 15 computer using a 'light pen', as shown in the picture (right).

The characters are then stored on a disc ready to be recalled by another program. The disc has room for four character sets or 'fonts', each consisting of up to 256 characters which means that more than one alphabet can be stored together; a useful capacity when referencing Greek text in Roman capitals for instance.

The processed text is fed to the SD4020 on a magnetic tape from the Atlas or the 1906A computers. The characters appear on a small cathode ray tube to be photographed and output either on 16 mm or 35mm film or on photorecording paper ('hard copy'), which can be split up into pages. The film is useful for storing several copies of a concordance in a small space, while the hardcopy gives easier access to a particular page.

Since any character can be plotted in any size anywhere on the screen, we can write titles and headings without defining extra characters for them. The lines are all straight so we can produce curves by drawing a series of short straight lines that will look

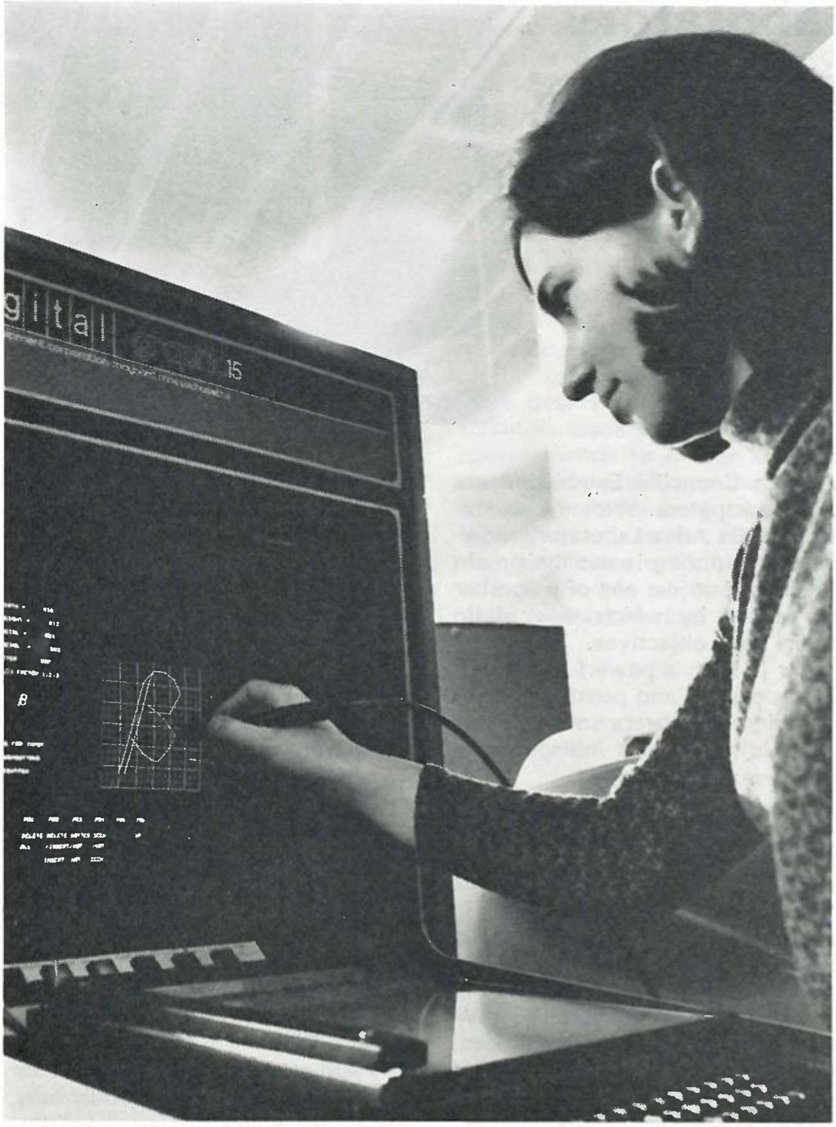


Above: Egyptian hieroglyphs; and left: part of the concordance to Euripides' Bacchae.

like one smooth curve when reduced to print out size. We can produce a thickened effect by drawing doubled lines that join up to look like one when the characters are reduced.

There is no problem in coping with Arabic or Hebrew which are written from right to left: the SD4020 simply types backwards. The spacing between characters is set by the program. At first this caused problems in Arabic and Persian, where most but not all of the letters are joined on to the following one. Then, again, the letters of the Arabic script are written in different forms depending on where they occur in a word, so that the letter B for instance has four different forms. The program therefore includes the rules for writing the script and choosing the right form of the letter on output so that we can simply input all four in the transliterated script as 'B' (thereby keeping the number of input characters below 64).

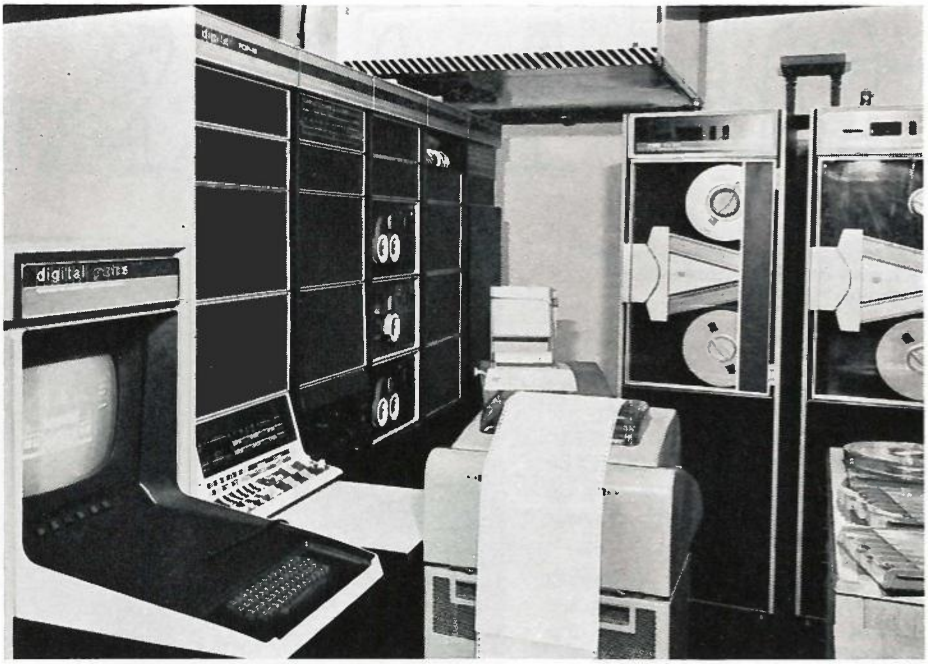
We have used COCOA to analyse the poems of Hafiz, a Persian lyric poet who lived in the 14th century AD. 495 of his poems survive; each consisting of about 10 couplets. A complete concordance of the text (over 71,000 words) produced nearly 4,000 pages of Persian. We have also been working on concordances of Greek drama. One play, Euripides' Bacchae has been completed on Atlas, but the others, all the works of Aeschylus, Sophocles, Euripides and Aristophanes are to be processed on the 1906A after the closure of the Atlas computer. These concordances will be used for research into the literary style of the authors.



Susan Hockey drawing a Greek β on the VT15 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 SD4020 microfilm recorder. Susan is a member of the Applications Software Group at the Atlas Computer Laboratory.

The advantage of our method of printing non-Roman scripts is that the same method can be used for all of them. Already we have Hebrew and Armenian character sets available and work has begun on Russian. To show that the same basic method can be used for non-alphabetic scripts, we have experimented with some cuneiform, which is syllabic, and some Egyptian hieroglyphs (illustrated above) which are a mixture of phonetic and ideographic characters.

the computer laboratory is changing



In the picture is the Atlas Laboratory's PDP 15 interactive graphics display machine which is used for generating animated films.

J Howlett

All the Council's Establishments have computers. With the exception of the Atlas Laboratory, however, computing is not their main business but just one of a number of means by which they attain their real objectives. The computer is such a powerful and versatile device, and possibilities for applying its powers so wide, that it rapidly becomes indispensable wherever it is installed.

At the Atlas Laboratory our business is computing. Of course, the computing is still only a means to an end, but the ends are outside the Laboratory – in other parts of the Council, in other Research Councils and Government organisations and, most of all, in universities. We exist to give computational support, in its widest sense, to research and development projects carried on outside the Laboratory. We also have our own research and development projects whose aim is to improve and widen the scope of this support.

Recently the Laboratory has been reassessing its role and, as a result, has embarked on a change of policy. To explain this a little history is necessary. We were set up in late 1961 as part of the NIRNS group: at the time the universities were badly under-provided with computing resources and many research workers had a near-desperate need for some real power. The Laboratory's terms of reference were such that we could give computing support without charge, and with very little formality, in pretty well any field. All we looked for was an assurance that the work could not be done on the university's own computer and that it had been planned and programmed with reasonable efficiency.

'We set a new standard . . .'

We started a regular service in October 1964 with this very open style and, to put it mildly, we have never been short of business. The Atlas computer was far more advanced and powerful than any machine then available to university people in Britain – or in Europe, for that matter. The staffing, equipment and organisation of the Laboratory were equally far beyond anything in the universities.

I don't see any reason to be coy about this; we set a new standard, and we have had the satisfaction of seeing it followed by the universities when re-equipping their own computer centres since.

The climate now is very different from what it was when we started. In 1966 a Joint Working Group on Computers for Research published a report (the "Flowers Report") that displayed the university situation very clearly and set out a programme of re-equipment. As a result the Computer Board was set up, and to date has put about £28M's worth of machinery into university computing centres. British universities, taken as a whole, are now as well equipped as any in the world. In these new circumstances it is natural – and necessary – to ask if there is still a need for a central service of the kind which we have been providing. The conclusion which we (and our masters) have come to is that there is most certainly a need but for a different kind of service: one that the Atlas Laboratory is well designed to provide.

There are several parts to the argument. Take first the need. In many important but difficult theoretical problems – the study of atomic and molecular structures or the prediction of observable properties of substances from atomic data, to name two examples – progress can only be made with the help of computers. There are many research groups with ideas for tackling such problems. They need great computing power, special ancillary hardware (such as visual displays of output) and special software. Most important of all they need to know that they can use the resources for quite long periods if their project is going to take two or three years or more to complete. It is this kind of support that university computer centres find difficult to provide. People from all over the university want their services and they must respond to them.

freedom to choose . . . a new style

Here the Atlas Laboratory has two great advantages. One is that we are not tied to any single institution, discipline or project, and therefore have freedom to choose what we shall use our resources for; the other is that we are part of an organisation – the SRC – which has powerful machinery, in the form of its Boards and subject committees, for assessing research projects in the whole field of pure and applied science.

When we put all these arguments together, the right rôle for the Laboratory becomes obvious. We should support research workers whose needs cannot be met by their own university; but because we are committing scarce and expensive resources, perhaps for a long period, the project must be able to stand up to the scrutiny of Council's experts. What this means is that applications for computing support are treated in just the same way as any others made to the Council but the grant, if given, is not one of money but of time on one of our computers and, perhaps, other resources.

An applicant might be awarded an input/output terminal so that he can use the computer from a distance. We have several already, such as the card-reader/line-printer in Professor Burke's Department of Applied Mathematics in Belfast, through which he and his colleagues use about ten hours a week on the ICL 1906A.

If the application has got through the Council's mill we can be assured that our resources are being used on work of good scientific quality. And the research worker can plan his project with the assurance that he will get the support he has been promised, and will not have to worry about being squeezed out when he is only half way through.

This is all quite simply stated, but it describes a really important change in our method of working. It should mean that the resources of the Laboratory are used in a more positive way in support of scientific research. One cannot of course switch to a new style of working overnight, and the transition is bound to be gradual. But we are already very much into the swing of it and everything seems to indicate that we are providing what is wanted, just as we did in 1964.

Dr J Howlett CBE is the Director of the Atlas Computer Laboratory.

Daresbury runs faster with IBM 370/165

Trevor Daniels

After four years of service, the IBM 360/65 main computer at Daresbury Laboratory has been replaced by a system based on the much more powerful IBM 370/165. In addition to a much faster processor, this system includes new tape drives, new disk drives and a new fixed-head file, all of which are faster and hold more data than their predecessors. The new tape drives are self-loading, which makes tape mounting faster and gives the operators more time to attend to their many other pressing duties. The new disks and the fixed-head file give the system about 850 million bytes of one-line storage compared with about 500 million bytes available to the 360/65.

The new hardware can carry out extensive checking and corrections and can detect and automatically put right many errors that would have proved fatal to the running of the 65 computer. This facility is very important to Daresbury Laboratory where the many on-line links demand a high reliability. We hope that the new features will make the 165 system even more reliable than the 65 has been.

Users have already benefitted from the improved turn-around time, but as the new system is controlled by the same number of operators the volume of card and paper handled had to be reduced before we could make full use of the power of the new system.

getting things done . . . on the spot

To achieve this we have made two important changes. The first was to provide a Users' area within the main computer hall, containing a card reader and card punch machine. This is separated from the main computer mach-

continued on next page

London Office joins in

Lawrie Wright

There is still perhaps a tendency for those in the "outside" world to regard administration in government bodies with faint amusement: thoughts, no doubt, of rigid hierarchies, high wing collars and quill pens spring to mind. Ridiculous of course but it is as well for us to remember these days that those who don't adapt tend to slide backwards at a faster and faster pace. Clearly, as administrators concerned with the business of research, we in SRC cannot afford to foster an image of old world charm.

Computers are modern tools that, used intelligently, can assist the administrative task enormously. A project is now under way in London Office to provide a data processing service for the staff dealing with research grant applications. It will also be capable of dealing with the vetting and payment of claims under the grants after they are made.

We have the use of time on ICL 1906A computer at the Atlas Laboratory through a remote terminal installed in an office on the fifteenth floor of State House.

Plans and specifications prepared during the last year were tested with a pilot run in the past few months and now the 'parallel running' stage (the new and the existing systems operating together) has started. Student awards work will be the next area to receive attention.

It is worthwhile to try to remove the drudgery associated with any repetitive process. In large administrative systems most transactions are perfectly straightforward – cheques in a bank, proposal forms in an insurance company, orders and invoices in private companies, and so on. They offer no challenge to the people processing them, other than to get through them as quickly as possible, and are the ones best handled by computers. The more unusual cases, those that are rejected by the computer because they do not conform to the sets of rules that the computer applies in each case, are the ones best handled by people. And because the cases are unusual, and therefore more interesting, there is greater satisfaction in dealing with them.

The idea that large numbers of staff can be replaced by computers has not much currency these days. Most suitable work for computers (usually large volume processing) has been mechanised in some way or other over the years to a point where the introduction of computer processing is merely the next logical step. And now that there are data-processing machines sophisticated enough for smaller scale operations, they may be used to increase operating efficiency and capacity, rather than just to make savings.

Staff in London Office will find that their jobs change as the potential of the computer system makes itself felt. I think that the change will be for the better.

Lawrie Wright is a London Office O and M Officer assigned to the 'computerisation' team.

Daresbury's IBM 370/165
continued from p. 11

inery and the operators by a job reception and output desk. If a job has to be corrected it can now be passed quickly to the user who can correct it on the spot and return it over the desk or through the users' card reader. The main card reader and line-printers are close to the reception desk so that movement of cards and output is kept to a minimum.

The second change will have a more widespread effect. This is to encourage the greater use of interactive terminals in developing programs and feeding in jobs. The 65 had only a few terminals and their use was limited by the power of the central processing unit (CPU) and the capacity of main storage. The capacity of the larger and more powerful 165 makes it possible to have more terminals and allow them to be driven by the IBM Time Sharing Option. This is a set of programs designed to assist the terminal user in carrying out much of his normal interactive work such as file interrogation and editing, program development and compiling, and job submittal/retrieval, as well as helping to debug programs by providing interactive aids which may be used while the user's program is running.

The user has a choice of terminal, either an IBM typewriter (for typed output) or a TV-like display which is more useful for file interrogation and editing.

The users found the installation of the new system almost painless. The 65 was in operation right up to the time the new hardware was ready and this was installed and the computing service reopened within a short time. Since the operating systems and programming languages of the two computers are compatible, most users have been affected only by the dramatic improvement in the service.

Dr Trevor Daniels is in the Computer and Electronics Division of the Daresbury Nuclear Physics Laboratory.

. . . and improves the estimates

This year, for the first time, the SRC's Estimates for the coming financial year have been produced by computer. A FORTRAN program was specially written for the purpose and has been successfully run on Atlas via the remote terminal in State House.

The aim of using a computer for this job was to eliminate as far as possible the tedious and error-prone manual reworking of the Estimates which goes on from the beginning of November, when the first draft is submitted to DES, until some time in December: in 1971 six versions of the Estimates were submitted during this period. When work like this is done under severe time pressure it is all too easy for small errors to occur which are extremely difficult to track down, if indeed they are discovered at all. The worst situation which can arise is that an error is overlooked by Finance Division's Estimates Section but spotted by DES: then it's back to square one!

Interestingly, when the program was tried out using last year's figures it could not reproduce the 1972/73 estimates: some errors had crept in which nobody had spotted, and some of the figures had to be amended to persuade Atlas to produce the "right" result. What Atlas unfortunately cannot be persuaded to do, and nor can the 1906A for which the program is now being adapted, is to knock up a set of Estimates from the crude data submitted by the Establishments. So there is no prospect at present of replacing the bulky wads of estimates forms with a couple of punched cards.

J A F

Plugged in

Picture shows Dr Eric Dunford at the Radio and Space Research Station using one of the teletypewriters connected to the Station's ICL 1904A computer in multi-access mode. By this means he can develop his own programs on line to the computer at the same time as it is running other jobs in batch mode.

See Barry Martin's article below.

GEORGE handles the data

Barry Martin

The ICL 1905 computer installed at the Radio and Space Research Station in 1967 was the Station's first large computer. Its prime task was to calculate the orbits of artificial satellites, but once the computer was operational research workers at RSRS began to find out how it could be used to solve other problems; in particular those associated with radio wave propagation in the troposhere and ionosphere. Later, as more experiments were flown both by rockets and the new artificial satellites, they were faced with an enormous number of results to analyse.

In 1970 because of an all round demand for more power the 1905 was upgraded to a 1904A. It was one of the first 1904A systems to be delivered and probably the first on which the GEORGE 3 operating system was used for an entire workload.

GEORGE 3 is a system that allocates jobs to the computer in such a way as to make the most efficient use of the computer time and facilities. It took a lot of thought and hard work to prepare; many special programs had to be written to tailor it to suit users and operators. Most of the programs are commands, known as 'macros', written in GEORGE 3 language. The macros do away with the need for users to learn the command language and some of them have been written with the operators in mind – some written by the operators themselves – to simplify the operation of the computer. They have saved a lot of time and effort.

On the satellite side the Station

Dr B R Martin is Head of the Division responsible for Space Systems Analysis and Computing facilities at RSRS.

GEORGE continued

has become more involved with many large scale computer projects and has now formed a new division under its Space Science Services devoted to systems analysis and computing for space science. The division's work opened with the processing of data from the Ariel 4 (UK) satellite (launched by NASA in December 1971): work that was shared with the Atlas Computer Laboratory.

commanding attitude

The satellite is carrying four experiments to measure waves and particles in the ionosphere, to be used in studies of their interactions. The data are telemetered from the satellite to NASA ground stations, recorded on analogue tapes (as continuous signals) and sent to RSRS. RSRS then convert them to digital form for the computer to analyse, to remove spurious errors and take out faults that have arisen while digitising. The cleaned-up tape is then sent to ACL for scientific analysis on the larger 1906A computer.

At present RSRS are setting up a Satellite Control Centre for UK 5, which should be launched in April 1974 (for details see J F Smith's article in Quest 5, 2 p. 11). The Centre will control the vehicle and the experiments it carries, and will collect and process the data for the experimenters. Since the experimenters will need to have a 'quick look' at their results within an hour from the time they are telemetered from the satellite, about a quarter of the information will be processed in near real time. The rest will be processed and sent to them within 48 hours.

The Control Centre will contain three PDP8 computers and peripheral equipment. One of them will be used solely to send commands to the satellite, through NASA data links, and to collect data. This one will be linked to the 1904A computer so that complicated calculations such as attitude reconstitution can be made almost immediately. The second PDP8 will transmit data to the experimenters, including information on the satellite's orbit and attitude, through the Post Office Datel 600 Service. The third computer will provide a back-up service to the first two and will be available for post-launch program development, as required. It is hoped that the complete system will be ready by this April.

For another large project: the International Ultra-violet Explorer (IUE) Satellite, RSRS is associated with the Astrophysics Research Unit (now administered by RSRS) and University College London (UCL) in providing the camera systems for an echelle spectrograph. The satellite is due to be launched in December 1976 and will measure the ultraviolet spectrum from Stellar sources.

RSRS have installed an Interdata 70 computer at UCL, and will write computer programs to calibrate the camera system (before launch) and to process the spectra information as it is telemetered to earth. Our main software task however is to write complete programs for post-launch data reduction which will, in effect, clean up the 'picture' received. These will be on the VICAR (Video Image Communication and Retrieval) System which was written by the Jet Propulsion Laboratory at Pasedena for processing pictures of Mars sent back by the Mariner spacecraft. The main object of these programs is to remove noise, enhance the image and generally clean up the 'picture'. The program was originally written for the IBM 300 range of computers so RSRS have installed a link to the IBM 360/195 at Rutherford Laboratory in order to speed up program development.

the pattern changes

The growth of computer applications to the work at RSRS has added a lot of interest; and the large collaborative projects that we have become involved with have presented new challenges. Since our first large computer arrived, the applications have been continually changing. Initially emphasis was laid on solving theoretical problems in mathematics and physics. Then the data analysis side grew and we had to cope with the problem of doing it on a large scale. Now the emphasis is on handling and transmitting data in near real time. We look forward to dealing with even more interesting and varied applications in the future.

nutcracker 11 – quorum

When the members of the Civil Service Institute had voted for their new Committee, they found (naturally enough) that they had simply elected each member of the old Committee to a new post. Thus Redbreast had been elected as Committee Member, having been nominated by the outgoing Treasurer, while the outgoing Committee Member had been elected to the post vacated by Gideon. The outgoing Secretary had been elected Whitley Representative, while Coutts had been elected to the post vacated by the man who took the post vacated by Hartfee. Ferguson had moved to the post vacated by the man who moved to the post vacated by the man who had been elected Chairman. Who is the new Secretary?

answer on p. 6

PC

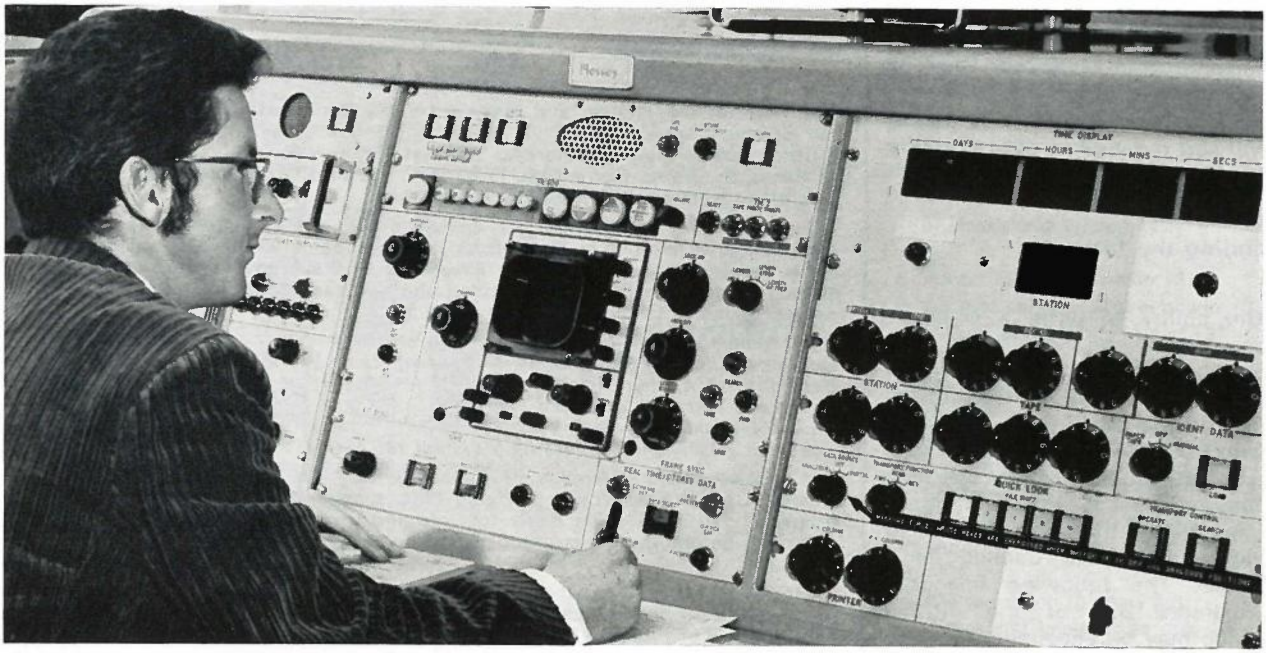
crossword solution – maxim 1

(Vol. 5, 4 p16)

Prizewinner and maxim 2 are on page 17.

Across
1 Solar eclipses
7 Indisposition
8 NASA
9 Punch
13 Elated
14 Galaxy
16 Sunny
17 Pair
19 Inner Mongolia
20 Young's Modulus

Down
1 Science Policy
2 Lodestar
3 Risk
4 Chorus
5 Pitch
6 Sensory Organs
10 Clan
11 Beau
12 Parallel
15 Inform
16 Stern
18 Aged



Name dropping doesn't help

Picture shows Brian Murphy at the control desk of the satellite data processing equipment, at the Radio and Space Research Station, *see article on p. 13-14. (ICL photograph)*

Both Arthur Clarke and Stanley Kubrick are said to have expressed surprise when it was pointed out to them that the name HAL given to the computer in the film "2001" could be obtained by a mild encipherment of the letters IBM. I don't suppose that anyone asked them if HAL might stand for **H**owlett's **A**tlas **L**aboratory, but that would have been wrong as well. HAL was in fact an acronym for **H**euristic and **AL**gorithmic, which is supposed to mean something to people who know about things like that.

The trouble with using acronyms as widely as we do is that one begins to see them where they don't exist. When the **S**igma/**A**tlas **M**ulti-access System breaks down and one is advised by one of the old hands to "Ring SAM" one automatically sees the connexion.

(I hasten to add that the System in fact rarely breaks down, at least not without good reason. The usual good reasons are:

1 Sigma is not working.
2 Atlas is not working.
3 The telephone lines are not working.
4 The modems are not working.
5 The remote console is not working.
6 Somebody pulls a plug out while **you are** working.)

Only that isn't the connexion. SAM – sorry – Sam is a person I mean a **real** person who is very helpful to people using the multi-access systems. I must confess that even after talking to him I did just wonder whether Atlas had perfected a Turing machine (Sigma Android Manipulator?) and given it a Berkshire accent but reliable sources assure me that he's Sam Harris and he is really real.

HAL's name wasn't really HAL at all, of course. He/It was actually HAL 9000. The days when computers had proper names seem to have gone. MERCURY, TITAN, and ATLAS are from a bygone age. And what of Joe Lyons' computer LEO?

Perhaps it is only natural justice that computers should be depersonalised and known only by numbers but it can be very confusing for mere humans. I don't find it hard to imagine the Council discussing one of those tortuous schemes put up by the nuclear physicists for saving themselves money whereby they take an old computer from RHEL and trade it in against a new one for DNPL, then give the old DNPL computer to University A, thereby saving rental which they capitalise and use to purchase peripherals to replace the rented ones at University B, then use the Green Shield stamps they got on the last deal to buy more peripherals for RHEL. After about ten minutes of this no one will be quite sure whether the new DNPL machine is a 360/175 or a 370/165 or whether the alternative proposal to buy replacement machines for universities involves four 125's or two 145's. It doesn't really matter though: the Council Secretariat will sort it out when they write the minutes.

finding the formula

The ability to write a coherent account of an incoherent discussion is one of the skills which staff at LO have to develop. It may seem a small thing compared with knowing how to work a particle accelerator, a telescope or a computer, but it is probably more fundamental than any of these to the work of the Council as a whole. The following anecdote illustrates one of the pitfalls which may be encountered in exercising it:

When Council discussed the Five Year Forward Look last year a good deal of time was spent in considering when provision should be included for the third large computer at Atlas Laboratory. Afterwards, there was some disagreement among senior officers as to what the decision was. One view was that Council had said "as early as possible" while another argued for "in 1974". The minutes record the Secretariat's compromise solution: they read "as early as possible in 1974".

J A F

nil desperandum

The heart of the layman and taxpayer is gladdened when he reads of all that the Sciences are doing on his behalf in the line of extensive researches. It is a little disappointing therefore to see that that worthy publication entitled "List of Research Grants Current on 1/10/71" slid into circulation without so much as a bleep from our public relations hierarchy.

Let us therefore correct this omission and allow our non-scientists such satisfaction as is open to them from knowing that after random selection from some thousands of others, such researches as the following are actively going ahead on our behalf. (We commend the accuracy in estimating costs to the nearest £ unit but why not to the nearest 1p?).

Road behaviour of a car in response to steering	*£23,321*
Determination of Susceptibility of Passengers to Vibration	*£14,474*
Behaviour of Anchors in Clay	*£16,679*
Noise and vibration on board ship	*£23,508*
Fluid Mechanics of Wet Steam	*£9,907*
Effect on Passengers of fast long distant rail travel	*£11,080*

Are these classic examples of "passing the buck" in that neither Admiral Nelson, George Stephenson or Henry Ford appear to have done their homework properly? Fortunately, its never too late and perhaps these deficiencies can be put right before those new fangled mediums of air and space travel catch up with us.

However, in case you should fear that the animal and bird kingdoms are left out in the cold, let us commend to you current valuable researches such as:—

Neural basis of classical conditioning in the Turtle	*£8,629*
Genetics and sex behaviour of the Mouse	*£9,724*
Mechanical design of a Frog's leg	*£5,104*
Endrocine control of Canary reproduction	*£4,110*
Drought resistance in Eggs of Chirocephalus Diaphanous	*£4,771*
Monograph of Fleas of the World	*£2,000*
Control of feeding and drinking in the Barbary Dove	*£21,992*
Control of the Cat's Sex Life (2 researches)	*£30,567*

There are no prizes offered as to winners in the above contest, but we can only presume that the Barbary Dove and Domestic Cat are hot favourites as they carry highest stakes. Perhaps we shall soon know what 'Cats on a Hot Tin Roof' really get up to.

The biggest slice of the cake goes to Computer Research and Development. One day it might even happen that this very costly and much misused Caliban will eventually be tamed and put in its rightful place, but perhaps not until the slice of cake is considerably cut down.

Finally, let us spur on to greater efforts and support for such causes as:—
"22 Paracylcophany Radicals and Homolytic substitution of mono-substituted 22 Paracyclophanes" *£4,611*
because we may need to learn to ride a bicycle one day – unless all that verbiage means something entirely different.

Philis Tine

blow that for a lark

When Peter and John saw QUEST's birthday cake with 21 candles they couldn't resist using it as the basis for a competition.

"We'll take turns at blowing the candles out," said John. "Whoever blows out the last one loses and will have to explain to the Editor why her cake is covered in grease."

"But how many can we blow out at a time?" asked Peter. "If it's as many as twenty the game will be over rather quickly."

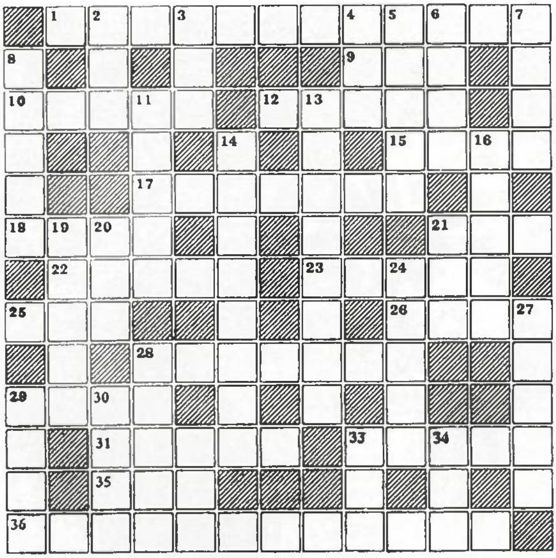
"We'll fix the maximum number," replied John. "We can blow out less if we like; but not less than one. I think the maximum should be more than two or I may run out of breath before we've finished."

So they picked a suitable number at random: Peter had first go and blew out the maximum number of candles. John had to apologise to the Editor.

Assuming that each of them used the best possible strategy, how many candles were put out by Peter's first blow? *Answer on p. 6*

ties to tie

Why don't we have an SRC tie? Competitors are asked to design one in a serious vein or satirical or say why we want one. Drawings should be black on white (suitable for publication) and descriptions or comments must not exceed 100 words – of prose or verse. The Prize is a £1 book token but a good design might also be taken up as a good idea – so it's up to you.



crossword

maxim 2

The first correct answer opened gains a £1 book token. Send entries to *Quest* at London Office not later than April 16 marked 'CROSSWORD'.

The winner of maxim 1 was J H Richards of LO.

Quest apologises to those who were caught by the early entry date.

Across

1 Encountered half a light-quantum in a code that's to change (12)
9 What's drunk in Bordeaux (3)
10 Bring forth (dog-eared) SOS for tungsten (5)
12 Photos of a kip on board (5)
15 Sir Robert's skin (4)
17 (7)*
18 Given for a while before Easter (4)
21 Rueful to worry without alternative (3)
22 Fake's real? A ruby, maybe (5)
23 (5)*
25 Urge that goes with chips (3)
26 Ted's vortex (4)
28 They appear in spring, disappearing in October (7)
29 Dash that could be written with Biro (4)
31 Sugar sometimes goes with a pop (5)
33 Give help to a good chap, though stuffy (5)
35 Upset French bird (3)
36 Rent-payers make irregular holes in Heath and Wilson (12)

Down

2 Found in every woman (3)
3 Current value of steam-power (3)
4 One of twins when in pod (3)
5 (5)*
6 Nothing oriental about American river (4)
7 Vile sort of characteristic (4)
8 It's dreadful and illegal to be beheaded (5)
11 They help to make footwear that endures, presumably (5)
13 (8)*
14 It's too much to bear, but distraught lover takes zero notice (8)
16 Half-undeterred, went wrong (5)
19 Regal variation (of Nimrod?) (5)
20 Continually criticise a horse (3)
21 A rising condensate is joined (3)
24 Uproot trees, and put back again (5)
27 Lots say R & D is in a mess (5)
28 Comes back in a miasma of bubbles (5)
29 Evaporate a seat of infection (4)
30 One with nearly costly notion (4)
32 Owing tax (3)
33 Poor 33 Ac., losing its titanium (3)
34 Song of O_2 and N_2 mostly (3)

** The answers to 5, 13, 17, 23 spell out a message.*

What's in a name

by our Etymological Correspondent

Many newcomers to State House have speculated on the origin of its name. It derives from the Old English word 'stede' or 'stead' meaning a farm. It is on record that in the 14th century the present site of State House was a farm lying just outside the western extremity of the City and no doubt providing the wealthy burghers who lived there with fresh milk and other country produce. At this time it was ecclesiastical property and quite possibly was deeded to the Church by some local minor noble who wished to escape his feudal duties to the King.

This must have occurred before the passing of the Statute of Mortmain in 1279. On the dissolution of the monasteries the property was bought by John Worthing, at that time Alderman of the Ward of Cheapskate and later in turn Master of the Worshipful Company of Whoremasters and three times Lord Mayor of London. In his will, which is still preserved at Stationers' Hall, he left the farm to his heirs on condition that 'there shall forever bee pafture for scheep and cowes'.

This condition remains in force even today and it is for this reason that, although a large building has been erected on part of the site and most of the rest has been paved, a number of plots of grass are still preserved and hurdles are kept in readiness to pen in any stray animals which might some day appear to take advantage of good John Worthing's 400-year old benefaction.

the great exhibition -1972

Seen right the solid gold mask that covered the head of the mummy of King Tutankhamun

photo by courtesy of the British Museum

F V Bale

I suppose that we started queueing about 9.30 am, after following a signed detour from Tottenham Court Road station presumably intended to get you to the end of the queue – with hindsight we would ignore it. In the road outside several shabby little men were selling the *Evening Standard's* Tutankhamun Supplement, a collection of "historic" pictures and headlines, such as "Tomb Sensation!" One had visions of the mummy having changed its sex, or a compromising cartouche found on the catafalque, but no – it continued: "Mummy Stuck when Removed from Tomb". How kinky can you get? We didn't buy one.

We expected a repetition of the business of going to see the Crown Jewels – a three hour wait in rows of ten followed by a quick glimpse as one passed by them at a sort of rough jog-trot – so we were relieved to get inside after only one and three-quarter hours, spent mostly in the yard and under cover. We were quite happy to keep moving and to read the handbook, which was just as well, because inside there were crowds, poor light, and constant exhortations to "move on slowly ladies and gentlemen, that's all we ask, remember the people waitin' be'ind!" It took another hour and three quarters to get through; often one was waiting to be admitted into the next room. There was plenty of time to look around.

The handbook was a superb production at 75p, with magnificent photographs that sometimes did the exhibits more than justice. One could buy a short catalogue little more than a list – which was more useful inside. I thought the lighting in some cases could be improved: mostly it was overhead and sometimes the sides were poorly lit, although there were mirrors in one or two. Each case had a thermometer/humidity meter, and perhaps too much lighting was not desirable. It was very hot.

the man from Texas

The crowds were a real problem; one Texan gentleman wanted to get out because he "felt the call o' nature" – I suppose it's all those open spaces he was used to – and announced that if he couldn't get out forwards he'd jest have to go backwards. I suggested that he was just making difficulties for himself, and he did offer "if you jest stay right there" to tell me a thing or two when he got back.

Room one had many small exhibits, in cases rather too close together for the number of people wanting to see them. For us it was made more difficult by two different queues going in opposite directions under the mis-guidance of two uncorrelated custodians. "It'd be easier to look after a battalion!" said one and I believed him. I wouldn't have his job for £10K a year!

There was a striking figure just at the entrance: a wooden statue of Tutankhamun in black and gold, about life-size (1.73m). Then a number of exquisite small items – a model of a typical ceremonial barge, alabaster unguent vases, a painted alabaster casket, a model of the canopic coffin of beaten gold inlaid with glass and carnelian – (really beautifully done in miniature) – an effigy of the king on a bier with a falcon and the human headed bird (Ba) – wooden effigies of the king and of the god Ptah standing (apparently) on a bootblack's box, which turned out to be a plinth of the shape of the sign for "Truth". It was the precision of the miniature work which we found most surprising – it would be hard to beat even today.

One moved on to a black-and-gilt head of the sacred cow, and the "bed of the divine cow" supported by two beasts whose length suggested inter-breeding with a dachshund, but not apparently intended for sleeping in, being purely ceremonial. Then the furniture: beautifully decorated stools and chests, a gaming board, a gold staff with a miniature effigy of the king surmounting it, a fan and a standing "emblem of Anubis" of strangely modern design. The state of preservation is truly remarkable, superior to that of much extant furniture of the seventeen and eighteen hundreds. Then there was a small golden shrine with most beautiful relief work on all its sides. These had been photographed, and were shown in panels about five feet high on the surrounding walls, and even with this degree of magnification were still of remarkable clarity and precision. This was workmanship of the highest order by any standards, artistic or technical.

. . . and a boomerang

Some beautiful golden effigies of the king in action, one of which is curiously feminine (tomb sensation?), came next and some truly magnificent jewellery, a trumpet, the crook and flail, a bow and a boomerang. Then finally, there was the pièce de resistance of the exhibition, the mask of solid gold, beaten and burnished, painted and inlaid, which had been placed over the head and shoulders after mummification. One could spend a good time examining this, and indeed we did, because by now most people had had enough and didn't stay in the last room for very long.

A superb exhibition if one is interested in antiquities, and particularly if one is interested in this period, and we felt that it was well worth it, exhausting as it could undoubtedly be. It was a pity that there were no special facilities for old people who found it all much too much.

After lunch my wife went shopping and I went to see the Wallace Collection. It is also a superb exhibition. It is free. There is so much to see that one could easily spend several days in it if one really paid attention to every item; I used most of my time looking at the pictures. There was nobody there at all. Curious, isn't it!

---

mottoes competition result

The number of entries and the standard were about normal for a Quest competition. The range of languages employed was small and we were particularly disappointed that NP Division did not produce its expected contribution in Sanskrit. Perhaps the examples we gave to start things off were of too high a standard, and deterred potential entrants.

Vigile et orare (watch and pray) is obviously appropriate to any observatory but *Lange Locken lei(s)ten* (or L^3) is particularly fitting for RGO at present. *Non multa, sed multum* (not many, but much) is apt for Nuclear Physics, despite continual pleadings of poverty, while *Panta rhei* (All things are in a flux) would suit the Neutron Beam Research Unit. *Ut tensio sic vis* (loosely rendered as "the strain is showing") is multi-purpose.

Although it was strictly outside the terms of the competition we felt we had to accept the suggestion that the Civil Service Commission adopt the motto "Many are called but few are chosen": it clearly represents a cry from the heart.

Honourable mentions to all the above, but no prizewinners this time.

Quest's BIG PRIZE competition

Quest thanks authors who have sent in articles recently. Since some of them will not appear until the next issue (for lack of space) – and in case they were written with the prize in mind – the winner will be picked from three issues instead of two (Vol 5, 4 and Vol 6, 1 and 2) and announced in the one after.

Meanwhile please keep writing; and you might encourage us to award another.

PS from Quest to authors

When we persuade you to write an article of so many words, we mean just enough to outline the subject. The aim of *Quest* is to tell everyone briefly what is going on in and around SRC; we do not try to copy the specialised journals (in science, technology, sport or whatever) that many of us read already. So please don't feel pressed to write a definitive article; we will be pleased to return to the subject to report progress and fill in details.

Quest needs more news and more blow-by-blow accounts of SRC projects and jobs. So if your work is being exhibited somewhere or you are setting up an experiment or working on a new method that might interest other people, please tell your local *Quest* correspondent; also if you are Angler-of-the-year, etc, or known who in SRC is.

PS to picture-makers

Quest wants more pictures of people at work or off, and more illustrations (diagrams) of experiments and results. We are also interested in comment expressed in cartoon drawings and in art for art's sake in the form of photographs or line drawings. We can use anything black and white and can make b & w prints from colour photos. So if you are handy with camera, felt pen or set square and compasses, please consider *Quest* as an outlet for your talents.

the light at the end of the tunnel

Seen left, three of the hundred scientists who came to Daresbury from all over the world to see and discuss the Synchrotron Radiation Facility ('SRF'). Beside the Wadsworth monochromator, l to r, are: Dr C Kunz from DESY, Hamburg; Dr M Lynch from Perth University, Australia; and Dr D Lynch from Iowa State Univ., USA. Daresbury's SRF is one of only ten in the world and the only one in operation in this Country.

The meeting, held in January, was the first in Europe held specially for people interested in 'synchrotron radiation': the light emitted as a by-product from high energy electron accelerators. Light is produced at all wavelengths, including the visible and a high intensity of x-rays.

It has many research applications in atomic, molecular and solid state physics and Medical Research Council physicists will use it for x-ray studies of crystal structures.

Is your Computer on fire?

We hope not, but just in case it happens you might be interested to go to the Conference on Fire Protection of Computer Establishments on Thursday March 29. The conference will be held at Rutherford Laboratory and is organised by the Atlas Laboratory and the Fire Protection Association.

Speakers will talk about case histories and protection devices. Visitors are expected from other SRC establishments, from university computer centres and fire brigades.

looking at the books *(see caption right and p. 2)*

Seen (left) at the opening of the Crawford Library at the Royal Observatory Edinburgh are: (l to r) Professor H A Brück CBE. Director of the Observatory. Sir Michael Swann FRS who has just retired from our Council on appointment as Chairman at the BBC Board of Governors; Lord Crawford whose grandfather created the library and gave it to ROE (see p. 2); and our Chairman, Sir Brian Flowers, FRS.

newsfront

new honours

We add Quest's congratulations to the three members of staff who received Honours.

H M Smith, OBE, Head of the Time Department at the Royal Greenwich Observatory.

C L Roberts, MBE, Head of Administration at the Atlas Computer Laboratory *(seen far right)*.

A L Jefferies, BEM, Telephone Operator at the Royal Greenwich Observatory.

We are sorry

Quest apologises to W J Parmenter (l) and C L Roberts (r) who got a personality switch in the last issue. It was Mr Parmenter who retired and Mr Roberts who made the presentation (and is also mentioned left).

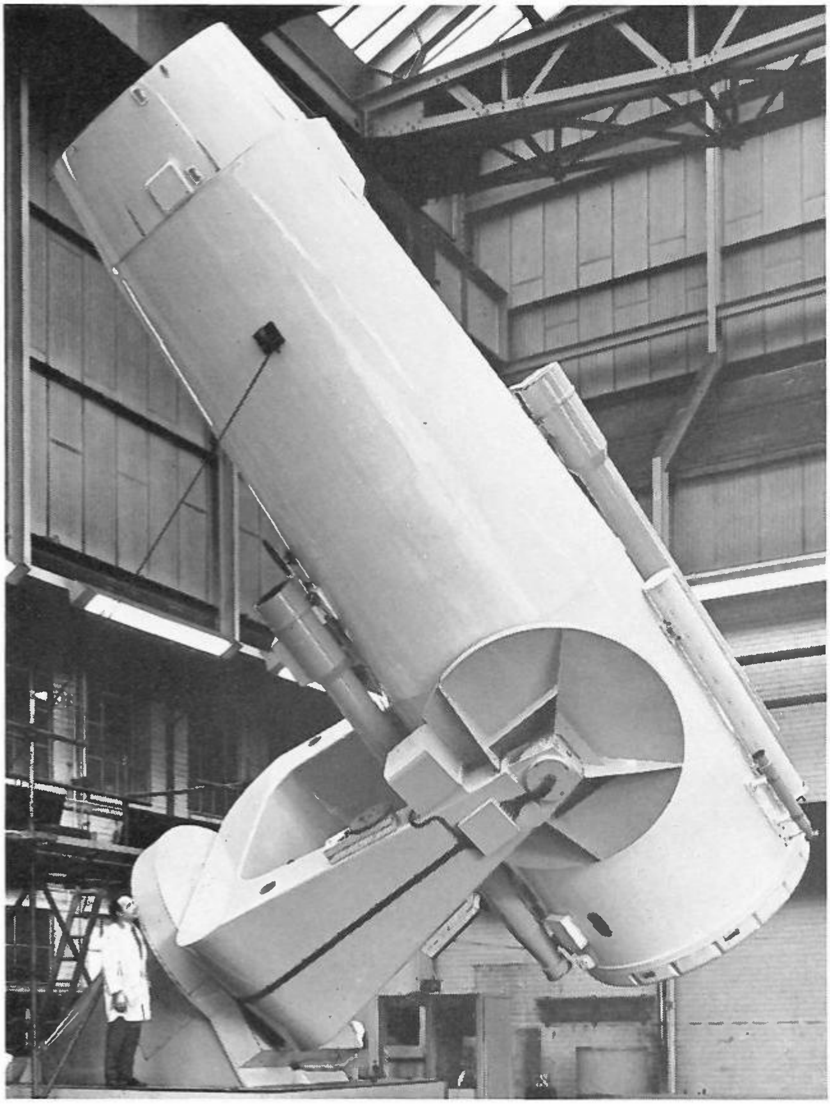
getting ready to sail

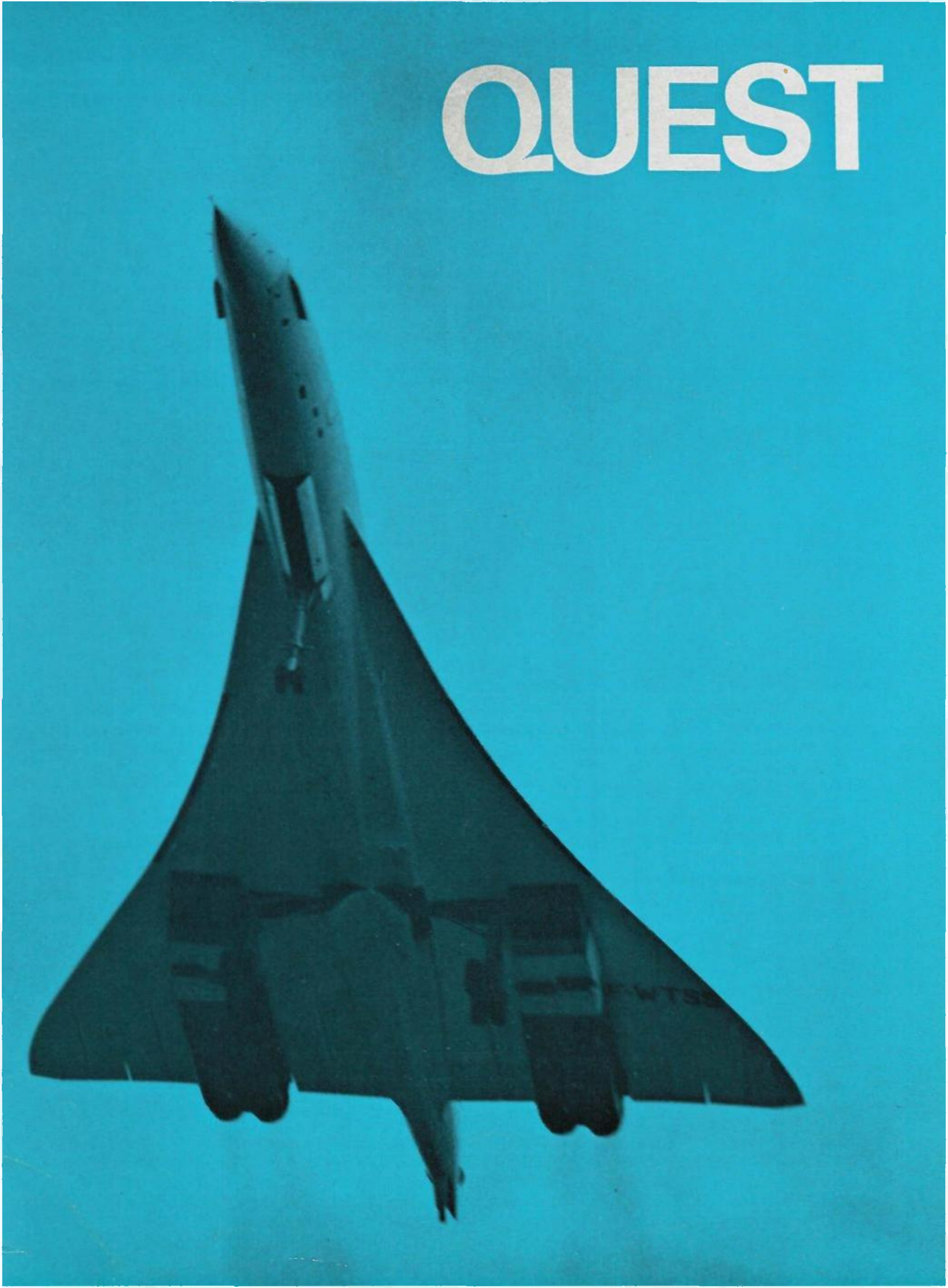
Seen right is the 48 inch Schmidt telescope that Sir Howard Grubb Parsons and Co Ltd have just built for the Science Research Council. It is undergoing final factory trials before being shipped to Australia where it will be put on the same site as the 150 inch Anglo-Australian telescope.

One of the first jobs for the telescope is to complete the sky survey that has been made for the Northern Hemisphere with the instrument of the same type and size at the Mount Wilson and Palomar Observatories. More advanced in design, the power of the new telescope will be extended by the latest automatic measuring machines like GALAXY at the Royal Observatory, Edinburgh.

Dr Vincent Reddish of ROE is the project officer and will be in charge of the whole operation from data collection at the telescope to reduction at ROE and distribution to UK astronomers.

Since each photograph taken on the 14-inch-square plates may record up to a million stars and galaxies, the project team will have a busy time ahead of them.




QUEST

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Vol. 6 No. 2
1973

contents

Concorde takes a moon shot

Cover picture: the French Concorde 001 that will carry scientific experiments to record the sun's eclipse by the moon on June 30 – *see page 13. Photo by kind permission of the British Aircraft Corporation.*

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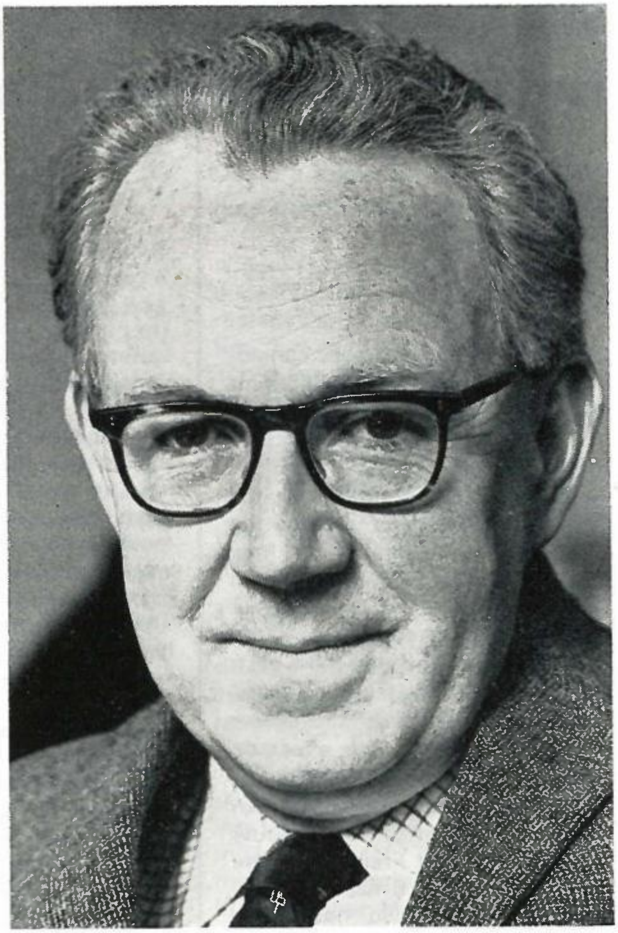
Chairman designate

seen right



Professor Samuel Frederick Edwards FRS who is to become Chairman of the Science Research Council when Sir Brian Flowers FRS leaves on October 1, 1973.

Professor Edwards is John Humphrey Plummer Professor of Physics at Cambridge University. He was educated at Swansea Grammar School, Gonville and Caius College, Cambridge, and Harvard. Before being appointed to his present position he held posts at Birmingham and Manchester Universities. He was elected a Fellow of the Royal Society in 1966 and has been a Vice-President of the Institute of Physics since 1970. He served as a member of the Council of the European Physical Society from 1969–71. He has been a member of various committees of the Science Research Council since 1968 and of the Council's Science Board since 1970. In 1971 he was appointed a member of the University Grants Committee.

Professor Edwards' interests lie mainly in chemical physics where he studies the properties of rubbers and plastics, basing their properties on their molecular architecture. He also has an interest in the application of modern theoretical physics to industrial problems, and has collaborated in the study of problems arising from reactor design and plasma physics.

Professor Edwards is 45 years of age, married with three daughters and a son, all teenagers. He lives in Newnham in West Cambridge. His relaxations are found in gardening and chamber music.

Is the next epoch 'EPIC' for Rutherford and Daresbury

Joint studies are now being undertaken by the Rutherford and Daresbury Laboratories on the design of a very large particle accelerator complex for future use in this country. At the same time, the high energy physics potential is being analysed in detail by various working groups involving both university and SRC staff.

The name EPIC stands for ELECTRON PROTON INTERSECTING COMPLEX. The basic difference between EPIC and the existing accelerators at RHEL and DNPL is that EPIC could have collisions between high energy particles that are moving in opposite directions, whereas in both Nimrod and NINA the high energy particles are fired into stationary targets. A much greater energy becomes available in the centre of mass of the system, leading to a new range of physics.

Such colliding beam devices are commonly known as Storage Rings and many are operating successfully around the world. At CERN there is the ISR which provides for proton-proton collisions, with incident protons of energies up to 30 GeV.

The EPIC design considers a system that first accelerates and then stores the particles. The types of particles to be stored are electrons, positrons, protons, and possibly deuterons. The complex will have a long-term development potential.

Two distinct possibilities are under study for a first development stage. In the one there is provision for collisions between electrons and positrons, both with incident energies up to 14 GeV. In the second there is provision for collisions between electrons and protons, with incident electron energies up to 14 GeV and incident proton energies up to 100 GeV. A single main magnet ring is adequate for the first possibility, but a dual ring is required for the second.

The feasibility study of EPIC will continue through 1973, and if the conclusions reached are favourable, a detailed design study will be proposed.

We join France and Germany for intense neutron beam research

This article is based on the one by Harry Norris published in the Rutherford Laboratory Bulletin 3/73.

Last year the Government considered the various possibilities of new high flux neutron facilities and decided that the interests of British scientists could best be served by collaborating with the French and Germans in using the new reactor at the Institut Max Von Laue, Paul Langevin (ILL) in Grenoble. In December an agreement was reached whereby the SRC became a full one-third partner in the Institute.

Under the terms of the agreement, which came into effect on January 1 1973, the Director of the ILL will be alternately German or British, one of the two Deputy Directors will be French and the other alternately British or German. SRC will also have one-third representation on the Steering Committee whose chairmanship and vice-chairmanship will rotate between France, Germany and the United Kingdom. In addition, a fair share of other posts will be available for British people, preference will be given to the placing of some contracts in the UK and it is agreed that any new source of intense neutron beams which the partners may decide to provide for the purpose of their collaboration will be built in the UK.

SRC will be responsible for one-third of the running costs of the ILL. This will be rather under £2,000,000 a year at current prices and exchange rates. We will also contribute about £1,000,000 a year (in real terms) for ten years towards the capital cost of the ILL reactor.

Interest in neutron physics is not new but until now the lack of suitable high flux facilities has greatly curtailed the amount and variety of research that could be undertaken. The flood of good research proposals that followed the decision to negotiate showed the interest that British scientists have in this field. Forty-seven of them were considered at a special meeting in October, thirty-five were accepted, and the rest can be resubmitted in later rounds. The first of them, from Reading, had a short run before the reactor was shut down for four weeks in mid-December, and several others are now under way.

This has all meant intensive and interesting work for the Neutron Beam Research Unit (NBRU) at the Rutherford Laboratory, led by Dr L C W Hobbis. NBRU has overall responsibility for the SRC/UK end and has concentrated hard on coping with subjects such as instrumentation, computing, experiment proposals, technical liaison and the transporting of samples and apparatus to and from Grenoble. They spared no effort to get things started and achieved a large amount of work in a very short time.

Apart from research on the neutron itself, a neutron source of high intensity like the ILL reactor provides a research tool that has applications in many fields: like solid and liquid state physics, chemistry, biology and materials science. The unique properties of the neutron — no electric charge (which enables it to penetrate matter very easily), and a magnetic moment (which enables interaction with magnetic structures) and, in the case of very slow-moving thermal neutrons, a wave-length roughly equal to the distances between atoms in liquids and solids — are all extremely useful in the study of the structure and dynamics of all kinds of materials.

The Grenoble reactor, similar in design to the Brookhaven High Flux Reactor is of the steady state type and apart, possibly, from the new Dubna pulsed reactor, which may be operating by this time, has the strongest thermal neutron source in the world. The fuel is concentrated in a small core from which fast neutrons can escape with relatively high energies of approximately 1 MeV. The core is surrounded by a heavy water reflector tank, 2.5m in diameter, in which the neutrons are slowed right down to thermal energies (of about 0.25 eV). Some of the neutrons return to the core to produce further fissions there and the rest are used for the experimental programme.

The core itself is constructed of thin plates of aluminium uranium alloy, highly enriched with U235, contained between aluminium plates; the whole system being removable as a single unit when approximately 30% of the uranium has been used up (or after about 36 days of operation at full power). The core/reflector assembly is surrounded by a tank of ordinary water, 6m in diameter and 15m high, supplemented laterally by 1.2m of heavy concrete. The intense thermal neutron flux reaches its maximum (1.5×10^{15} neutrons per square centimetre per second) in the heavy water outside the core at a distance of approximately 15cm from it: it is here that the channels used for extracting neutron beams are arranged. (For further information on the Grenoble reactor see *Endeavour* vol XXXI May 1972, Page 67).

Concrete jackets suit the magnet men

Radiation damage to the insulation of electromagnets is one of the problems encountered in high energy physics experiments. But the Rutherford Laboratory has now come up with a solution.

The electromagnets are essential components in particle accelerators and the ones most exposed to radiation damage. One way to protect them is to use insulation made of mineral materials instead of resins or plastic. So someone suggested cast concrete and although it seemed an unlikely candidate at the time, it was tried.

As a result of the tests they found that insulation systems made of selected cement and aggregate, if adequately dried, could have the required resistance. So they went ahead and eventually produced two prototype electromagents with the new type insulation. One of them, a dipole bending magnet, was built at the Laboratory and the other, a quadrupole focusing magnet, was built by Lintott Engineering Ltd, Horsham, Sussex.

The dipole is now in use at the Daresbury Nuclear Physics Laboratory and the quadrupole is installed at the Deutches Eleck-tronen-Synchrotron High Energy Laboratory at Hamburg. Both are performing well without radiation trouble. The quadrupole in fact replaced a conventially insulated magnet that had been destroyed by radiation after 5,000 hours, and it has already sustained a greater exposure without any noticeable effects. As accelerators are developed to produce beams of higher intensities, the demand for radiation resistant components will grow. Beams now being planned for the Rutherford Laboratory's own accelerator are going to need the new magnets.

IMPORTANT NOTICE

Do you know all about annual confidential reports?

A new report form is to be introduced for general use in SRC to replace the several different varieties that have been used to date. The new form which has been agreed with staff side will assist in achieving a uniform standard of reporting throughout SRC.

As well as retaining the best features of the old forms, the new form incorporates some completely new concepts.

Don't panic; we are arranging a programme of training courses which will give you a chance to discuss the form and check your standards against those of other reporting officers in the same group.

The form will be first used for the P & TO review and the training for this group will take place in June & July. The training for the Administrative Group will be in September & October and for the Scientific Group in November & December.

● **If you are a reporting officer make sure you attend a course.**

Nimrod will get 8 million million more ppp

In November the Council agreed that a new Injector should be built for the Rutherford Laboratory accelerator Nimrod which, it was also agreed, would be kept in operation until 1978 and beyond (see Council Commentary on page 5).

Why a new injector? The present beam intensities extracted from Nimrod are 1.2×10^{12} ppp (protons per pulse) and various improvements are raising this to 2×10^{12} ppp, still using the present 15 MeV injector. However, the range of physics using Nimrod as the secondary particle source could be much extended if the intensity was increased by a factor of 5, up to 10^{13} ppp, or in other words 8 million million more ppp. To achieve this increase, the energy of the injector has to be raised (because of transverse incoherent space charge effects) to 70 MeV.

The new injector should be ready early in 1975 and, for a time, both injectors will be available.

Last year Nimrod's total of good beam time for experimental teams was the highest yet – 5,398 hours – with an efficiency record of 90.5% of scheduled operating time. A record number of protons was accelerated – more than 22×10^{18}–which was twice as much as in 1970 and three times the number achieved in 1968. This is because of the many improvements made to the machine since it was first built – and is also due to the efficiency of the people who run and maintain it.

The new injector will be an Alvarez type of linear accelerator consisting of 4 RF cavities. The design of the 1st and 4th of these tanks is based on corresponding parts of the injector in use on the 200 GeV accelerator at the National Accelerator Laboratory, Chicago. The 2nd and 3rd will be tanks 2 and 3 from the Rutherford proton linear accelerator (the PLA, now closed down), only slightly modified, and where possible PLA quadrupoles will be used and its de-buncher ramper cavity.

More power might cost less

An SRC Working party, led by Mr D Harcombe of the Central Electricity Generating Board, has been looking at university research into Superconducting ac Generators. The use of zero-resistance superconductors, at least in the winding of the rotor, hold a promise of savings in cost, size and weight in the high-power generators of the future.

The working party have published their findings and their suggestions for future research in a report.* They say that while the eventual justification for such generators will depend on numerous economic and development factors, not yet assessable, nevertheless their potential is such that research should be undertaken now into several aspects. They consider that universities are well equipped to do it and that the work offers good opportunities for collaboration with industry and a promising focus for future university research and training. By these means the present UK lead should be maintained and built up.

***'SRC Report on Superconducting ac Generators'.** *Copies available from the Electrical and Systems Committee, Engineering Division at London Office.*

Calling Mr. Chairman . . .

How far off is the day when we can participate in a meeting taking place the other side of the world and yet not leave the office? is it mere fantasy or will the time really come when we have no need to travel even to the office?

Professor Sir Hermann Bondi, FRS, Chief Scientific Adviser to the Ministry of Defence put these questions in his opening address to the Conference on "Satellite Systems for Mobile Communications and Surveillance" held at the Institution of Electrical Engineers (IEE) in March.

Telecommunications was a growth industry and the prospects were almost limitless, he said. But he considered that the greatest handicap to full communications might be our lack of understanding of ourselves, particularly of our reactions to each other. The extension of satellite communication to ships and aircraft was going to emphasise the global character of telecommunications; there was an evident need to introduce world-wide discipline into such operations.

From the discussion that followed a paper presented by D O Fraser of BAC it appeared that airlines were unhappy about the development of satellite systems partly because they felt they had not been sufficiently consulted and partly because they were concerned about the costs that they would have to bear.

On the subject of suitable frequency bands, one speaker said that the choice of L band had been made 2 years ago at the World Administrative Conference. A delegate from the Ministry of Posts & Telecommunications said that 11-14 GHz bands were likely to be recommended for earth station/satellite links.

E J Martin from the US Communications Satellite Corporation (COMSAT) said that a satellite service for the US Navy would open in September 1974. There would be two satellites, one for the Atlantic and one for the Pacific and it might perhaps be possible for the merchant service to use the facilities in the L band.

The 3-day conference was organised by the Electronics Division of IEE, in association with ESRO, IERE, RAS and the Royal Institute of Navigation. The papers are published as IEE Conference Publication 95 at £7.60 (or £5 to members of a sponsoring body).

MSSL senses the ionosphere

The Mullard Space Science Laboratory (MSSL), whose geographical and astronomical research in space is supported by the SRC, currently has an experiment running in the ESRO-4 spacecraft, launched last November.

The spacecraft is carrying five different experiments to study particles in the vicinity of the Earth. The other four belong to the Psysikalisches Institut, University of Bonn, the Kiruna Geophysical Observatory, the Space Research Laboratory Utrecht and the Max Planck Institut, Garching-München.

The MSSL experiment is measuring the density, temperature and composition of ions in the F-region of the ionosphere using three sensors. The main sensor is a gridded, spherical ion-collecting probe (200 mm dia) mounted on a 1.3 metre boom to keep it outside the charge cloud surrounding the spacecraft. Its potential is swept repeatedly from negative to positive voltages so that it acts as an ion mass spectrometer. A smaller probe (10 mm dia) on the same boom, collects electrons as its potential is swept above and below the spacecraft's potential, and variations in the electron current show when the probe is at space potential, thus indicating the spacecraft's potential relative to space – information needed to interpret the mass spectrometer's measurements.

The third probe (100 mm dia) is mounted on a 0.35 metre axial boom and carries a constant negative potential with respect to the spacecraft so that a total ion current can be measured as a check on the constancy of the ion density during each mass sweep of the spectrometer. The measuring circuits have a new feature whereby the output is set at mid-scale at the beginning of each mass sweep so that short period fluctuations of ion current as low as 2% can be detected whatever the ion density.

council commentary

September 1972 to February 1973

Because of Council business that continued over several meetings, the autumn Council Commentary was held over from the last issue of *Quest*. It appears below combined with the commentary for the winter quarter.

Visit to Swansea

The annual weekend meeting of Council members, Board representatives and senior staff was held in September at the University College of Swansea. The meeting reviewed two areas of wide and current interest – Materials Science and Technology and the field of Artificial Intelligence. It went on to discuss international collaboration, particularly in Europe.

Welcome to new Members

In October, the Chairman welcomed Professor H G Callan, Mr J M Ferguson (new Chairman of the Engineering Board), Dr R W Pringle and Professor D W N Stibbs, who were attending for the first time as Council members. He also welcomed Professor Mason and Professor Matthews in their new roles as Chairman of the Science Board and the Nuclear Physics Board, respectively.

Chilton visit

The Council decided to hold the May 1973 meeting at the Rutherford Laboratory and to visit the Atlas Laboratory.

Assessor from DOE

The Council agreed to invite Mr D J Lyons, Director General of Research and Development at the Department of the Environment, to join the Council as an assessor.

Estimates 1973/74

The Council agreed the 1973/74 estimates within a net total of £69.0M. These estimates were based on the forward look approved by Council in April 1972, but took subsequent developments into account. The two major uncertainties in the preparation of figures were the exchange rates to be used for international subscriptions and other major items that involved foreign currency, following the floating of the £, and the effect of increased costs that would arise from the introduction of Value Added Tax.

Forward Look 1974/5–1978/9

In November the Council agreed the financial guidelines which have now been given to the four Boards for the preparation of the 1974-79 Forward Look. Boards are required to make their submissions to Council in April so that the Council-wide Forward Look can be submitted to the Department of Education and Science at the end of April. The guidelines given to the Boards, which vary according to present policies and priorities, are based on the provisional allocation for the Council for 1974/5 and assume a 3% per annum growth rate thereafter.

The Council took note of a submission from the SRC Staff Side concerning the future nuclear physics programme. The submission was relevant to the Council's consideration of the Forward Look guidelines and of some individual projects in nuclear physics.

Postgraduate Education

The Council was informed that the Education and Arts Sub-committee of the House of Commons Expenditure Committee intended to examine official spending on postgraduate education. The Research Councils and DES had been invited to submit evidence and, later, to provide witnesses for examination. There would be a joint memorandum by the ARC, MRC, NERC, SRC and SSRC covering items of common interest and in addition each Council would submit separate memoranda setting out their individual policies and procedures. An SRC team would give evidence to the Sub-committee in April.

Postgraduate Awards

In November the Council confirmed the Forward Look assumption that the number of awards for 1973 should be 3950, an increase of 3% over 1972, and then decided on the allocations to the special schemes and the studentships quotas to Boards.

In December SRC postgraduate awards policy was discussed in the light of the UGC quinquennial settlement, which provided for an extra 7000 postgraduate places in universities by 1977. The UGC had advised the universities of their views on the relative priorities of subjects and the extra provision which should be made for postgraduates at each university. With the exception of applicable mathematics and computing science, the UGC considered that expansion should be less rapid in science and engineering than in, for example, the social and medical sciences. The priorities they proposed in science and engineering accorded reasonably closely with SRC planning.

The Council asked Boards and Committees to consider SRC policy in the light of the UGC guidance to universities and to advise the Council on any points of difficulty or apparent conflict.

The Council confirmed that 3950 awards should be allocated in 1973 and agreed that planning for the Forward Look should be based on an increase of about 1.5% per annum in the number of postgraduate awards at universities, the increase in the polytechnics to be considered later in the light of the Polytechnics Working Group's report.

New Buildings at Rutherford and Atlas

During 1972 the Council approved proposals for an extension at the Atlas Computer Laboratory, a library for the Rutherford Laboratory and a 70 MeV injector for Nimrod, including the necessary building work. When tenders were obtained, it was clear that building costs had risen greatly since the first estimates of costs had been prepared and that reference back to Council was required on all three schemes. In addition, revised estimates had been made for the Nimrod injector equipment. The Atlas Laboratory extension design had been simplified following Council approval in July 1972, but even so the total cost had risen slightly. The building and civil engineering works on all three schemes had been combined into a single invitation to tender and work was scheduled to begin on March 19 – the date required to fit work on the injector building into the Nimrod operating and closure schedule.

In February, subject to confirmation being obtained from DES and the Treasury that the unit building cost for each of the three schemes was reasonable, the Council approved the simplified Atlas Laboratory extension at a cost of £87,000 and agreed to seek DES approval for the construction of a new library at the Rutherford Laboratory, at a cost of £158,000, and for extra-mural capital expenditure on the Nimrod injector project of £1,171,000 (£221,000 building costs and £947,000 equipment costs).

Location of SRC Facilities

In January the Council agreed that the Nuclear Structure Facility, which they had approved in November, should be sited at Daresbury, subject to planning permission. They also agreed that a northern laboratory need not be confined to nuclear physics. In addition the Council initiated a general study of the regrouping of SRC's various intramural activities.

ASTRONOMY, SPACE AND RADIO

Skylark Rocket

The Council approved an increase in expenditure on Stage 5 of the above project which was for the development of a three-axis star-stabilised platform suitable for astrophysics experiments. The increase, which was caused by redesign and modification of sub-units and some extra work not covered by the original estimates, brought the total approved to £767,000. The star-pointed stabilisation had been developed through sun-pointing and moon-pointing stages.

The work had been commissioned through the Procurement Executive of the Ministry of Defence by the Department of Trade and Industry. High priority had been accorded to the work by the ASR Board because of the exciting opportunities in stellar physics that this project now offered.

Astrophysics Research Unit

After careful consideration, the Council decided that responsibility for the ARU should pass to the Director, RSRS, on January 1, 1973.

Northern Hemisphere Review Report

In October the Council noted that the ASR Board's assessment of the requirements for optical astronomy in the northern hemisphere would be reported to the Council as soon as possible. In December the ASR Board considered the recommendations of the NHR Report and decided that the management issues in the report posed fudamental questions about the role of the Observatories that ought to be considered at Council level. In January the Council agreed to set up a Panel, under the Chairman, to review the whole area of the ASR Board's activities including both the executive and the complementary committee structures.

RGO Computer

The Council agreed to ask DES to approve the purchase of an ICL 1903T computer for the Royal Greenwich Observatory at a cost of £252,000, and noted the SRC Computer Review Panel's proposal to set up a link-line between RGO and ACL to allow access to a larger machine.

Radio Astronomy at Cambridge

The Council also agreed to seek DES approval for a consolidated grant to Professor Sir Martin Ryle at Cambridge University of up to £105,000 for 1973 to support a wide range of investigations at the Mullard Radio Astronomy Observatory.

Satellite UK-6

The satellite would contain three experiments with equipment for studying ultra-heavy cosmic ray primaries and x-ray astronomy. Council agreed to ask DES to approve the project at a cost not exceeding £3.4M, plus grants for payloads and data processing. RSRS would be responsible for the management and financial control of the project.

The Engineering Board has been developing a concept of wider training for postgraduate engineers which has been summarised under the term "Total Technology". Approval was given by Council in November to the introduction of a pilot scheme for postgraduate education in 'Total Technology', which is defined as:–

> 'the practice of engineering broadly comprising research, development, design, production, marketing and operation of plant; in addition the service and construction industries require a special emphasis to be placed on planning and operational management. The functions of this continuum of activities are not distinct and separate but merge into each other with ill-defined boundaries and any one function has a marked influence and interrelationship with the others. Success can only be achieved with a well-balanced synthesis of all these functions. Total Technology is the name given to cover this wide spectrum of functions in the practice of engineering, coupled with the skills and experience required for welding them together.'

Some financial support was being sought from the University Grants Committee and the scheme was strongly supported by the Department of Trade and Industry.

High Voltage Electron Microscopes

The Council approved in principle support for the continued operation of three HVEM's at the Universities of Oxford and Birmingham and at the Imperial College of Science and Technology until 1977, within a total estimated cost of £415,000. Commitments within this total would depend on approval of individual applications. Experience had fully confirmed the expected advantages of HVEM, in particular their ability to probe thicker specimens owing to the higher penetrating power of the electron beam, the possibility of carrying out in-situ dynamic experiments and the direct observation of radiation damage produced by the electron beam itself. Both physicists and biologists were interested in using this new technique.

The Council also approved the first individual case in the above programme – a grant of up to £122,650 to the Imperial College of Science and Technology for the cost of operating the HVEM facility until 1977.

A fourth HVEM had been installed at Rotherham, and was owned jointly by the British Steel Corporation and the SRC. The half-time use of this instrument, available through SRC support, was mainly being used by northern universities. The arrangement was due for review in about two years' time.

Polymer Science

Pending the outcome of the review for materials science and technology, undertaken as a result of the Swansea weekend conference, the Council approved the Engineering Board's interim recommendations for support for the five Polymer Science Research Centres – Queen Mary College, Imperial College, Liverpool, Glasgow/Strathclyde and Manchester Universities – until mid 1974, within an overall total of £213,000.

NUCLEAR PHYSICS

The Future of Nimrod and NINA

In March 1972 the Chairman had agreed to make a personal assessment of the situation in order to help the Council take a decision in the following November on the future of NINA and Nimrod and in preparing his paper he discussed the problem with many senior physicists in the UK and abroad. In July Council had considered the proposal to build a 70 MeV injector for Nimrod and had agreed to it in principle, subject to the further decision that Nimrod should continue in operation beyond 1978.

In November it was agreed that Nimrod, with its new injector, should continue to operate beyond the immediate 5-year period and that DES approval should be sought for construction of the new injector at a total cost of £2.18 million.

As much effort as could be spared should be devoted to the NINA experimental programme for the next few years, but NINA should gradually be phased out as a national high energy physics facility; the exact time scale being a matter for the NP Board to propose in the light of its total programme. The Council also noted that the Science Board was examining ways of meeting its future requirements for radiation facilities.

Nuclear Structure Facility

In April 1970 the NP Board had reported to Council the need for a powerful new electrostatic accelerator for nuclear structure research and in June 1970 the Council had approved the preparation of a design study for the construction of a Nuclear Structure Facility (NSF). The completed design was presented to Council for approval at the November 1972 meeting and Chairman, on behalf of Council, congratulated Professor Ashmore

and his staff on the quality of the work done at Daresbury on the design study.

The proposal under discussion was that the NSF should be sited at Daresbury but a decision was deferred – and made subject to the outcome of planning permission – until January, when a paper dealing with the manpower implications of the Nuclear Physics programme, with particular reference to the siting of the NSF, would be submitted to Council.

The Council approved the design study and agreed to seek DES approval for the construction of the NSF as a national facility at an estimated total cost not exceeding £7.2 million. The siting was agreed in January – see 'location of SRC facilities' on p 6.

Computers for film analysis

Purchase of two IBM 370/145 computers, with associated peripherals, was approved at a cost of just over £500,000 each for the film analysis groups at Birmingham and Glasgow Universities. These will replace their rented IBM 360/44 machines.

High Flux Neutron Beam Research

In January the Council welcomed the successful completion of the negotiations with the French and Germans which had begun in September 1972 on the terms of UK membership of the Institut Laue Langevin at Grenoble and had resulted in the UK becoming a full member of ILL on 1 January 1973. Appreciation was expressed of the efforts which Professor E W J Mitchell and the officers concerned had made to bring this about. Thanks to the goodwill of ILL, some British experiments on the reactor had already been fitted into the current programme. The UK had already been asked to submit names for appointment to various ILL committees and the SRC Neutron Beam Research Unit and ILL were discussing future instrumentation.

The first formal meeting of the expanding ILL Steering Committee was due to take place in April; the UK delegation would be Mr M O Robins, Professor Mitchell, Dr L C W Hobbis and Mrs J O Paton.

Flash Photolysis

Amongst the grants approved by Council was a supplement of up to £12,500 to the Royal Institution (Professor Sir George Porter) for work on nanosecond and picosecond flash Photolysis.

Graphics Display of Molecular Models

A supplementary grant of up to £27,500, for a graphics display system based on a Digital Corporation PDP 11/45 computer was awarded to Dr H C Watson and Dr H Muirhead at Bristol University. They will use the system to simulate molecular model building for the x-ray diffraction studies of enzyme structure and function, for which they already have a 7-year grant of £88,220.

New generation accelerator discussed at DNPL

See picture left:

Dr R G P Voss (second from l.) talks about plans to build the world's largest electrostatic accelerator at the Daresbury Nuclear Physics Laboratory (where he is Deputy Director).

With him are visitors to the Conference on the Technology of Electrostatic Accelerators (held at the laboratory in May).

L to r: Professor K Purser, General Ionics Corporation USA; Dr Voss; Professor A Gallman, Centre de Recherches Nucleaire, Strasbourg; Professor A Ashmore, Director of the Daresbury Laboratory; Professor P A Assimakopoulos, Greek Atomic Energy Commission; and Professor O Sala, University of Sao Paulo.

In front of them is a prototype tube module designed and built at the Laboratory as part of the design study for the proposed accelerator (see 'Nuclear Structure Facility' on p6 and p7).

Electrostatic accelerators are large and complex machines that generate very high voltages. Although they have been in use for many years, not all the problems that arise in their design and operation are fully understood. A strong team of scientists and engineers at Daresbury, with help from several universities and the UK Atomic Energy Authority, are studying all the fundamental aspects.

By using such an accelerator British scientists will be able to keep their place in the front line of nuclear structure research.

How ROE created a cold cold space at Culham

Cryogenics reveal the secrets of the stars

T J Lee

At the UKAEA's Culham Laboratory in March 1969 five physicists and astrophysicists talked about using the low temperature equipment available at Culham to simulate cold interstellar space where the background temperature is just 2.7 Kelvins (degrees) above absolute zero.

They believed that simulation could help understand the processes by which stars are formed from hydrogen gas clouds in interstellar space. The theory is that something causes the large uniform clouds to break up into local dense regions known as 'protostars'. These masses have become so dense that their own gravitational forces cause them to shrink extremely rapidly, which sends up the temperature until the star 'turns on'. Which means the nuclear fusion processes that convert hydrogen into helium and release the light and another energy, by which stars are seen, have started.

Did Reddish know the answer ?

Vincent Reddish of ROE had shown that under the right conditions the fragmentation could be caused by the freezing of hydrogen molecules onto dust grains. Freezing out of molecules in slightly colder areas of a cloud causes the gas from warmer regions to be sucked into the colder ones to increase the density and form the 'protostars' mentioned earlier. This fragmentation process induced by cooling of grains could be part of a feedback loop which acts as a cosmic thermostat and controls the evolution of stars and galaxies. Such an idea is attractive because it shows that the things we observe are a result of the competition between physical processes.

Dr Terry Lee (left) is a Senior Scientific Officer at the Royal Observatory Edinburgh.

At that time it was not possible to test the theory by comparing conditions in space with the conditions within which hydrogen freezes. The latter are controlled by the vapour pressure curve, this was known from experiments at temperatures greater than 10K, and though sound theoretical predictions down to the temperatures of interest (about 3K) had been made no experiment gave results which agreed with them. Indeed the experiments didn't agree with each other. So the answer seemed to be to go to the laboratory and make the measurements with the best possible simulation of interstellar space conditions.

The talks at Culham ended with a rough outline programme based on the cryopump developed by John Chubb at Culham to reduce hydrogen gas to very low densities (pressures) in plasma physics experiments. The link between ROE and UKAEA Culham was made formal with a contract approved by SRC's Astronomy Policy and Grants Committee, whereby SRC paid for the use of Culham's resources. Then they began to look for a Research Fellow to carry out the programme.

On the other side of the Atlantic where I was studying the way in which ions, atoms and molecules 'stick to' and are 'boiled off' from surfaces at temperatures greater than 1000K, not below 4K, an advert in the back pages

How RDE created . . . continued

of *Nature* caught my eye. Three months later I arrived at Culham and 'low temperature laboratory astrophysics' was born.

My first meeting with the hissing, clicking, clattering mass of pipes, wires and meters shown in the photograph was somewhat alarming, but helped by Len Gowland (in the picture) and John Chubb I was soon able to drive the machine with great panache.

The first few months were given to overhauling the equipment and modifying it to astrophysical rather than technological needs. Our volume of interstellar space was contained in the cylindrical vessel in the top right-hand corner of the photograph. Very low gas densities (pressures) were maintained by the plumbing below, and the experiments were controlled and data recorded with the equipment seen left. Automatic control and recording meant less work for us and fewer chances of mistakes; it also enabled us to make very many measurements and thus increase the detail and accuracy of the observations.

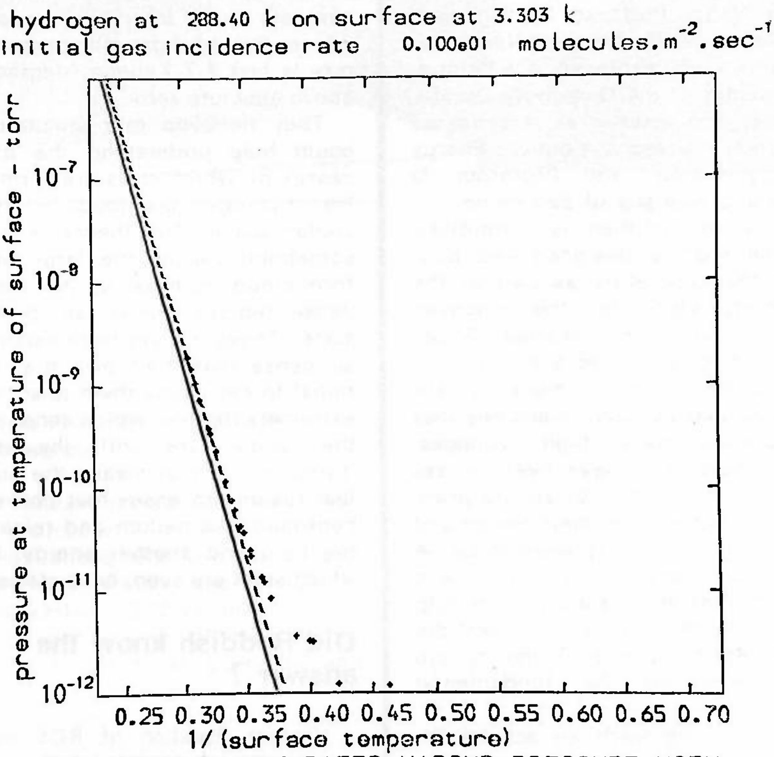
. . . the unexpected had to be explained . . .

We used Culham's brand new ICL 470 computer for data reduction and unfortunately had to contend with the growing pains of the new system. Sometimes we were completely held up. But at last it began to run smoothly and to keep up easily with our rate of production. One of the ten kinds of graph produced from our readings with the Culham GHOST computer graphic system is shown right.

To go back a little. The theoretical prediction of the hydrogen vapour pressure had indicated that hydrogen molecules would freeze on dust that had a temperature of 2.7K if the number of molecules was more than 1,000,000 per cc (this corresponds to a pressure of about 10^{-16} atmospheres or 10^{-15} pounds per square inch). Experiments concerned with high speed cryopumping of hydrogen failed to freeze out hydrogen molecules in conditions where there were 100 times this number. This suggested that the vapour pressure (density) did not follow the expected temperature dependence at temperatures below 3.5K and that an anomally existed.

Our experiments were set up to make reliable measurements of the vapour pressures at temperatures below 4K. We needed to explain the unexpected behaviour so as to find out what effect it might have in an interstellar environment. To this end we considered the effects of radiation, the presence of gases other than hydrogen and different grain surfaces. In our experiment the grain was the copper bottom of the liquid helium cryostat which could be cooled with different materials (eg argon, water, CO_2).

At the start of each experiment, the density of gas was reduced to below 10,000 molecules per cubic centimeter. Then layers of solid hydrogen were built up in a slow and controlled way. The temperature of the liquid helium cryostat was varied between 1.6K and 4K and vapour densities (pressures)



VARIATION OF SATURATED VAPOUR PRESSURE WITH 1/(SURFACE TEMPERATURE) - RUN 3. 2. 71

∇ ion gauge g2 + ms10 ⊙ etl gauge

POINTS 139 TO 178

TEMPERATURE DECREASING

SIGNAL MULTIPLIERS

BBG 0.000 MS10 1.000 MODG 0.000

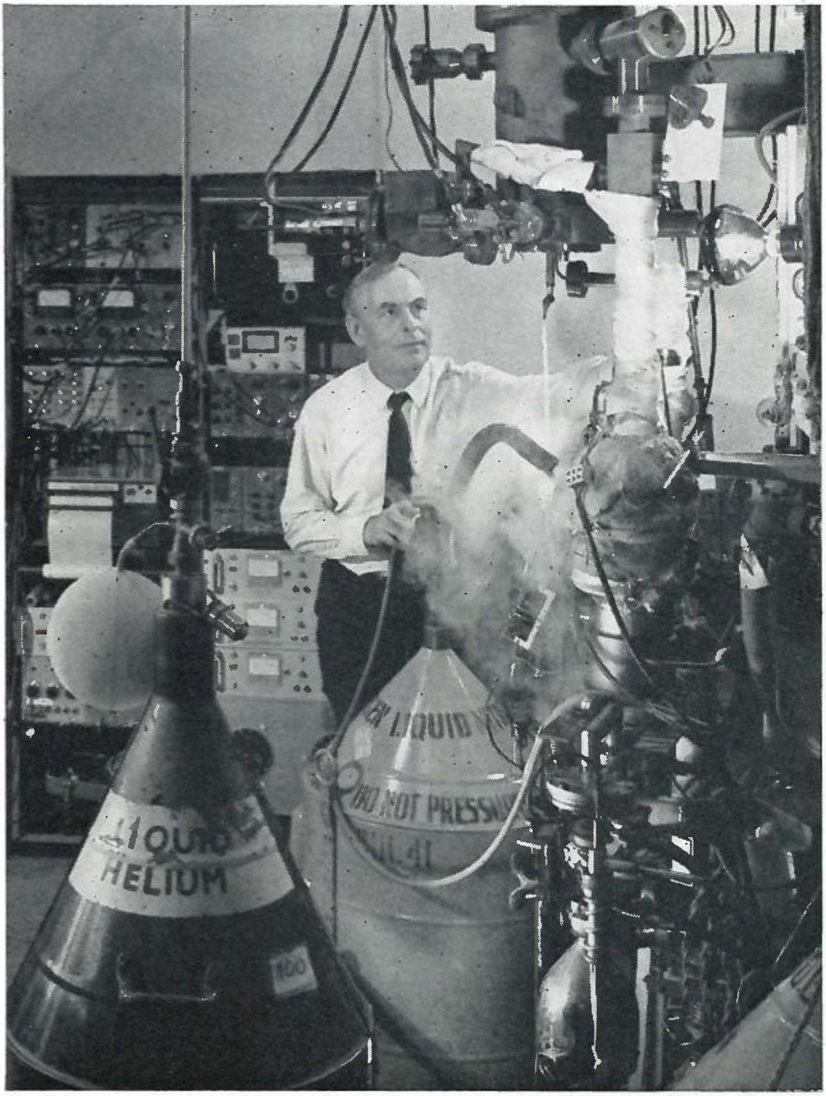
ZERO OFFSETS IN M-3

BBG 0.0000E00 MS10 0.2200E13 MODG 0.0000E00

COVERAGE OFFSET 0.1380E21 M-2

of molecular hydrogen in equilibrium with the solid were measured every few hundredths of a degree. In this way vapour pressure data was obtained for different thicknesses of layer under different conditions. All measurements were recorded automatically on punched paper tape.

The computer produced graphs of these measurements. Those that were of most interest showed the variation of molecular hydrogen density with temperature, which is the basic information we needed, and the log (vapour pressure) – reciprocal temperature relationship which should, in theory, be a straight line. Deviations from this line were always observed, sometimes they were very small and at other times large. A systematic analysis of the way in which these depended on controlled conditions gave me a clue to their origin. They could all be explained in terms of a temperature "step" at the solid hydrogen/substrate boundary. I was able to deduce that there would be no deviation for solid hydrogen in the conditions prevailing in interstellar space and that solid hydrogen has normal vapour pressure properties. The real vapour density at 2.7K is a little larger than predicted theoretically and a density greater than 8 million molecules per cubic centimetre is required at this microwave background temperature for solid hydrogen to freeze on to grains.



Len Gowland, UKAEA Culham, gets to grips with the 'hissing, clicking and clattering mass of pipes, wires and meters' that refrigerate and reduce gas density at temperatures down to absolute zero (–273°C). As described in the article (begin on p. 9), it was used recently by Dr Terry Lee and a team from ROE to simulate interstellar space.

Molecule formation could well be the mechanism . . .

Can such conditions exist in space? Densities a hundred times greater and temperatures of about 5 Kelvin's have been observed separately in our galaxy. However, it seems unlikely that solid hydrogen can exist in clouds which are not already breaking, up, it could well accelerate the fragmentation process.

During the course of the experiments Reddish discovered that the formation of hydrogen molecules from atoms (two atoms per molecule) could also trigger star formation and control the evolution of stars and galaxies in the same way as solid hydrogen formation (though not as efficiently). Here again there was a problem, practically no experimental data existed which theoreticians could use to test the feasibility of the idea. The estimates which theoreticians were able to make indicated that very stringent conditions were required for molecule formation.

So again, we modified the apparatus to start a second series of experiments. This time the aim was to measure some of the physical parameters which govern the rate at which two atoms can form a molecule when they collide with a cold object. The result of these experiments is that we found conditions for molecule formation to be in fact much less severe than had been thought. Molecule formation could well be the mechanism that is the cosmic thermostat and controls star formation.

continued on p. 12

We're off to Africa to catch an Eclipse

What goes up . . . must come down safely

The picture shows technician Tom Hawkins working on a rocket payload at Culham. This payload will be launched from Mauritania on June 30 into the path of the total solar eclipse over North Africa to record ultraviolet spectra of the solar chromosphere and corona and in this way study the structure of these regions of the Sun, as described in the *Sky at Night* programme on BBC 1, April 2. It will be recovered afterwards from the Sahara Desert.

The payload is being prepared by the Astrophysics Research Division of RSRS at Culham Laboratory in collaboration with Imperial College London, Harvard College Observatory and York University, Toronto. The rocket, an Aerobee 170, will be provided by Kitt Peak National Observatory, USA, who are also responsible for the launch and site operations.

The experiments will complement and extend the measurements made by the same groups during the 1970 eclipse. (*Quest* 3, 2 p. 25).

Picture by courtesy of *Oxford Mail.*

This year a total solar eclipse will be visible from North Africa. SRC are supporting experiments from three research groups, one from ARD/RSRS to be launched in a rocket and another two from universities to be flown in the latest and, as some might think, the least likely vehicle to be pressed into the space research service: *see pictures, left and on p. 14 and article right.*

There will be ground-based observing stations in Mauritania at Atar, on an old French airbase – four French experiments, and at Nouadhibou – the ARD rocket launching site; also at Chad – a joint experiment from the Paris Astrophysics Institute and the University of Kiev (it continues some observations made during the 1968 eclipse over Siberia).

Although eclipses can be predicted, the fact that at certain times the moon stands before the sun and appears to be the same size is an extraordinary accident. If it appeared to be smaller, a total solar eclipse would never

How ROE created . . . continued from p. 11

We had answers to all the questions that could reasonably be asked of the apparatus by mid '72 and found we had finished the programme nearly three months ahead of schedule. We found the interest shown in the project by the people at Culham made working there particularly enjoyable. Many made small contributions and the computer staff co-operated wonderfully.

Our high rate of production was possible only through the skill, enthusiasm and self-discipline of Len Gowland, the UKAEA member of the team. So we decided that the customer/contractor principle worked well for us. No account of working at Culham would be complete without mention of Jerry Janes of ARU and his staff who were an admin department really worth having around.

. . . the jet-age way is supersonic

occur, if it appeared much larger eclipses would last for hours instead of minutes – and just think what that would have meant to the superstitious!

Since the moon is relatively close to the earth and since its apparent diameter cannot be more than very slightly greater (sometimes smaller) than the sun's, it can only be seen to completely obscure the sun from a fairly limited zone known as the "totality zone". The maximum duration of an eclipse, slightly over 7 minutes, occurs when the moon has the largest apparent diameter (when it is closest to earth) and the sun is at its furthest point from earth (in summer in the Northern Hemisphere). Most eclipses are much shorter and some are not total but "annular" (when the moon's disc is not big enough to entirely cover the sun).

As eclipses are rare (about 3 a year) and the belt of the totality zone is narrow, the probability of seeing one in a given region is so small that observers have to be prepared to move their instruments to the path of the eclipse. Sometimes this is impossible, as in 1965 when a total eclipse lasting 4 minutes crossed the Pacific and two almost inaccessible atolls. But even from an accessible place bad weather often spoils the viewing.

In 1973 the eclipse is not only the longest sort but it can also be seen from the Southern Sahara where the weather should be fine and the skies clear. So several research teams are looking forward to June 30 very hopefully.

Aero-technicians who watched a recent "Sky at Night" programme on BBC 1, will have been considerably shaken to hear that "four small holes will be drilled in the skin of the aircraft" before Concorde is flown across 1,900 miles of desert. But all is well, we found out later that the "holes" are in fact special observation windows that have been fitted for the first ever eclipse-watching experiments to be flown at supersonic speed.

One of the windows will be used by Dr J E Beckman of Queen Mary College (who appeared on the programme). His is one of two SRC-supported experiments that will be looking at the solar eclipse over North Africa on June 30, the other is Dr M Gadsen's of Aberdeen University. The Radio and Space Research Station is providing general support and management services for them. The aircraft will also be carrying two (or three) French experiments and one from the USA, all studying different eclipse phenomena.

Why Concorde ?

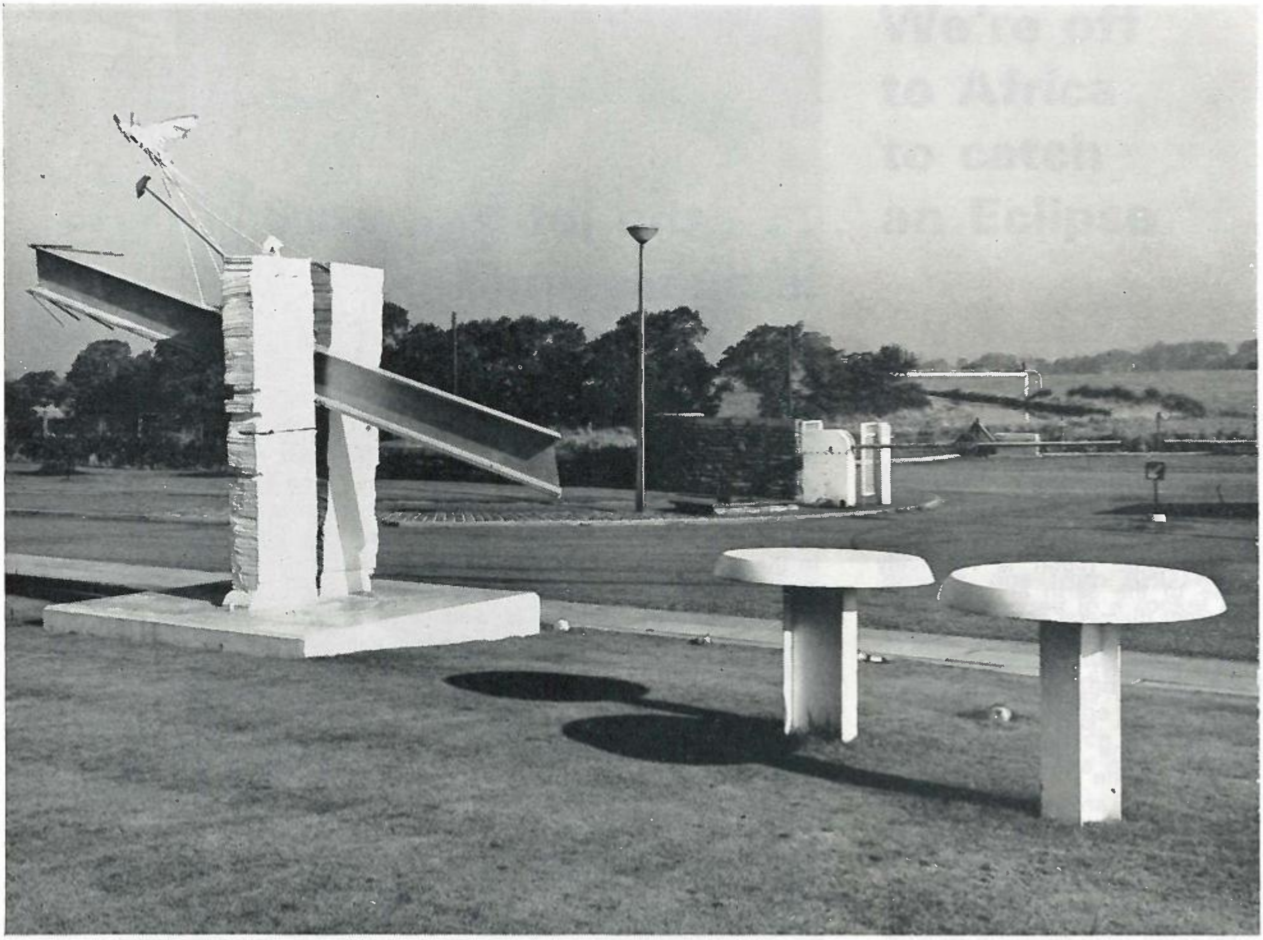
How did we get hold of a Concorde? The story begins in 1952 when aircraft were first used to prolong observations of eclipses. These are never seen for much longer than seven minutes – often less – from a fixed point on the ground and are often only visible over almost inaccessible areas like oceans (1965) and deserts (1973). By flying in the direction of the lunar shadow a subsonic aircraft can watch an eclipse for five minutes longer and this year an American crew will be doing this in a KC135.

But a supersonic aircraft is another thing altogether and both French and British astronomers asked for the Concorde prototypes 001 and 002, respectively, to be used during the 1973 eclipse. As a result they have the use of the French Concorde 001 shortly before it will be withdrawn from service. The French invited the UK to provide two experiments and these were chosen from seven proposed.

Concorde will establish a 'world record' for eclipses with an observation time of 80 minutes. Flying right over the difficult terrain and well above bad weather conditions, it will also, at a height of 17,000m (55,000 feet, be above most of the atmospheric effects that prevent infrared observations at lower altitudes.

Before the flight, there will be several ground tests and three test flights so that this first ever opportunity is used to its fullest possibilities. In the last fifty years the total duration of every solar eclipse put together amounted to only 129 minutes; none of them so fully observed as on this occasion.

From the UK, Dr Gadsen (Aberdeen) will observe the emission of molecular oxygen in the earth's stratosphere, when it suddenly stops being irradiated by solar radiation. Dr Beckman (QMC) will observe distant infrared radiation of the solar chromosphere in order to determine its temperature, structure and, generally speaking,



The jet-age way continued

prevailing physical conditions.

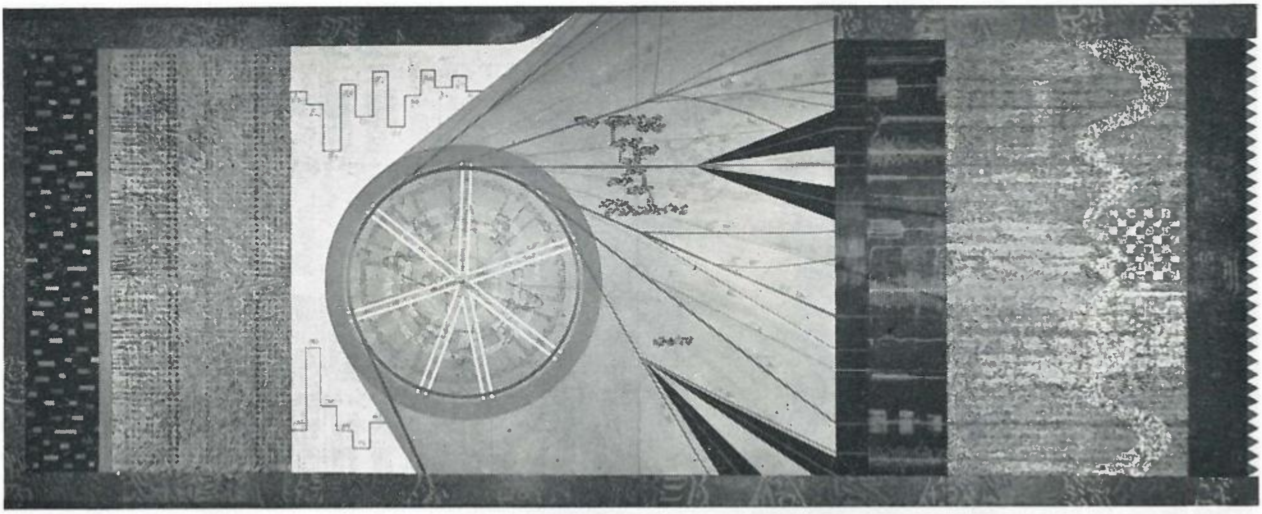
A French experiment from the Paris Observatory, Meudon, will study the thermal corona – the accumulation of dust round the sun that is called 'zodiacal light' when it diffuses the sun's light. Two spectral analysis systems coupled to two highly sensitive infra red detectors will be used to determine the spatial distribution of the dust between 2.5 and 10 solar radii and to analyse their spectrum to show the composition of the particles and to find out if silicates occur very close to the sun. The same experiment tried in 1970 from the ground by an American team was unsuccessful.

The Paris Astrophysics Institute will photograph the internal white corona (free electrons diffusing sunlight) for about an hour, using a telescope with a 10cm aperture with an equivalent focus of about 3m. This should show dust movement in the corona and the lifetimes of certain structures linked to the evolution of the coronal magnetic field, such as 'polar feathers'.

The reduction in the observed relative speed of the sun and the moon will also increase the time of the so-called 2nd and 3rd contacts, in which the solar chromosphere is eclipsed. These intervals were previously used to make 'flash spectra' lasting only a few seconds, but flying in Concorde at a speed only slightly less than that of the lunar shadow, several minutes will be available to make such studies just before and after the total eclipse phase.

An experiment from Los Alamos Scientific Laboratory, USA, will observe the emission lines of the solar corona at the chromoshere-corona transition level during the second and third contacts, followed by a determination of the oscillations of the lower corona in order to study the energy transfer in this medium. During totality the emission lines will permit a study of the behaviour of the corona further away from the sun. Their second experiment will test the propagation of coronal disturbances. These are believed to be caused by waves that heat it then dissipate in perhaps 300 seconds, but they have not yet been detected.

Recommended reading, if you want general (not too technical) information on eclipses and aircraft observations and more details of the experiments, is the SRC press notice 9A/73 and its several enclosures on which these articles are based. (Ask your local Librarian or the Press Office LO extn 114 for copies).



Daresbury's visible assets

M J Moore

Although the Daresbury Laboratory is dedicated to Nuclear Physics, this does not imply that other disciplines are neglected, and not the least the arts.

Our contributions, encouraged by the Chairman of NIRNS the late Lord Bridges, are modest perhaps in the artistic sense – posterity will judge – and take the form of a mural by John Hart and a massive work by the well-known Liverpool sculptor, Arthur Dooley. Both men spent several days at the Laboratory, at different periods, acquiring "atmosphere".

John Hart's mural *(seen above)* covers one wall of the entrance hall. It is based on the construction principle and uses of NINA (National Institute Northern Accelerator), mingled with quotations from Lewis Carroll, born locally, and James Joyce. (Carroll's 'Tale of a Mouse' shape and a chessboard can be seen right).

Arthur Dooley was given ten tons of scrap steel from accelerator magnets and two pole tips (designed by John Cockcroft in 1937) from the Liverpool 37 inch Cyclotron. After much heart searching he made a symbolic 'beam' splitting the uranium nucleus *(see picture left)* with various fission products and emitted neutrons. The pole tips (right) represent the mushroom clouds of Hiroshima and Nagasaki. On the left the dove of peace is seen emerging from the disintegrations of the heavy nucleus. The sculpture stands in front of the Laboratory beside the entrance gate.

To add a personal note, the 37 inch cyclotron was built by Sir James Chadwick at Liverpool before the last war. Gerry Pickavance, 'George' Holt and I sweated some of the best years of our life in keeping it working during the years 1939-1942, before we joined the Bomb Project in other places, but that is another story.

The ties between Liverpool and Daresbury are strong indeed.

M J Moore OBE, joined the Daresbury Laboratory in 1963 as Head of Engineering Division. Previously he was a Senior Lecturer in physics at Liverpool University and a Research Assistant to Sir James Chadwick.

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nutcracker 12: uneasy bedfellows

The King of Concilia has six ministers, whose offices are ranged along a single corridor in the following order: Foreign Affairs, Education, Disinformation, Counter-Insurgency, Budget, and Agriculture. In order to inject new dynamism into his government, the King proposes to reverse the order of these ministries. However while offices are being exchanged, the two ministers concerned will have to work in the King's Stately Pleasure Dome (currently also housing a large telescope). This creates difficulties, since most of the ministers cannot stand the sight of each other. Thus the Minister of Foreign Affairs refuses to share the Dome with any of his colleagues from Education, Budget or Agriculture. The Minister of Agriculture refuses to share with the Ministers of Education, Counter-Insurgency and Disinformation. Neither the Minister of Education or the Minister of Disinformation will share with the Ministers of Counter-Insurgency and Budget. All of which makes the moves rather difficult. Can you find the shortest sequence of exchanges which puts everyone in the right place?

Answer on p. 27. *If you can solve the problem with less than 11 moves, there is a prize too.*

In a clear space we can see space

The opening of the South African astronomical observatory on March 15 1973 opens a new chapter in observations from South Africa

In foreground l to r: Mrs Margaret Thatcher, Sir Richard Woolley, FRS, and Mr B J Vorster at the opening of the new Observatory. *Photo 'Die Burger'.*

A L T Powell

In March eminent astronomers from all over the world came to a Symposium at Cape Town, held to mark the opening of the new South African Astronomical Observatory (SAAO).

On March 15 the observing station, at Sutherland, was officially opened by the Prime Minister of South Africa, Mr B J Vorster. The SRC was represented by Mrs Margaret Thatcher, Secretary of State for Education and Science, Dr Margaret Burbidge, Director of the Royal Greenwich Observatory, Mr J F Hosie, Director Administration, Mr M O Robins, Director Astronomy Space and Radio, and Professor D W N Stibbs, Chairman of the Astronomy Policy and Grants Committee (from St Andrews University).

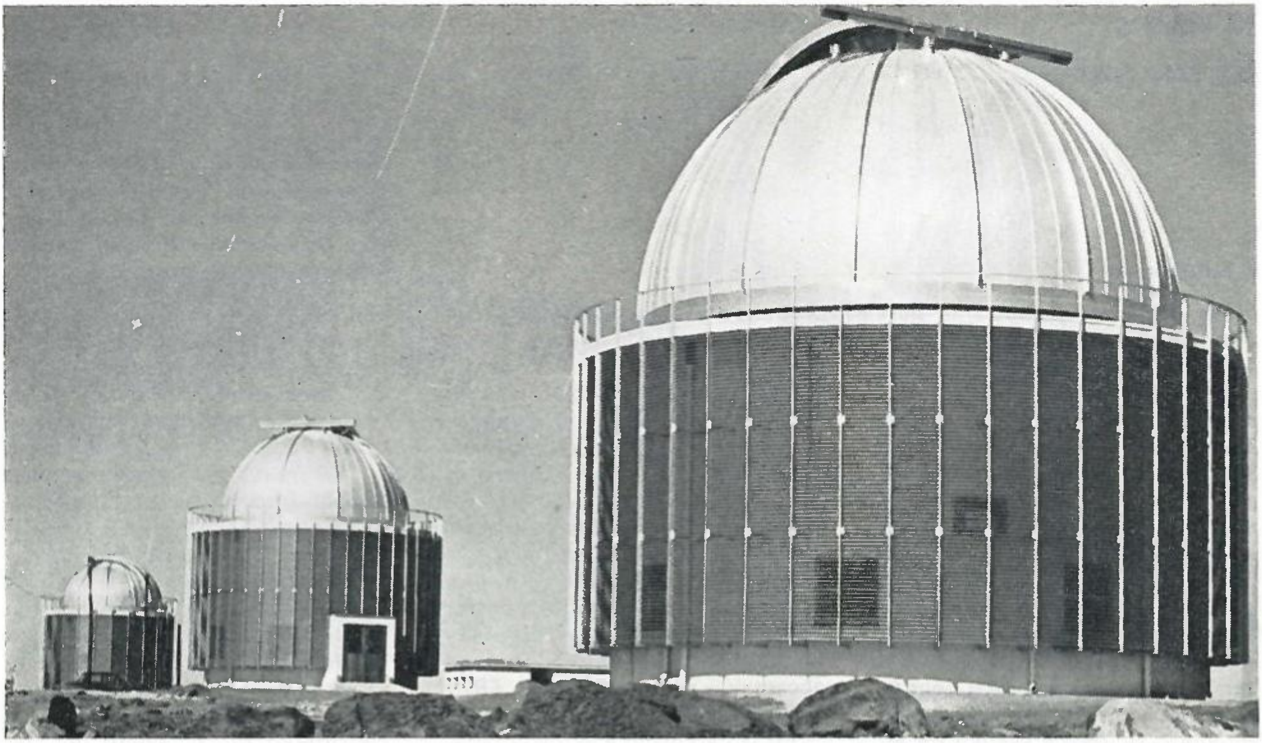
Both occasions were a great success, and thanks are due to Mr George Harding, Deputy Director of the SAAO, the rest of the observatory staff and to the Press Office, led by Mr B G Pautz, of the South African Council for Scientific and Industrial Research (CSIR) and its Director, Mr D G Kingswell and Miss Maura de Havilland who planned the function.

Why we must leave town

The opening of the South African Astronomical Observatory heralds a new era for optical astronomy in South Africa. Until now most observing has been done from sites in Cape Town, Bloemfontein, Johannesburg and Pretoria, none of them ideal. With the possible exception of Bloemfontein, they are close to the centres of large industrial cities with their associated pollution and background illumination. Although living near a big city presents few problems in the domestic lives of the astronomers and it is easier to recruit local staff and obtain the strong technical support so necessary for modern telescopes, nevertheless the telescopes cannot be used to their full potential.

Work on the brighter stars is possible in these city sites but spectroscopy of faint celestial objects and photoelectric photometry are difficult, if not impossible. Pretoria in particular has its greatest percentage of night cloud in the summer months when some astronomically important objects such as the small and large Magellanic Clouds (the closest extragalactic system) are overhead. The SAAO site at Sutherland in the South-Western Karoo 200 miles North-East of Cape Town is well away from any large city so it suffers from none of these disadvantages. Initial studies indicate that it will be a very good observing position.

The Karoo has long been known as an area of great geological interest, containing rich fossil deposits. The site itself is on a high plateau eight miles outside the town of Sutherland. At present observers spend a week there continuously observing and then,



Above: the three aluminium-clad domes of the new Observatory.
The 40-inch telescope from the Royal Observatory Cape Town and the 20-inch from the Republic Observatory Johannesburg, are in the two nearest domes. Living quarters for staff and astronomers are further down the mountain.

driving Observatory transport, return to Cape Town to make reductions of their week's work.

The sunshine is bright and nights are dark

I was fortunate enough to observe there in February of this year. Out of seven nights' observing, six nights was photoelectric of a high standard, while all seven were spectroscopic. I was luckier than average although the site is nearly always incredibly dark at night. The observers can rest in the daytime in cool, sunproof and quiet quarters, protected from the heat, light and the noise of traffic, children and household activities which are usually associated with one's recovery from observing.

The maintenance and domestic running of the site are directed, respectively, by Hennie and Hettie Barnard. The SAAO are extremely fortunate to have such an ideal couple, who live on the site with their children.

On this remote site even the population of sheep are very sparse as the flora consists of arid scrub bush. Apparently they lose their herd instinct in these conditions where it's every sheep for himself.

Sutherland is a small town, or dorp, that mainly caters for the outlying farms. Without television or cinemas people rely on the open air, sunshine and surrounding countryside for their enjoyment.

It will be well equipped . . . for British astronomers

The CSIR (the South African equivalent of SRC) and the SRC are collaborating in the formation and running of the new observatory. The Director is Sir Richard Woolley, formerly Astronomer Royal. While he was at the Royal Greenwich Observatory he was in close touch with South African observing mainly through the Royal Observatory, Cape, and the Radcliffe Observatory administration (RGO supplied staff and funds) and as a visiting astronomer.

The Director is on the staff of the CSIR who are responsible for the day-to-day running of the SAAO. The observatory is an amalgamation of the Cape Observatory and the Republic Observatory at Johannesburg.

The 100cm Elizabeth telescope from the Cape and the 50cm reflecting telescope from Johannesburg have already been moved to the SAAO. In April 1974 the SRC's seven-year contract for the running of the 74 inch telescope at the Radcliffe Observatory, Pretoria, (that belongs to the Radcliffe Trustees) will end. It is strongly rumoured that the telescope will then be moved to the SAAO. If it is, the combination of this, the other two telescopes and a new 30 inch now being made, will make the SAAO a very well-equipped site of great interest to British astronomers.

The author, Dr Alan Powell, is a Senior Scientific Officer at the Radcliffe Observatory (from RGO).

It pays to be safe

B H Crabtree

Bernard Crabtree is in charge of the O and M Unit in the Management Services section of Establishment and Organisation Division, London Office.

In an organisation such as ours that has a number of laboratories and workshops – and the hazards that go with them – it is not surprising that most of the suggestions we receive under the Suggestions Award Scheme are concerned with safety. In fact to read the suggestions is to realise what a dangerous world we live in!

Since the scheme became Council-wide in January 1971, ideas have ranged from putting a 'push' or 'pull' notice on a door to a design for a self-correcting automatic guidance system for an astronomical telescope. This last came from a Clerical Assistant in the London Office whose hobby is astronomy. The idea was followed up at our own observatories and the NRDC but regretfully the replies were 'A good try but not novel enough to change from existing systems'.

The very first suggestion received by the Daresbury Committee resulted in an award of £20 and a saving of nearly £900. This one was from Mr K Evans, Foreman of the Electronics workshop. Early in 1972 much time and effort was expended trying to produce a satisfactory scale which could be read to fine limits. It was decided to use Vernier height gauges suitably modified; but as each gauge costs in the region of £20 and fifty such gauges would be needed the expense of the exercise was a problem. Mr Evans' suggestion was to use an engraving machine to copy an existing scale and produce further scales. It was found that scales could be produced to an accuracy of 0.0008" which was more than acceptable and, even better, £875 was saved on fifty sets.

Mr D Parkinson a skilled craftsman at the Rutherford Laboratory earned himself £90 when he looked at a difficult problem and found a simple solution. The problem lay in the flexible tubes used to refill containers holding liquid nitrogen. The liquid nitrogen was making the tubing brittle and easy to damage, leading to frequent repairs or replacements.

Mr Parkinson's solution was to use two cryogenic stainless steel tubes, one fixed to the feed line and the other as a sliding sleeve that could be dropped a certain way into the container and held clear, after filling, with clips. It is estimated that this should save 80 man hours plus £100 a year on repairs and replacements. It also increases safety since the risk of the flexible feed tube blowing out of the vessel has been eliminated.

One matter that should be mentioned although it was not strictly a suggestion – unless it implied that more visits should be made to universities – was that Mr Eric Sampson of LO should put his collection of maps of the environs of Universities and SRC Laboratories in the LO Library for general reference. He did not wish to be considered for an award but the LO Committee has asked *Quest* to thank him publicly.

Statistics to date show:
204 suggestions received,
54 awards made
£720 paid out in total
(in awards from £5 to £90).

I think we can say that the scheme is well and truly launched and that ideas will continue to come in.

One idea we could do with now is for an eye-catching poster for the scheme. Any offers? If you have please put your written or illustrated suggestions in the scheme's boxes or send them to me.

. . . drunk in London

Our allusion to Rutherford Lab's water bill (last year) led a reader with a taste for the bizarre to draw our attention to the almost incredible fact, quoted by our own Fiona Steele in an article in 'The Ecologist', that water drunk in London has already passed through ten people on its way down river. Is it possible that the intermittent nature of the flow of drinking water on the top floors of State House could be due to a devious plot on the part of our colleagues at Slough and points west to withhold supplies?

Talking of spending pennies, has it occurred to you that if the SRC's budget of £71.429 M for 1973/4 were converted into pennies (the post-Halsbury sort) they would, if laid end-to-end, reach a third of the way to the moon? The old-fashioned sort would have reached all the way there with enough left over to pay the whole annual cost of both Rutherford and Daresbury, or the cost of the Royal Observatories for the next decade. Perhaps that's why the Council pays most of its bills by cheque or payable order.

The financial information related above is taken from the Council's Estimates, published by HMSO and by common consent one of the most entertaining pieces of light fiction on their list.

The start of the race – see story below

How we got into Europe

Martin Hall

Eight days before the start of the Civil Service Sailing Association's annual offshore race I received an urgent 'phone message: "We have a boat reserved for you for the race next week. Can you let me know within two hours if you can raise a crew". After several 'phone calls to all but DNPL and ROE (sorry!) we were still without a full crew, but had enough to say 'yes'. So for the second year running we had an entry to represent SRC and by the day of the race we had a full crew.

Friday 13 October

Three from Rutherford: Alan Bishop, Eric Groves and Philip Seager; myself from RSRS; and Harold Arnold and Bob Davis borrowed from Ministry of Defence (without them kindly stepping in we would not have got an RNSA charter) all reported to HMS Dolphin, Gosport, and took over RNSA yacht 'Electron of Portsea' (– an apt name!). 'Electron' was a twelve year old, 35 foot, seven berth boat, and looked as if she was built and fitted out for speed.

It always seems to take a long time to prepare a boat for racing, and we had none to spare for sail practice. So the boat and crew were still new to each other when we reached the start line with only a few minutes to spare. By the code flags flying at the starting point we saw that the finish would be at Cherbourg harbour entrance.

17.30 Start of race off Southsea, one of nine entries. Course 175°; wind NE force 4, a good blow, but at this time of evening we could expect it to double or to die completely.

17.55 Forecast gave warnings of possible NE gales (force 8) in Dover, Wight, Portland and many other shipping areas. So we were to expect an exciting race; and we got it!

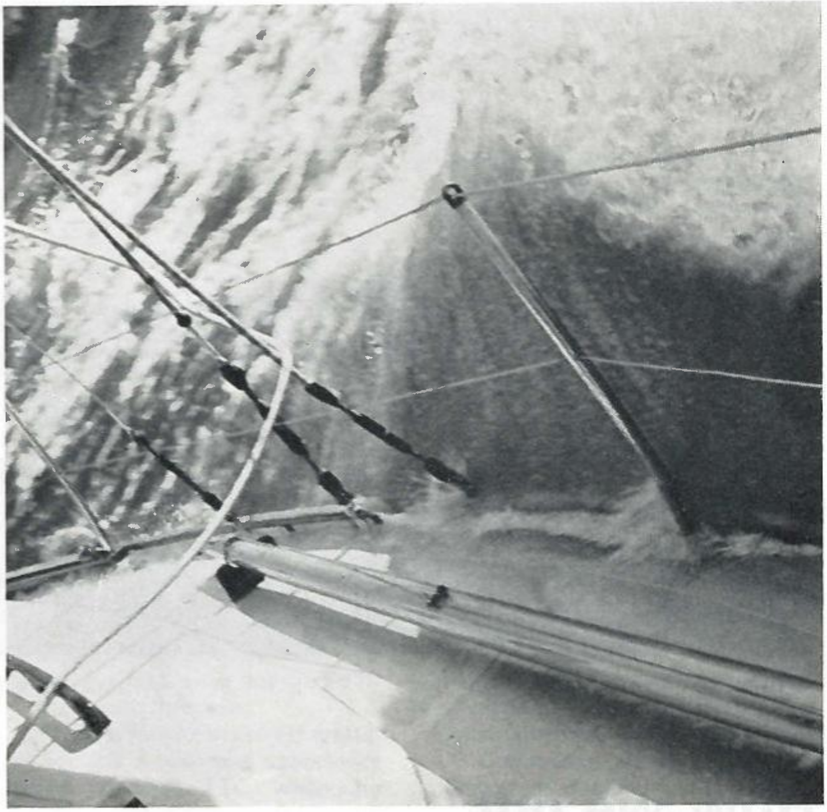
18.27 Bembridge Ledge buoy abeam, altered course to 210°; the 'rhumb line' (and we hoped, the rum run) for Cherbourg, bringing wind on port quarter. Watched others putting up spinnakers and taking them down in a variety of ways exciting to spectators but potentially expensive and highly dangerous for the crews concerned. The most alarming was the one that resulted in a heavy 15-foot long boom lashing about under the 'control' of nearly 300 square feet of canvas! We decided against having a go since conditions were difficult and likely to deteriorate, it was almost dark and only two of us had flown a large spinnaker before.

21.30 Wind now a strong force 6, gusting 7, so we reefed the mainsail to first batten, while still carrying so-called "racing" genoa. This would have been rather small in normal conditions but ample as things were. Reefing did not noticeably reduce our speed, which was now about 8 knots (almost our theoretical maximum), but it did make steering easier: at times this had become a two-man fight.

02.30 (Saturday 14). Lights on land came up in rapid succession; soon able to get a good optical fix on Pointe de Barfleur, Cap Lévi, Tête Septentrionale with radio bearing confirmation on Fort de l'Ouest (Cherbourg), showing our position to be nine miles from finishing line. Eased course to 230° and homed fast with wind dead aft.

03.30 Quite exceptional to be able to see so much so clearly. Now able to see the lights of other competitors – all heading for the western entrance. The wind had eased to force 5 or 6, and seemed less as we were running before it. Glad and surprised not to have that dead chill in the air of early morning. We had been lucky for mid-October.

04.20 + 10s Finished third, being beaten by two new racing machines that had been consistently successful in races throughout the season. However, 'Electron' herself must have been quite an impressive racer in her time, and being the largest boat in the race helped too.



. . . some had it wet and rough both ways

In Cherbourg we enjoyed cold water washing in the clubhouse (which was officially 'closed' for refit) and the duty-free shop of Henri Ryst – soon to disappear as a privilege of our entry to EEC? At midday we had an (alcoholic) get together with the other crews, exchanging hairy stories of adventure and misadventure in the night, and enjoyed the cuisine (especially the moulles) and impromptu cabaret of the rather tired looking Café de la Grande Surf.

The beat back home into a still strong NE wind was less damp than expected, though there was sufficient sea running to keep three members of the crew busily gathered round a bucket for much of the night. What a waste of a good meal! Also we needed eight reefs in the mainsail to make things tolerable. However, a drop in the wind and the sight of sunshine on the Isle of Wight next morning did much for morale. Then all too soon we were clearing Customs and cleaning up the boat.

Speaking to the Racing Secretary back at Gosport, I mentioned how we had expected things to be a lot worse on the way back. "It depends what sort of boat you were on", he replied without much enthusiasm. It seems the smaller boats had a hard and wet crossing both ways. The winner, who spent almost an hour of the race planing over the waves at 10 knots before he decided it was too dangerous, completely ruined his boat on the way home by cracking the hull as he buffeted the waves.

So we came back pleased to have represented SRC and to have gained third place. Next time perhaps we can do even better, with two crews to give us a team entry. That will be on October 12–15. We shall need crews and boats in order to enter. Anyone interested please 'phone me at Slough 24411 ext. 328.

Apprentice

A G Wilson

"Well, I'm sorry son, but I told you and your dad when I agreed to teach you the plumbing that it wouldn't be small-bore central heating all the time.

"Closets, as you might say, are our bread and better along with the burst pipes in the winter, only we get 'em all the time if you see what I mean. I know they hum a bit, son, but you get used to that. We're craftsmen and we serve the community. Same as undertakers like, someone's got to do it.

"Now give me the plunger and I'll see if that'll shift it. But before I do I'll just put my hand down and see if I can feel the obstruction. That's where the craftsmanship comes in. A bodger would get cracking right away. Well, the idea is that if it is there we don't want to force it further down. That would mean having to get a ladder and cut the soil pipe open outside. Soil pipe? why that's what the closet runs into before it reaches the drain. I can see it is time you started the night classes! No, we don't call them drains until they run along in the ground.

"Well, that seems clear, must be at the junction. Give me that cloth to dry my arm. Don't be silly, son, it's nothing to worry about. When you get out with the tools you'll think nothing of it. Rats down there? Don't be ridiculous.

"Right, now where's that plunger. Here we go. Ah! – right, she's going. Bit of luck that, these old valve-closets are beggars sometimes. All crusted up inside.

"Of course it's different from your one at home. This must be at least seventy years old. Don't see many of 'em now, but when I started all the big houses in Chelsea and Kensington had 'em. Kept nice they were too. All polished mahogany, and willow pattern designs inside the pans. I used to have one of the lids for a drawing board when I was going to night school. Of course I cleaned it up first.

"The Water Board don't like 'em though. See, as long as you hold up the handle water rushes down, and this one's got a one-inch supply. Empty a hundred gallon tank in no time. No son, they don't have ball-cocks in these. As a matter of fact the modern flushing cisterns were designed not to use too much water and in the profession we call them Water Waste Preventers. They will only use what's in the tank, see, and that's about two gallons.

"You'll find when you're doing your City and Guilds that they'll ask you about these. All this wood's supposed to be insanitary, but I don't know. They used to keep 'em nice, these old housemaids. At it from morning till night, they were. The girls don't go in for the domestic work now though. Can't blame 'em, I suppose. They used to get looked down on rather by the girls in the shops and offices. It's a funny thing, though, my son says they have the same trouble in the Civil Service with the typists. I suppose we all have our pride. Remember, son, what I said just now – we're craftsmen and that means a lot to a man.

"And another thing, look at the lead tray on the floor here. Lead safes they used to call 'em. Had 'em everywhere; under the tanks in the roof, under the sinks in the housemaids' cupboards – look, inside that cupboard, the sink's been pulled out but the safe's still there. Got waste pipes they have to drain away water that gets spilled or leaks. Must have saved pounds, but you don't see 'em now. Progress, Hmm!

"And you don't see sheet lead work now on roofs like you used to. Too expensive, I suppose, or they can't find the chaps to do it. I expect you'll have to make a box or two for the City and Guilds, but I doubt if you'll ever do any with me. That's the real art in our craft. Why, any mechanic can run a copper pipe about, an electrician or even a gas fitter can do it, but sheet lead – that's another story. Our old cathedrals are full of the stuff and it's lasted for centuries. They thought a lot of the plumbers who worked in them too. I saw a tombstone of one recently in the cloisters at Westminster Abbey, or was it Canterbury?

"OK, get these tools packed up. The lady wants us to have a look at the drains before we go. Nothing wrong really, but these old dears like to think they're 'looked at' occasionally.

"Well, that's the back manhole down. We'll just go and have the front one up and then we're off. The cook'll give us a nice piece of cake with our tea here, she's one of the old school. Yes, that channel takes the soil pipe. There it is coming down in that corner over there – a nice bit of four inch lead. You don't see much of that now, either. No son, that water is supposed to be there. That's what we call the interceptor. It is a trap between the house drain and the sewer. It's the same as you get under any sanitary fitment – what the lady in the adverts calls the bend in the pipe!

"There's always water in the trap, see, and that stops the sewer gases escaping into the house. Yes, it also traps things that drop in, but that's not the real purpose. I'll tell you this, though, there are two or three old gentlemen here and old gents aren't as steady as they used to be. It's surprising what they drop down things. While we're here I'll just feel round inside the interceptor. A mate of mine swears he once found a gold watch!"

Letter from Fiji

Graham Tidmarsh

When I mentioned to my friends in London Office that I was off to Fiji, they had nearly as much difficulty as I did in trying to work out which ocean it was in. Well, for those of you who have been too busy gazing into the sky or watching tiny particles chase themselves frantically around race tracks until they meet a nasty end, Fiji is a group of islands in the South Pacific which straddle the 180° meridian and lie about 20° south of the Equator. For geographical experts, the International Date Line takes a detour around us so we cannot step to and fro in order to repeat the days we like or miss out those dreadful Monday mornings. We are twelve hours ahead of you in London (give or take an hour of British Summer Time) so, roughly speaking, while you sleep I work and vice versa.

. . . talking of the weather

Before you try to picture me lazing on a fine, sandy beach, shaded by coconut palms and being served exotic drinks by voluptuous maidens let me point out that you are thinking of the wrong film! We live in Suva, the capital of Fiji, which is situated on the **wet** side of Viti Levu, the largest island of the group. By wet, I am referring to a rainfall of the order of 140″ per annum (or, since we are going metric, 3500 mm) which is four or five times as much as we suffer in London. So this part of the island is as green as the Emerald Isle and the only decent beaches in easy reach are on tiny islands inside the reef or thirty miles away down the sort of road that if you found one like it in Britain you would go a different way.

'the hub of the Pacific'

Fiji became an independent Dominion within the Commonwealth on 10 October 1970, 96 years after it was ceded to Britain. The population of just over half a million is mainly concentrated in the large islands of the group – Viti Levu and Vanua Levu ("Levu" is Fijian for "big"). Two races predominate, native Fijians and Indians. The Indians were brought over at the end of the 19th Century as indentured labourers to work on the sugar cane plantations and are now the largest racial group. Europeans and Chinese are well represented on the islands, and there are some members of all the South Pacific races.

Fiji's Government is modelled on the British system with an elected House of Representatives and a nominated Senate as the "Upper House". The main source of export revenue is sugar and tourism is growing fast. Fiji is a duty-free country for the luxury articles most sought after by tourists, such as cameras, radios, tape recorders and hi-fi equipment, mainly imported from Japan, but spirits and tobacco, though much cheaper than in the UK, are taxed. Much of the food-

stuffs and manufactured products are imported and Customs duty makes up a large proportion of Government revenue. (The Fiji High Commission in London publishes information on this).

The purpose of my being in Fiji is to work in the Organisation and Methods Division (O & M) of the Public Service Department. I am serving here on secondment from SRC London Office where I was previously employed on O & M work. The Fiji Government is the largest employer in the country and covers a wider range of activities than the UK Civil Service. For example, schooling, hospitals, roads and water supplies are Central Government responsibilities so the work I am doing is quite varied. Over the past few years the Civil Service has been almost entirely localised, apart from some specialised and technical posts. This has given the Fiji citizens early responsibility for running their own country and the changeover is proving to be both interesting and a challenge.

Fiji is described as the hub of the Pacific due to its geographical location and is therefore a transit point for many sea and air services. It is also becoming a focal

Picture opposite: Graham Tidmarsh in Fiji.
Above: Graham's wife Madeleine with Siteri from Fiji and her family.

point for Pacific co-operative activities such as the University of the South Pacific which is here in Suva and has just produced its first graduates. The University runs a four year degree course as well as Diploma and extra-mural courses and seminars.

from cannibals to computers

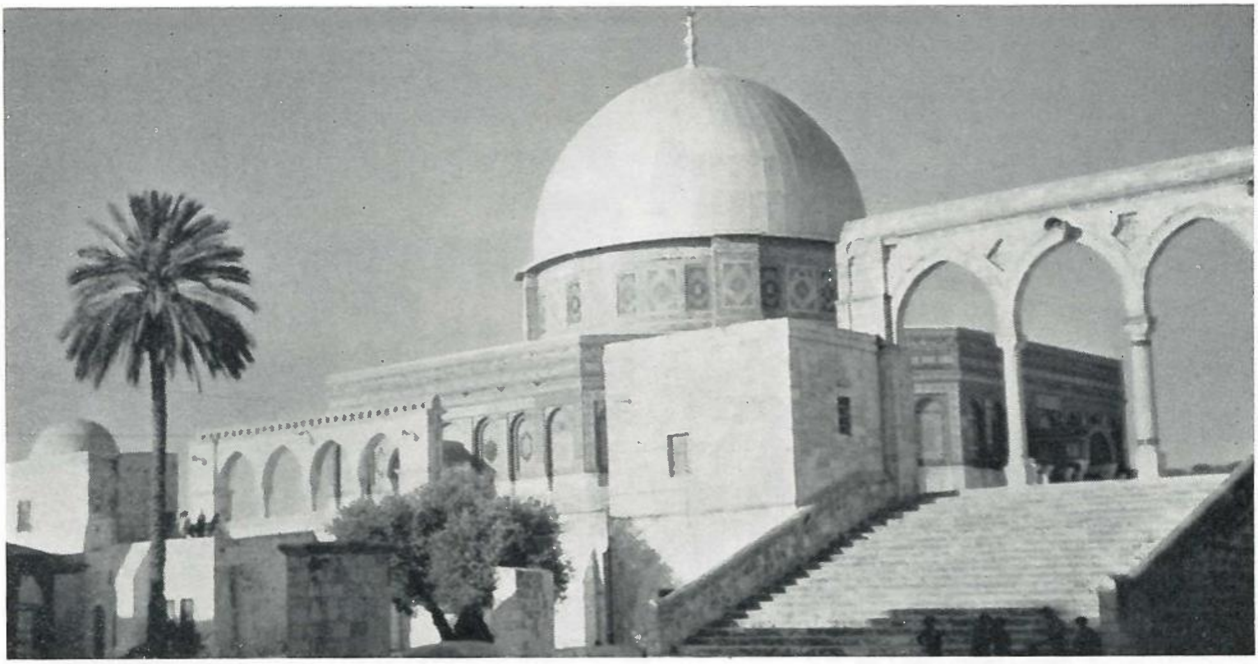
Thus Fiji is a country of wide contrasts; although the total land mass is small, the islands are spread over a large area. Suva, the capital, is similar to many urban centres, a mixture of old and new buildings. Multi-storey office blocks are replacing the old wooden, colonial style buildings – reminiscent of "Western" films. There is a Scandinavian designed Civic Centre and plans for a new Civic complex are gradually being implemented. The Government has a computer to calculate salaries and some of the many statistics used to forecast the further development of Fiji, and to satisfy the various international agencies to which Fiji, like any self-respecting country, has to belong. The shops stock a wide variety of goods mainly from Australia and New Zealand. British goods are available but the supply is more spasmodic, relying on the monthly arrival of the boat from "home" when we carefully check the shelves of the stores for new acquisitions.

Outside Suva however it is easily possible to see village life as it has been for many years, except for cannibalism of course – that was abolished a century ago! Corrugated-iron, breeze blocks and concrete are used partly in place of the pandanus thatch and walls of the traditional bure (or house) but village women still sit all day in the shallows of the river doing the washing. Light at night is provided by benzene lamps as the men sit around the yaqona bowl – yanggona is a muddy looking liquid made from a variety of pepper plant, slightly narcotic but most refreshing and reputed to be good for the kidneys. Main drainage in the islands is by the river or sea, but drinking water may be fetched or piped (in bamboo pipes) from a fresher source!

These are of course extremes and some villages, even in the small islands, have spent the profits from copra (when the price was much higher than at present) in building a reservoir or even buying a power generator. Copra is the smoke-dried flesh from the coconut, crushed to produce oil which has been the main source of income for many Fijians. They are now seriously affected by the drop in world prices for the product. Dried copra has a sweet, slightly sickly smell which wafts over Suva when the mill is crushing.

Books have been written about Fiji and this short article can do no more than give some impressions of the country. However I hope you have been able to get a glimpse of our life on a Pacific Island.

Graham expects to be back in England by the end of the year.



You can relax in Israel

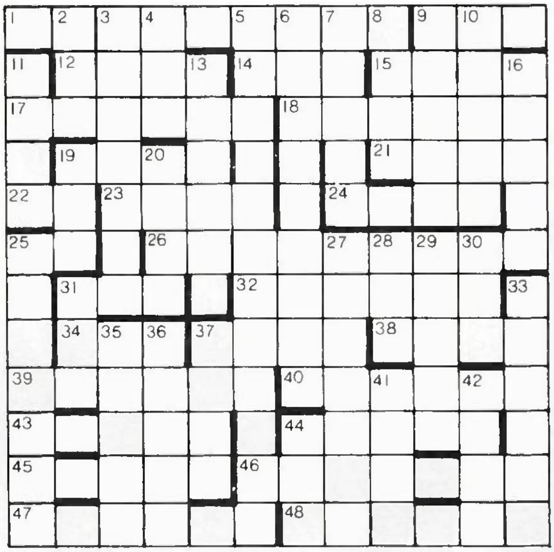
Some pictures from Dennis Fogerty's car 'safari' to Israel via Greece and Turkey in 1972 (*Quest* 5, 2 p. 20).
Above: the Dome of the Rock, the most holy Moslem site in Jerusalem. In Jordan until 1967, it was restored to its present magnificent condition by King Hussein.
Below left: Dennis's wife Rose and daughter Susan visit a Turkish caravanserai.
Below right: on the Golan Heights, Susan and his son Daniel look at a relic of the '6-day War' (1967). Behind them is Baniyos Castle built by the Crusaders on a hill that was once a centre for worship of the God Pan.

Twelve people went on the holiday, including Dr Roger Burdett (RSRS) and his wife Wendy, Barry Silcock (RHEL) and Ken Somerville (ROE).

Dennis (from LO) was last in Israel 25 years ago during the final 2 years of the British mandate. He says the atmosphere now is placid and relaxed by comparison.

His favourite place was Masada, but it was very hot - over 110°F. The social highlight of the holiday was an invitation to a Jewish wedding with 600 guests – including local Arabs – at a farm near Haifa.

This year he will go to Southern Turkey again (as described in *Quest* Vol 4, 2 p. 16) and has room for 1 or 2 more passengers on August 3 to September 2 (30 days).



crossword

maxim 3

The first correct answer opened gains a £1 book token. Send entries to *Quest* at London Office not later than August 31 marked 'CROSSWORD'.

The winner of maxim 2 was Mr R Swifte of the Meridian Department, RGO.

Not only LO, but all SRC establishments are to be "dispersed". They will be moved from the locations asterisked to a new, though oddly-shaped, site.

Across

1. Possibly is proof against wakefulness (9).
*9. Word that's a mean Spaniard's exclamation (6).
12. The introduction of slander and the end of your reputation (4).
14. Free from iridescence (3).
15. Could be "hello" with this in it (4).
17. Tree, an organisation found tidier (6).
18. The easiest afternoon's occupation (6).
19. (Part of new site).
21. Earnings see returns on fixed capital (4).
22. (Part of new site).
23. A lout was thus finally re-formed (4).
24. Small hill to take small pressure (4).
*25. Only a temporary gift, by the sound of it (4).
26. To clarify a situation that is muddled, Euclid had a meal (9).
31. (Part of new site).
32. Type of eclipse that can be seen from Honolulu and Narvik (5).
34. (Part of new site).
37. Bolted and barred – with iron from Durban? (4).
38. Manner that sounds averagely reluctant (4).
39. Knock the bloody drink back! It might kill you (6).
40. Fakers can produce unlikely results (6).
43. A calm spot where electrical activity occurs (5).
*44. Listens in to the genuine dry-run (9).
45. At no time lost nerve (5).
46. Measure the strength of bird-speed (7).
47. Timid, about to get led astray in drink (6).
48. Set up house in a street in poverty (6).

Down

*2. Our sea is choppy to start the adrenalin circulating (6).
3. Polymer claps it out (7).
4. It's not in the South. Oh yes it is! (3).
5. One unusual event, holding gun the wrong way round – it's against the rules (12).
6. Singular kind of boxing: self between puncher and punch (9).
7. Foolish fellow I, to inner self returning (5).
8. Head with a distinctive hat (4).
9. Model problem (5).
10. Change? Change later! (5).
11. (Part of new site).
13. Outcome of Ulster disturbance (6).
*16. What a comforter does about 7 – sure mistaken (9).
19. (Part of new site).
20. (Part of new site).
25. Average short answer – they won away at Hastings (7).
*27. Meal's infrastructure is insecurely pinned R and L; what one did off it, nevertheless (6, 5).
28. Mum, holding water (3).
29. Tune up, as about to give operatic numbers
*30. Change direction – the French footballer's action (6).
31. (Part of new site).
33. Followed a girl in extremity (6).
35. What keeps us here, to wander in woodland (5).
36. Outside diameter the German finds less concentric (5).
37. His prognostications' eerie content (4).
41. Queen visits half our site at Slough, and gets lost (4).
42. Starts kissing a tired executive? She was asked to (4).
*44. Area of stellar (eg) ionisation (6).

Crossword solution – maxim 2

Vol. 6, 1 p. 17

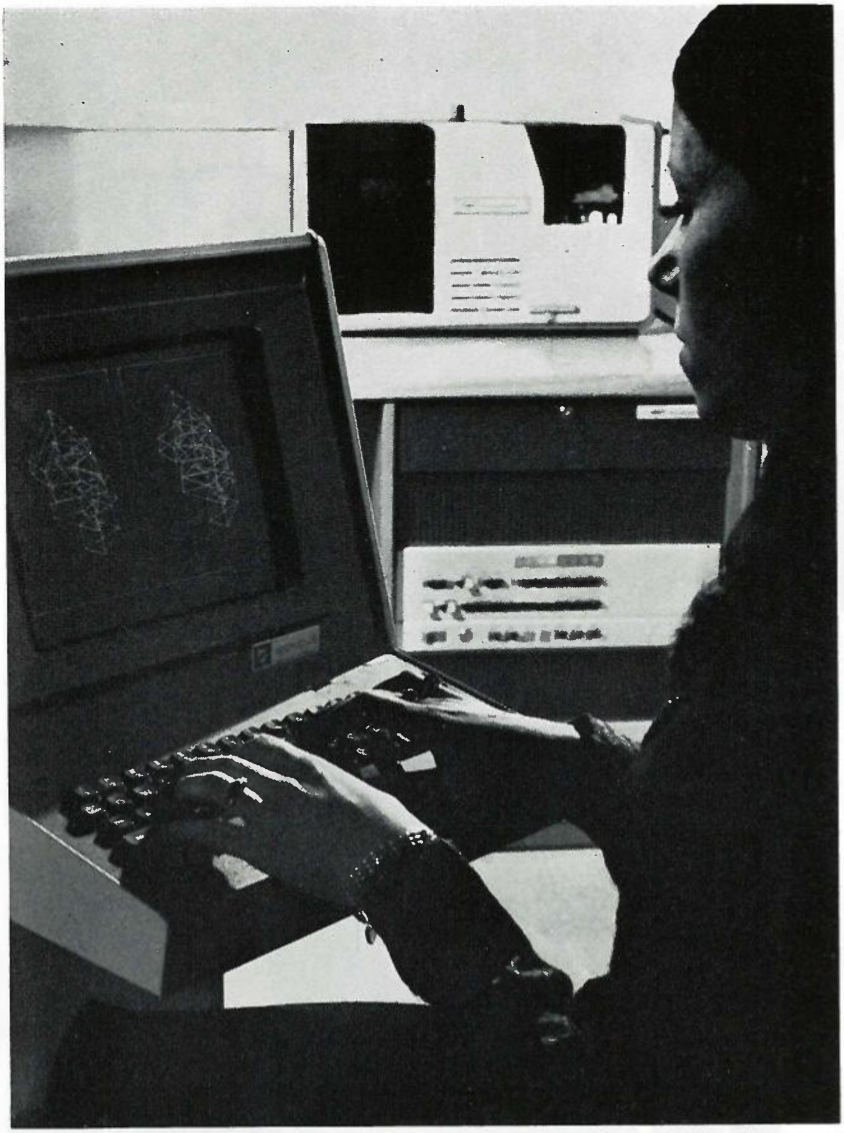
Across

1. Metamorphose
9. Eau
10. Whelp
12. Snaps
15. Peel
17. Seventy
18. Lent
21. Wry
22. Laser
23. Three
25. Egg
26. Eddy
28. Flowers
29. Brio
31. Daddy
33. Staid
35. Emu
36. Leaseholders

Down

2. Eve
3. Amp
4. Pea
5. Happy
6. Ouse
7. Evil
8. Awful
11. Lasts
13. Nineteen
14. Overload
16. Erred
19. Elgar
20. Nag
21. Wed
24. Reset
27. Yards
28. Foams
29. Boil
30. Idea
32. Due
33. Sad
34. Air

newsfront



'Lets see what I can do with this magnet . . .'

Seen left: A visitor to the Rutherford Laboratory stand at the Physics Exhibition in London, looking at a magnet design produced on-line to the IBM 370/195 computer at the Rutherford Laboratory. The design can be seen in 3-D through special spectacles.

That such a complex job can be done from so far away is due to GEC Computers' Remote Job Entry System 2050. Connected over telephone lines, the work station has a 300 lines a minute lineprinter, a card reader capable of reading 400 cards a minute and a teletype console. It can also communicate with various interactive programmes in the computer.

GEC also provided the photograph.

Seen on opposite page

Top: Mr G Joe Matthews (centre of picture) and his wife say 'au revoir' to the Director of the Royal Observatory, Edinburgh, Professor H A Bruck, CBE, (left) and Mrs Bruck. Mr Matthews was Professor Bruck's first member of staff when ROE had a complement of *one,* 15 years ago. He is now off to work at the 150 inch Anglo-Australian Telescope. Professor Bruck will receive an honorary Doctor of Science degree from the University of St Andrews on June 28 (his second Hon. D.Sc).
Centre: Seen on the Council visit to the Rutherford and Atlas Laboratories in May, l to r: Professor S F Edwards FRS, Chairman designate of SRC, Dr G H Stafford, Director RHEL, Sir Brian Flowers FRS, SRC Chairman, and Dr J Howlett, CBE, Director, ACL.
Below: House Journal Editors discuss their worries and troubles, Quest Ed is on right.

Nutcracker 12: answer
(see page 15)

One such sequence is (FC) (CB) (FC) (AB) (DE) (FD) (DE) (FC) (CB) (FD) (FC). I believe this to be the shortest possible sequence (11 moves) — can anyone beat it?

Seen right: **Mr Arthur L Jefferies, of the Royal Greenwich Observatory, receiving the British Empire Medal that was presented to him by Mrs Margaret Thatcher, Secretary of State for Education and Science.**

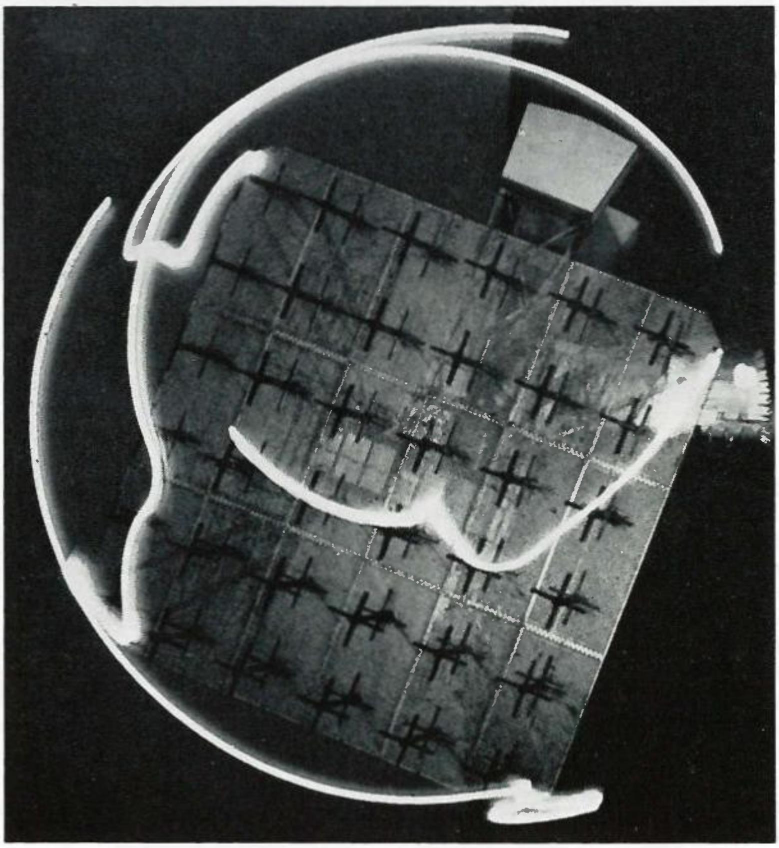
Birthday Honours

Quest offers congratulations to Dr J A Saxton, Director of the Radio and Space Research Station, who receives a CBE, and to Mr R H Elston, a Craftsman, also of RSRS, who receives a BEM.

Strange things seen at ESRO

Seen right: an impression of antenna movement during satellite tracking, as seen through the camera lens of Erich Hartmann of Magnum Photo.

ESRO commissioned Mr Hartmann to take several hundred photographs to illustrate ESRO activities. Some were on exhibition at the Photographers' Gallery, London, earlier this year and some have been published in an album 'Space—focus earth' (£4.20, pub. Arcade, Brussels). Of his assignment, Mr Hartmann said 'I had the singular opportunity of seeing through the camera scientific and technological enterprise of imagination and boldness'.



'It worked . . . but now it's had its time too'

'It works and about time too'. Historic words in the world of computers, for they were the first program run by Professor David Howarth and his team as a simple test routine on the line printer of the original Atlas computer.

Appropriately it was David Howarth, now Head of the Institute of Computer Science at London University who used those words again to run the final program in the computer when it was shut-down after eight years of service by SRC Chairman, Sir Brian Flowers, on Friday, March 30. An invited 'family gathering' of many of those who had been associated with the machine since its inception, watched the ceremony.

Introducing the speakers, Director Jack Howlett referred to the presence of Lady Cockcroft, to Dr Pickavance 'father of the Chilton site' and to Basil de Ferranti, who represented the original Atlas manufacturers and later amused the audience with anecdotes of early Atlas days.

Before pressing the close down button, Sir Brian pointed out that he was closing down a computer and not a Laboratory! In future the Laboratory would provide a more specialised service for specific projects rather than continuing its earlier role of topping-up the computing power of the universities.

Now parts of the machine will depart – some, no doubt to the breakers yard but others to immortality in the Science Museum.

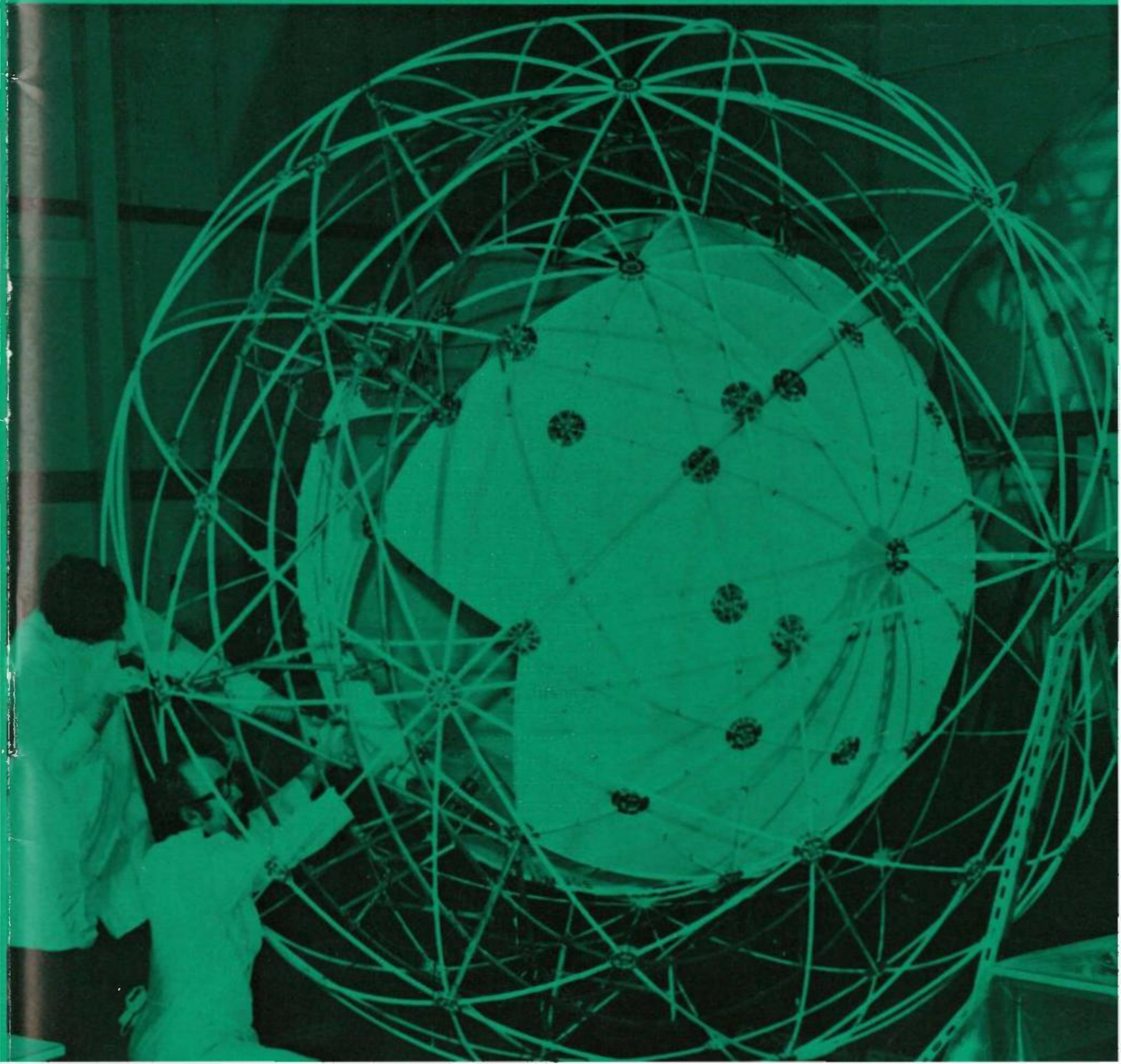
Seen above (l to r) at the closing ceremony:

Sir Brian Flowers FRS, Chairman of SRC, who joined the Computer Board in 1965.

Mr Basil de Ferranti, Director of International Computers Ltd and of Ferranti Ltd, the Firm who built the original Atlas computer;

Dr Jack Howlett, CBE, Director of the Atlas Computer Laboratory;
and Professor David Howarth, Head of the Institute of Computer Science at London University, who ran the first and the last programs on the first Atlas computer, 1965-1973.

QUEST



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QUEST

House Journal of the Science Research Council

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Editor

Vol. 6 No. 3
1973

contents

Balloon stops rays

Cover Picture: **the skeleton of a gas scintillation counter that is to be flown under a helium filled balloon 25 miles up to measure the abundances of heavy elements in primary cosmic rays.**

The equipment is being made by the British Aircraft Corporation Space Systems Division for SRC supported research carried out by Professor Peter Fowler's Group from the Physics Department of Bristol University.

Within its field Professor Fowler's Group is one of the foremost in the world. Cosmic rays are a very high energy radiation whose energy is not known. To study them, detectors need to be flown as high up in the atmosphere as possible to measure the rays before they are altered too much by collisions with the material of the atmosphere. The flux of cosmic rays is not very great so the detectors have to be exposed to them for long periods. For this reason and because the apparatus is bulky the experiment is not suitable for flight in sounding rockets.

At present the balloon is the most useful vehicle for this type of research and Professor Fowler has an SRC grant to support his examination of cosmic rays with the object of determining the nature of the bodies or other sources that they originated from and the conditions prevailing there. He also has a grant to investigate the charge spectrum of very heavy cosmic ray particles.

It would be even better if the rays could be studied from outside the atmosphere, and a proposal from the Group for a satellite borne detector has been put forward for consideration. Professor Fowler is a member of the SRC Astrophysics Working Group and a member of the Space Policy and Grants Committee.

Photo by courtesy of BAC.

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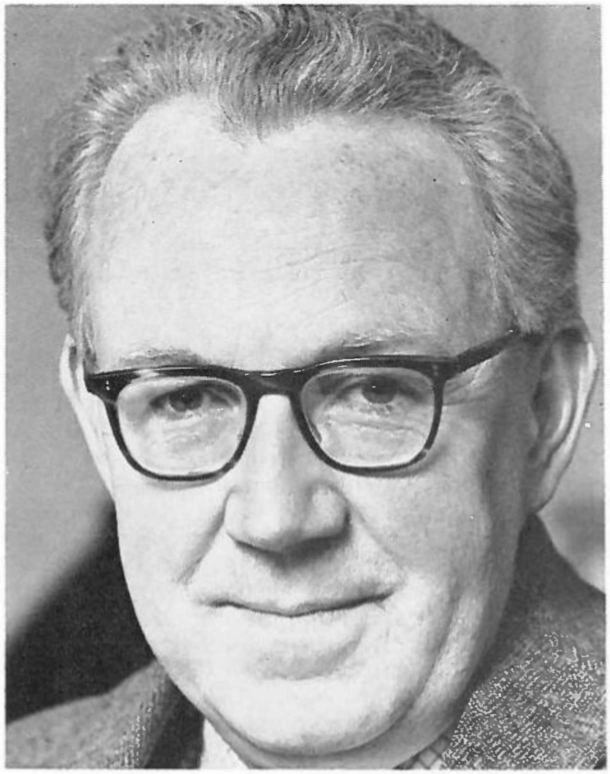
To the staff of SRC from Professor Edwards



It is a great honour to become Chairman of the Science Research Council. I have had several years' experience of the Committees and Boards of the Council and therefore know the excellent support which I will get from the staff.

Sir Brian has left SRC in good heart. After the reorganisation of the Government's support for research and development, SRC has had its position as the principal agency of selective scientific support of the universities confirmed, the Civil Service Department's review of its management has given SRC high praise, and a first class scientific programme is in hand and planned. But the future will have to be within a restricted budget, and there will be a number of problems to be sorted out. I am confident we can continue the standard of support that SRC has given British science in the past, and look forward to SRC achieving even more success in the future.

I have already paid flying visits to the establishments and hope to repeat them regularly so that I can become well known to you and hear your views.

Sir Brian thanks SRC staff

'I am delighted with the choice of my successor. I couldn't have wished for a better one', said Sir Brian Flowers at the SRC Annual Report Press Conference on September 26, four days before his office passed on to Professor S F Edwards FRS. Later, talking to the London Office staff about the Report, he said that he had known Professor Edwards for a long time. They had even attended the same school, although that was before they met. 'He and I and Dylan Thomas and Harry Secombe all went to Swansea Grammar School'.

About his six years with SRC, Sir Brian said 'Together I think we've done more good than harm, and that's more than can be said for many people. It's been a very stimulating experience for me and I know I shall remember it. That's more thanks to the staff of SRC than to anything I have done'.

---

editorial

On Saturday, August 11, at Bushey, Miss Anne Smith, Editor of *Quest*, became Mrs Anne Walls when she married Robert (Bob) Walls, a fellow Council Employee, formerly at the Radio and Space Research Station.

Bob has now gone to work at CERN as British liaison official. He is looking after administrative matters on behalf of British experimenters using the CERN facilities.

Anne will be joining him at the beginning of November. *Quest* is therefore losing an Editor and this is the last issue to appear under her name.

Since being appointed Editor in the 'Year of the Lunar Samples,' Anne has worked diligently to raise its editorial content and presentation to a level which will appeal to as many of the Council's diversified readership as possible. She has worked very happily with the editorial board of representatives from each of our establishments and, at the same time (and often in her spare time) she has studied editorial and printing techniques. She recently passed the examination of the British Association of Industrial Editors.

Now she is hoping to continue in similar employment in Geneva.

We are sure that all readers will join with the editorial board, in wishing both Anne and Bob many years of happiness and prosperity together.

The Council is now in process of appointing a successor who will, it is hoped, continue to produce a journal of comparable quality at quarterly intervals.

There may, however, be a short interval before the next issue appears and we hope that readers will bear with us while the change over takes place.

ILA

Daresbury has a machine for the future in view

Some plans and possibilities for a Nuclear Structure Facility

D A Eastham

Recently there has been a good deal of discussion at Council level about the future programmes of research at Daresbury and Rutherford, and how to strike the correct balance between the use of the two high energy accelerators NINA and Nimrod and the facilities at CERN. The present programme is that NINA will cease to be available for high energy physics within the next few years, though Daresbury will continue to support research in this field at CERN.

Thus one aspect of the future role of Daresbury becomes more definite. Another aspect is the laboratory's increasing involvement in nuclear structure physics (as opposed to high energy physics). For two years a considerable amount of effort has gone into a design study for a national nuclear structure facility (NSF), incorporating a very large and advanced electrostatic accelerator.

Plans put forward

This has been accompanied by an extensive research and development programme. In January the Council gave its approval to the construction of the NSF at Daresbury, and it is hoped that final approval from the Department of Education and Science and planning permission will soon be forthcoming. The capital cost of the facility including some initial experimental equipment is about £5M and the building and commissioning is estimated to take 4½ years. During this period the staff at DNPL directly associated with the project is expected to build up to over 100.

This facility will be an accelerator of the kind known as a tandem Van de Graaff, and from its completion in 1977 it will be used by nuclear structure physicists throughout Britain, especially those in the northern universities.

Most people know that atoms have a nucleus consisting of particles called protons and neutrons, which is surrounded by a cloud of electrons. Nuclear structure physicists study the way in which protons and neutrons bind together to form nuclei. This is in contrast to high energy physicists, who study the properties of individual particles themselves.

. . . for exciting experiments

Nuclear structure physicists get their information about the nucleus by bombarding it with particles, usually the nuclei of other atoms, which have been accelerated in a particle accelerator. The problem is that nuclei are electrically charged, and so they repel one another. The electrical charge is proportional to the number of protons the nucleus contains, so the heavier the bombarding nucleus, and the heavier the target nucleus, the more energy the bombarding nucleus must be given to overcome this repulsion.

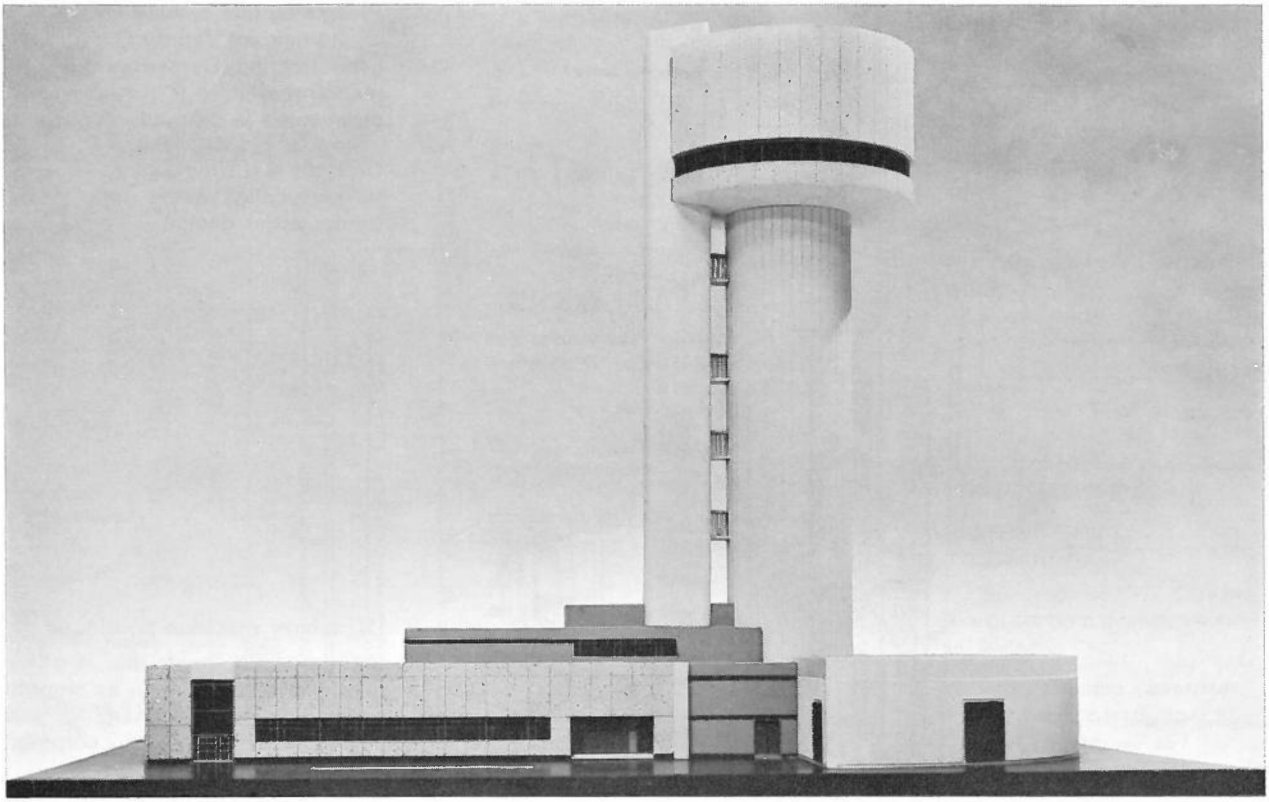
Because of this, most nuclear structure work so far has been confined to using relatively light nuclei as projectiles. For example, with an existing accelerator generating 6 MV, oxygen (atomic weight 16) can be made to interact with magnesium (atomic weight 24). The Daresbury NSF will allow a wide range of nuclei to be accelerated to much higher energies so that, for example, iodine (atomic weight 127) could bombard uranium (atomic weight 238). There is a great number of very exciting experiments which can be done with such a machine, including the search for "superheavy" elements – stable, or nearly stable, atoms much heavier than those which occur naturally.

In an accelerator, nuclei are accelerated in the form of ions. These are atoms with one or more electrons missing (positive ions), or with one or more electrons too many (negative ions). Positive ions are usually much easier to produce, and so tended to be used in earlier accelerators.

Van de Graaff accelerators are not new; they have been around almost since the beginning of nuclear physics. They consist of a terminal supported on an electrically insulating column, and an insulating tube with a vacuum inside, with one end connected to the terminal and the other to earth. The terminal is charged positively by means of an insulating "conveyor belt" which carries charge up to the terminal. Positive ions are produced from a source inside the terminal, and being repelled by the positive charge on the terminal, accelerate down the tube and can be used in experiments.

High voltage . . .

Clearly, the higher the voltage that can be maintained on the terminal, the higher the energy of the resulting ions. To enable higher voltages to be reached both the tube and the column are divided into sections of alternate metal and insulator, and a chain of resistors is used to keep each metal section at a different potential, between that of the terminal and earth. This keeps the electric field along the column and tube uniform, which means that elec-



trical breakdown (sparking) is less likely to occur. A further increase in the terminal voltage can be obtained by enclosing the whole accelerator in a high pressure insulating gas such as nitrogen or sulphur hexafluoride.

The picture above shows a model of the proposed building to house the Nuclear Structure Facility. The tandem accelerator will be housed in the tower (230 feet/70 metres high).
Experimental halls, control rooms and a service area will be in the surrounding buildings.

for a leap forward

A diagram of a simple Van de Graaff accelerator is shown in the picture on page 5.

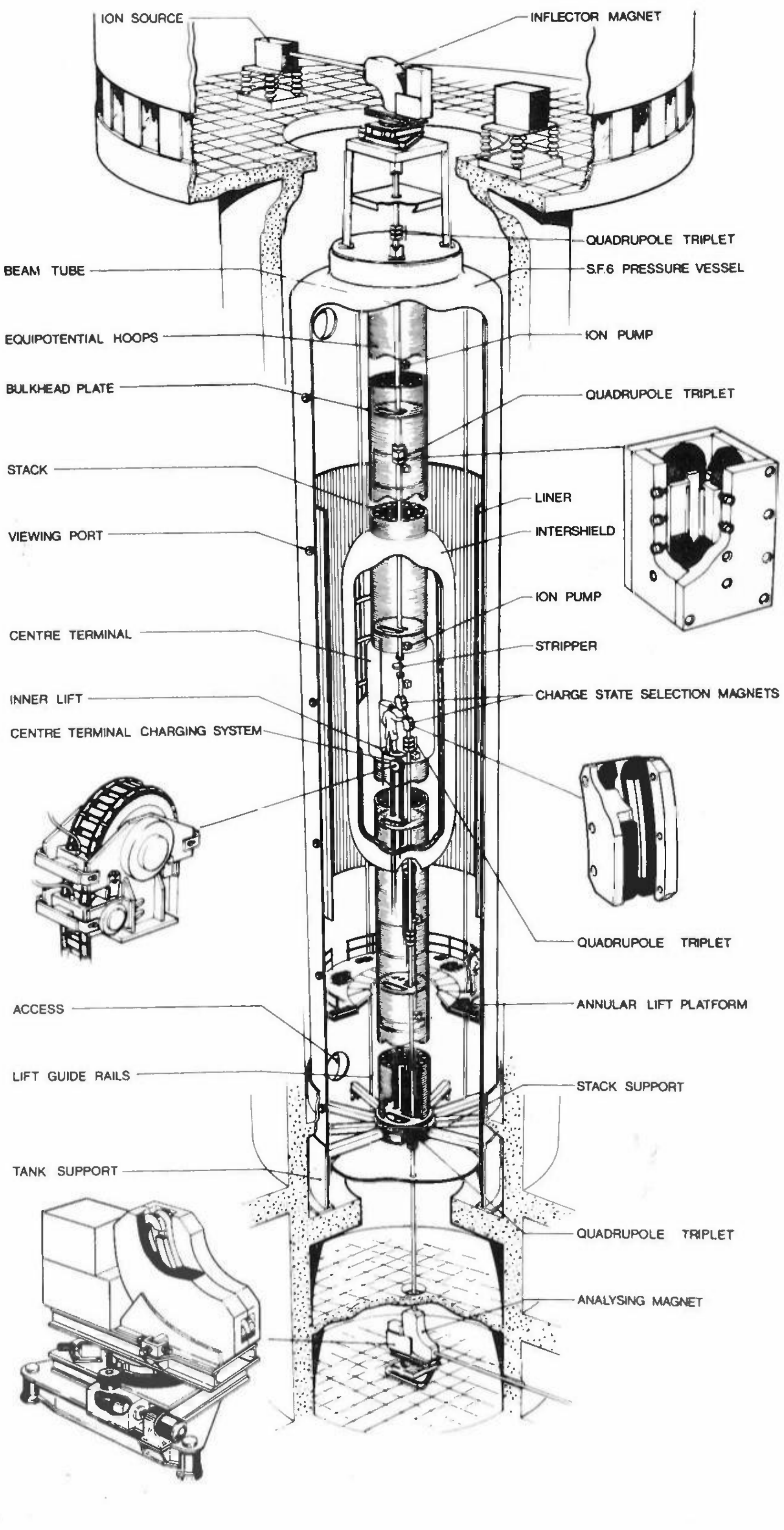
A tandem accelerator, like the one to be built at Daresbury, is one stage more complicated (see picture on page 4). It has two columns and two accelerating tubes placed end to end with the high voltage terminal in the middle. Negative ions are produced at one of the earthed ends and, being attracted by the positively-charged terminal, accelerate towards it down the tube. At the centre terminal they pass through a "stripper" (usually a gas or a thin foil), which removes some of their electrons and converts them into positive ions. They are now repelled by the terminal, and continue accelerating away from it down the second tube, for use in experiments.

A typical existing machine will have a terminal voltage of 6 MV, and the most powerful machine under construction elsewhere (at Canberra in Australia) is expected to develop 14 MV. The Daresbury machine is designed to produce up to 30 MV on the terminal, and thus represents a great leap forward in accelerator technology. To prepare for this, an extensive programme of research and development was necessary at Daresbury. This was carried out in collaboration with universities and UKAEA Establishments. Many of the problems connected with Van de Graaff accelerators, particularly the high voltage problems, were very poorly understood before this study, and great progress has been achieved in putting the design of this kind of accelerator on a more scientific basis.

The high voltage problems have been the trickiest, but at last a design of insulating column has been produced which will withstand the voltage gradients expected in the NSF. A special method of joining the metal and insulating sections of the tube has also been evolved which will allow a far better vacuum inside the tube than in most existing Van de Graaffs.

The Laddertron

One of the most interesting developments is a new kind of charging system called the "laddertron", developed in collaboration with the University of Reading. This replaces the old continuous insulating belt with a series of metal "rungs" coupled



Picture on left: a diagram of the tandem Van de Graaf generator that Daresbury are planning to build if planning permission is granted.

On right is a simple generator that shows the fundamental design.

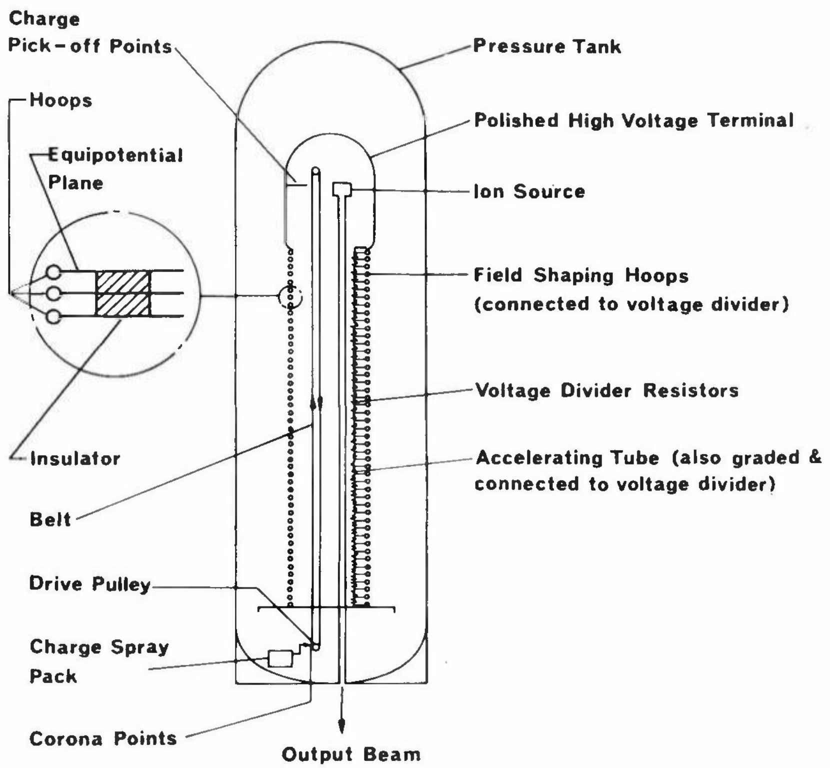
Daresbury machine continued

together with insulators. It offers many advantages such as smooth operation, uniform charging, and absence of dust (a common malady with belts).

Considerable study has also been necessary on the control of the ion beam. Because of the length of the accelerator tube and the variety of ions to be accelerated, three sets of magnetic focusing lenses have had to be included inside the machine. There is also a system of magnets within the centre terminal to make sure that, after stripping, only ions with the right number of electrons missing continue on their way. Detailed computer calculations have been made on the beam optics of the machine.

The NSF itself will be housed in a 70m (230 ft) tower see picture on page 3. A semicircular building at ground level will be used as an experimental area, with a number of different beam lines, and an adjoining three-storey building will contain the counting room, control room, and service areas. Space on the site is being reserved for possible later extensions, such as a linear accelerator or a cyclotron.

It is clear that the NSF will provide the United Kingdom with an experimental facility unique in the world.



Quest quarterly quote

'. . . I must first apologise for my delay in replying. This has been due to an abnormally high amount of work which has necessitated my absence from the office during the past few weeks.'

Letter from an LO Committee Secretary

'600 ON THE WAY IN WHITEHALL SHAKE UP

'BOFFINS SHIFT TO SWINDON

'Hundreds of Civil Servants are to set up a headquarters in Swindon.'

Swindon Evening Advertiser Report on proposed move of 388 SRC posts and 191 NERC posts to Swindon

We take a look at the sea

'Ultimately, it may well be necessary to get away from "hunting" of fish and find ways of farming the sea', says a recently published SRC Report on Marine Technology. The Report was written by a Panel set up to look into university research and training in all aspects of marine technology as it exists at present and to make recommendations for the future.

'There are many economic factors which will force man to turn more of his attention to the sea', says the Report 'and the rapid advances which mean so much to technology on land, in the air and in space can be equally productive at sea.'

'If the resources of the sea and sea-bed are to be harnessed for the benefit of mankind . . . it must be done wisely and carefully so that the ecology is not permanently damaged. The design of better equipment to operate in a marine environment clearly depends on fundamental and applied research of the highest order.'

The Report names the four main aspects of Marine Technology as: the production of off-shore oil and gas; the transport of these, and other, problem materials by sea; the fishing industry; and underwater activities, such as dredging and perhaps, later, building of well-heads on the sea floor for oil and gas sources found in deeper water.

When the Panel was set up the members knew that a number of research programmes were currently sponsored by SRC and that there were some university departments with considerable interest in and knowledge of various aspects of marine technology. But no up-to-date information existed as to the full extent of research in progress sponsored by universities, industry and other agencies.

So two questionnaires were sent out: one to gather current information and the other to collect suggestions for future research within universities. The Panel found the response to both very good indeed. The number of suggestions for new work ran to several hundreds.

Since all the projects were put forward by academics or industrialists active in marine technology, the Panel knew that it was not likely that many would be complete non-starters so far as attracting financial support was concerned, but it would clearly be impossible for SRC to support them all.

Each member of the Panel assessed the replies within a

Look at the sea continued

certain field and compiled an edited list of topics to which university research could reasonably contribute. The Panel has not recommended support of very large and complex projects that are probably not suited to a university environment. It feels that the money would be better spent on improving fundamental knowledge and widening the education of students. The lists are published as an Appendix to the Report – high priority subjects are asterisked – for the guidance of universities seeking support.

focus wider knowledge on the chosen areas

The Panel recommends that each group of research workers supported by SRC should maintain a broad interest in marine technology while becoming a focus of research activity in chosen areas. Research should preferably be tackled by multidisciplinary groups consisting mainly of engineers – mechanical, civil and electrical – and naval architects. These would be joined by physicists, metallurgists, applied mathematicians and marine biologists as and where required.

It is possible that such a group could exist within a university department, but the Panel would prefer to see a separate Centre or Unit set up that would have staff from different departments seconded to it or would even farm out work into other departments. Since the work should also be related to economy and viability, the Panel suggests that economics and planning departments should be involved, as well as engineering and science departments.

some things to think about

About one-sixth of the present world oil production comes from underwater sources and one of the biggest maritime transport problems is how to construct tankers that will transport it safely.

The world fish catch in 1970 was 69.3M tons: about 60M tons came from the sea. This is three times as much as 20 years ago and represents about 12% of the present protein consumption of humanity. Better ships, fishing equipment and processing plant are needed to improve the UK fishing industry and the competitiveness abroad of the associated manufacturing industry. Developing countries are asking for advice over the whole range of the industry, from catching and processing to distributing, and in the construction of port and land facilities.

Eleven million tons of gravel are being dredged from the bed of the Channel and the North Sea at depths of 30-50m. More and more is needed for harbour works and land reclamation in projects such as Foulness. As we dredge deeper, new tools, power supplies and even vehicles will be needed for use under the sea. Eventually, oil and gas wells may be installed and serviced on the sea floor itself.

These are only some of the things that may benefit from support of research into marine technology.

An NP laboratory controls a telescope

'The most advanced telescope control system in the world' is how CERN describes the fully computerised system that has just been built for the European Southern Observatory (ESO). The system is the first concrete result of the ESO-CERN collaboration. ESO, based at Hamburg and the La Silla Observatory in Chile, have established a telescope design and development division at CERN, Geneva, and a laboratory* for processing the sky photographs taken by ESO's 1m photometric telescope.

Belgium, Denmark, France Germany, the Netherlands and Sweden are the member countries of ESO. Switzerland is a member of CERN but not yet of ESO. There are five telescopes at present on ESO's mountain site 600km North of Santiago on the edge of the Atacama Desert. A Danish 1.5m telescope is being built, and a 3.6m reflecting telescope is being designed at the ESO division at CERN. CERN staff have contributed their experience of designing big and delicate machinery and computer control systems for nuclear physics research. 'The system will have accuracy and flexibility of operation previously unknown in astronomical circles' claimed the CERN-ESO press release announcing the system's departure for Chile, followed by the five members of the installation team – J Van der Lans and J Van der Ven of Holland. P Stürzinger and R Zurbüchen of Switzerland, and S S Lorenson from Denmark.

The control system was developed as a prototype for the 3.6m telescope but soon proved so successful under test that ESO decided to fit it immediately to their 1m telescope.

When switched on the computer will direct the telescope to a

*The Laboratory will also be used in conjunction with SRC to produce an atlas of the Southern Sky from photographs taken with the SRC 48 inch Schmidt telescope in Australia and the ESO telescope in Chile.

predetermined position and begin to compensate for the rotation of the Earth when the astronomer types in the sidereal time. To point it at a certain star, the astronomer will type in its co-ordinates from the star catalogue or indicate one already in the computer memory. He can feed in a complete programme of work on punched tape and leave the rest to the computer. When moving the telescope to new positions, the computer steadily builds up the speed of the drive motors to a safe maximum so that delicate components are not damaged by sudden movements, and they are slowed down in a similarly controlled way before the telescope reaches the target. This means that as little time as possible is wasted. The astronomer can set the telescope via the computer by push button operation. If he wants to offset it for a check on sky background intensity he will indicate how many steps he requires. Afterwards the computer will reset to the previous position without further instructions. The control soft-ware is installed permanently in the in-core memory which is not likely to suffer mechanical breakdown. But there are emergency switches to cut the power from the telescope. If it descends too low, for instance, a large ball in a conical container will roll out at a very precise angle of tilt to disconnect the circuit. But if necessary the astronomer can over-ride the computer and steer the telescope himself.

Because of possible supply difficulties in Chile, particularly just now, the system has been given intensive in-house tests to make sure that last-minute modifications won't be necessary. The team have also made sure of taking everything they might need with them.

SRC improves post-graduate training research

A third of SRC funds is spent on awards for universities and other centres of higher education. Of this, two-thirds goes to research grants and the rest is used for post-graduate training and education. Facts that SRC staff working away in our own research establishments may not be very aware of. What you probably do know is how much of your own, or perhaps your Establishment's, effort is concerned with providing research facilities for research workers from those centres and, less tangibly in money terms, providing a place where ideas can be freely exchanged both nationally and internationally: 'further' education indeed.

Below are some of the things mentioned about post-graduate training and education in the SRC annual report for 1972-3.

The funds given to Engineering Research and Training have doubled since 1967 in current money terms, says the SRC Annual Report and this field will continue to have special priority for two more years at least. 1,000 extra studentships have built up schools of post-graduate engineering and computing science, with preference given to specialist and vocational advanced courses rather than research training.

Professor Ford and a special Panel have just completed a study into the most useful sort of post-graduate training for engineers who do not intend to enter research or academic careers. Their findings are published in the SRC Report called 'Total Technology'. The term (coined by professor Ford) is used to denote instruction in Engineering Science combined with training in the related commercial, economic and management activities that will fit an engineer for a career in industry. The first courses and research projects in Total Technology begin at Aston, Cambridge and Strathclyde Universities in 1973. They will be carefully watched, and developed in the light of experience.

a better service

Since 1966 SRC has developed its central facilities and services for the common use of universities and SRC establishments alike. In 1966/7 only a small amount was spent but by 1972/3 the amount had reached £3.3M for new facilities like the telescopes in Australia, the Physico-Chemical Measurements Unit, the Polymer Supply and Characterisation Centre and Neutron Beam and X-Radiation Research Facilities. The SRC establishments, too, have increased their support of university research.

The SRC's four Boards – the Astronomy, Space and Radio Board, the Engineering Board, the Nuclear Physics Board and the Science Board – have a dual function. They advise the Council on the award and administration of post-graduate studentships and they also administer SRC's research support. So their knowledge of the strengths and interests of university departments gained in giving research grants can be applied to reviews of training schemes and studentship allocations.

Membership of the Boards and their specialist committees represent academic, industrial and Government interests in post-graduate education and research. Prospective employers in industry, the scientific community and Government Departments therefore participate in SRC decisions. Training opportunities are constantly balanced with employment prospects and educational requirements so that limited resources are used to best advantage.

unemployment avoided

For example, the ratio of post-graduate awards made has not kept pace with the increase in the number of graduates between 1966 and 1972. Awards have been related to long-term national needs for highly trained man-power. As a result, serious unemployment among post-graduates has been avoided and now that the employment situation has improved, there is still no shortage of highly qualified people.

The proportion of SRC's total funds spent on post-graduate education was 12% in 1973 compared with 13% in 1966. But the drop is also partly due to the fact that maintenance grants, fees and other support grants have not increased as quickly as prices in other sectors of SRC expenditure.

The studentships for people who have been in industry or school-teaching for a few years since graduation have now been opened to graduates from other types of employment.

Business and administration games form part of a course to help graduates in their choice of career. The intellectual challenge of work in industry, commerce and Government is demonstrated in an intensive one-week course. About seven courses a year are held in different parts of the Country.

An economical way of giving research students a chance to get instruction in very specialised subjects, is how SRC describes its Vacation Courses. In 1973 Lasers and Non-Linear Optics, Magnetism and Polymer Technology were covered; next year it will be Molecular Physics, Perfect and Imperfect Crystals, Plasma Physics and Polymer Technology. SRC runs each course for three years so that it can be judged and, if successful, be taken over by universities.

SRC express a hope in the Report that the discrimination against some married women in the maintenance grants for research students will be eliminated in the next triennial review of these grants. Also that the allowance for older students will be set high enough to encourage more people to return to training after a few years in employment.

The stipend for Fellowships has now been raised to the University Lecturer scale, and should attract more people to apply. However, the standard expected of the candidates will be very high.

Giant is aimed higher for European physics

The target for CERN's giant proton synchrotron is now 400 GeV instead of the 300 GeV maximum energy envisaged when the member countries of CERN first decided to build it.

When the decision was made, the size of the synchrotron ring was fixed but the form of the eight-year building programme was left flexible so that it could be improved in the light of the latest technical developments. One of the possibilities foreseen was a pause at 200 GeV and the introduction of superconducting magnets into the main ring to make a higher energy level possible.

The decision to go to 400 GeV is based on iron-cored magnets throughout and without any pause at an intermediate energy level. Dr B J Adams, Director-General of CERN Laboratory II (the SPS Laboratory) said that although pulsed superconducting magnets had now been shown to be technically feasible, there were still unknowns, such as cost, reproducibility and manufacturing time scales that prevented them from being adopted for the main ring, where reliability is of prime importance. Nevertheless, there will be a place for them in the experimental areas.

Not only will 400 GeV be reached within the original budget but the machine will be ready for the first physics experiment during the sixth year of the programme. The decision to aim for 400 GeV was taken at the CERN Council's 50th session which coincided with the 20th anniversary of the signing of the CERN Convention.

In order to meet the target date, considerable effort will be demanded from European Industry as well as from the team at the Laboratory which is responsible for design and construction. The principal buildings are complete and 1,200 metres of the ring tunnel has been bored. Nearly all the main components of the machine have been ordered and the cores and windings for the first production magnets have arrived on site. Work has begun on the 380 kV high tension line between Genissiat in France and the electric sub-station at CERN, and on construction of the reservoirs and pipe-line for the cooling water supply from Lac Léman on the Swiss side of the site.

A visit from an old friend

During a visit to England in June, Professor Peter Kapitza, the renowned Soviet physicist, and his wife Anna, visited the Daresbury and Rutherford Laboratories.

In the photograph of their visit to Daresbury are (left to right) Mrs Kapitza; Professor A Ashmore, Director of Daresbury Laboratory; Mr M J Moore, OBE, Head of the Engineering Division; Professor Kapitza, FRS; and Dr David Shoenberg, FRS, Director of the Royal Society Mond Laboratory.

Professor Kapitza was particularly interested in the Laboratory's Synchrotron Radiation Facility. Fifty years ago he was at the Cavendish Laboratory, Cambridge, with Lord Rutherford, working with John Cockroft on producing magnetic fields of up to 300 kilogauss and in developing a cryogenic laboratory. He became Assistant Director of Magnetic Research in the new Mond Laboratory from 1924 to 1932 and then Director of the Laboratory. In 1935 he returned to the Soviet Union to continue his work in low temperature physics.

He then became Director of the Institute of Physics Problems of the USSR Academy of Sciences; he has been a member of the Academy Praesidium since 1961. He is editor of the Soviet Journal of Experimental and Theoretical Physics.

The work for which Professor Kapitza is best known is his discovery (in 1938) of the superfluidity of helium II (=helium at temperatures within 2.2° of absolute zero) and his studies into its behaviour and into its application to the production of machines for producing liquid air commercially. The papers he published gained the Soviet State Prize for Physics in 1941 and 1943. Another Soviet physicist, Lev Landau, went on to clarify the quantum properties of liquid helium and to gain the Nobel Prize in 1962.

In the 1950's Professor Kapitza turned his attention to the nature of ball lighting and published his hypothesis of Standing Waves. He received the Lomonosov Gold Medal (USSR) in 1959 and the Rutherford Medal of the Institute of Physics (UK) in 1966 for his work in low temperature physics. He has received similar honours from many international scientific institutions. He became a Fellow of the Royal Society in 1929.

A seven-foot crocodile (a sculpture by Eric Gill) on the wall of the Mond Laboratory recalls the days when he was one of Rutherford's team of promising young men and chose the 'animal-who-never-lets-go' to symbolise the great man. (His one-time secretary, Joy Clarke, wrote an article for *Quest* about the Cavendish, the Mond and the crocodile, *see Vol 4, 4 p.6*).

Dr David Shoenberg, FRS joined the Mond Laboratory in 1932 and has been its Director since 1947. He is Reader in Physics of Cambridge University and UNESCO Adviser on Low Temperature Physics. His publications include papers on low temperature physics and magnetism.

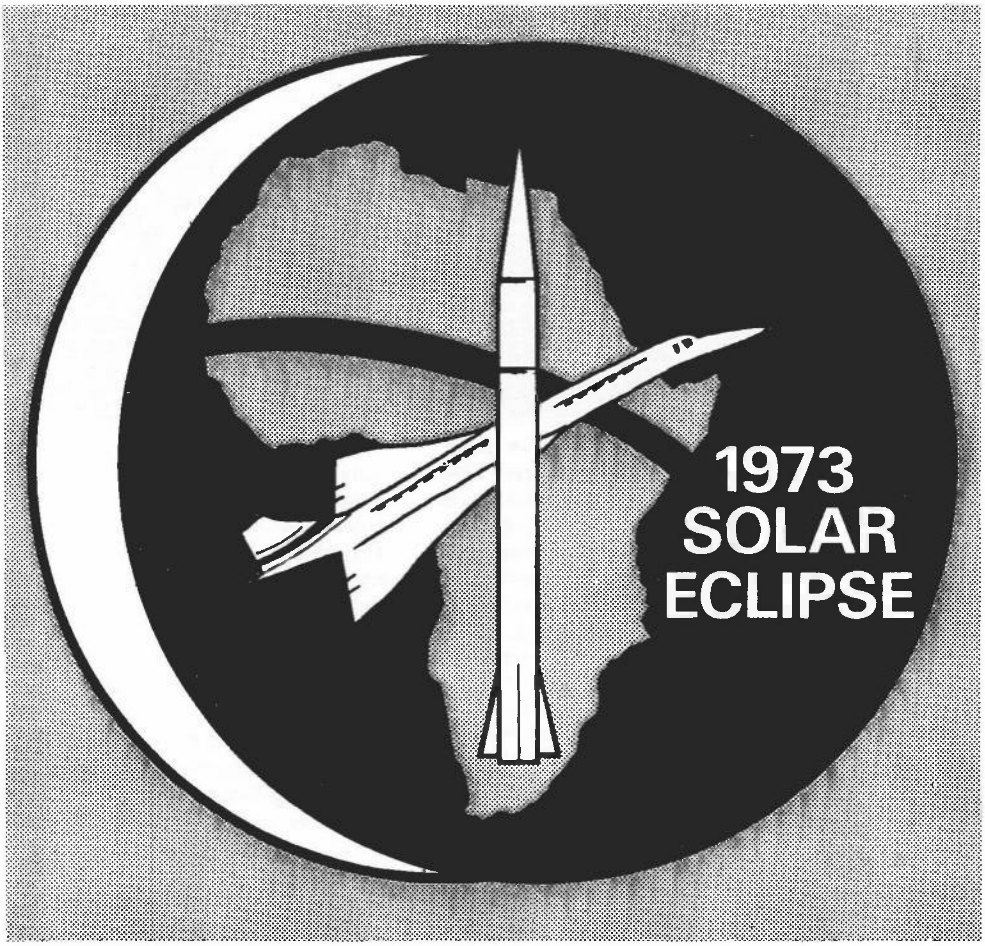
Guess what . . .

'The invention . . . took place in the face of four major criticisms:

1. by scientists who said it was not physically possible;
2. by technologists who said it was not technologically feasible;
3. by biologists and materials scientists who said it wasn't necessary;
4. by industrialists who said there was no market for it.'

Taken from a summary of a lecture given by Dr T Mulvey, Professor of electronic physics, University of Aston. The talk, in the Rutherford Laboratory Lecture Series, was about the remarkable development of the Electron Microscope, the disarming of its critics and the enthusiasm with which it has been adopted and applied to scientific problems in many disciplines.

J D Lawson,
Rutherford Laboratory



. . . or a shot in the dark

H J B Paxton

In 1970 a small group of British engineers and scientists took part in a unique eclipse observation by rockets, fired from the NASA launch site at Wallops Island, Virginia, USA. It was unique because, for the first time since rocket-fired experiments began, an eclipse of the sun (on March 7 1970) came close enough to an established rocket range for the larger, high altitude, sounding rockets to be used to observe it.

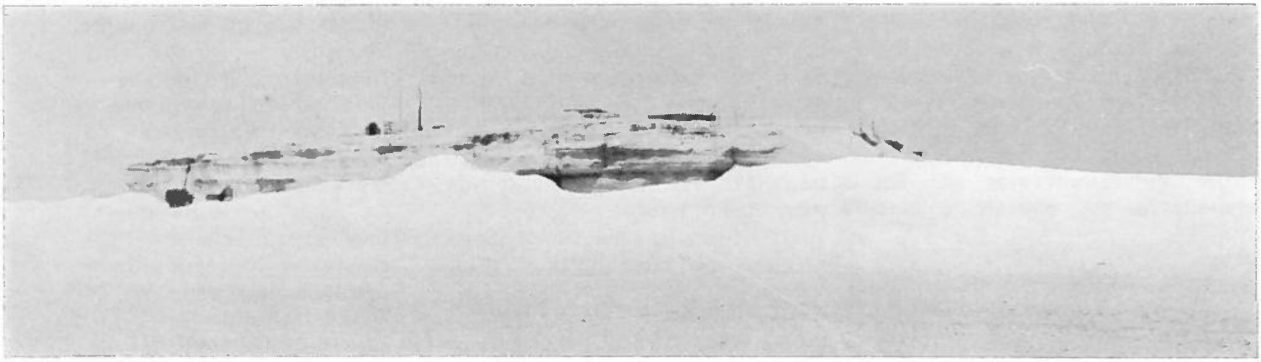
It was far from an easy task. The sun-pointing system that keeps the rocket on course had to operate after the sun 'went out'; the launch time had to be right to within a second or so in order that the all important 'second contact' of the moon's disc was observed. The film on which the photographic records were made had to be sealed into watertight containers so that they could be dropped by parachute into the Atlantic ocean and recovered by US Navy frogmen who would transfer them to a helicopter for safe delivery into the hands of the experimenters. All in all what the grant committees would call a 'high risk' experiment.

But it worked, excellent results were obtained and the undamaged payload and the rest of the data obtained was brought safely home to give valuable information on the ultra-violet regions of the sun's spectra as seen in the moon's shadow. Later, it was proudly demonstrated to Her Majesty the Queen Mother at a Royal Society Soirée. And there we thought, the matter ended. But the solar physicists thought differently.

The 1973 'Eclipse of the Century' (see previous *Quest* p.12) did not pass close to an established rocket range. So NASA commissioned a team of experts to examine the predicted track of the moon's shadow over the earth, to establish whether it would be possible to launch an Aerobee rocket from a temporary launch site. The track of the shadow stretched from South America to the eastern coast of Africa, 10,000 miles in all. In the centre, the 160 mile wide shadow passed over the Cape Verde Islands off the West Coast of Africa, over beautiful Lake Rudolf in Kenya and over the cool beaches of Somalia on the East African coast. I suppose it was inevitable that the site chosen as most suitable for the launch would be in a desert!

a remarkable spot

Mauritania, the chosen spot, is nearly all desert and therefore sparsely populated; but if you intend to pitch a ton or so of metal a hundred miles into the



air and drop it back to Mother Earth it is sensible to keep possible human targets to a minimum.

The Republic of Mauritania was formerly a part of French West Africa. The port of Nouadhibou, near the northern border with Spanish Sahara, handles the iron ore from a large mine inland. The coastal waters are some of the richest in the world and fishing vessels from as far away as Russia and Japan are regular visitors. The people are very friendly although their patience can be tried by a Pidgin-French-speaking Englishman negotiating for a pint of eau mineral.

The site chosen for the launch was an outcrop of sandstone just outside Nouadhibou. Once used as a fortification, the Remarkable Table (as it is known locally) has a cavern beneath, which was formerly the ammunition store, and a small building on the surface which was probably used as offices and living accommodation. Whoever was responsible for the layout must have been endowed with 'second sight'; he could not have done better if he had known that it would later be used for rocket launching.

I arrived ten days before the launch, with Steve Lillington and Allan Ridgeley, all from the Astrophysics Research Division of RSRS. The American launch team from Kitt Peak National Observatory had transformed the 'Table'. With the rocket launcher and its power supplies on top and the control room in the cavern below, the place looked like any established launching site. Radio theodolites were mounted on the old gun emplacements and aerial arrays erected to give communication links not only with the aircraft and recovery teams down range but direct to the eastern seaboard of the United States. The American crew members were regularly 'patched' into the US 'phone system by radio 'hams' in the States so that they could talk to their wives and families.

' . . . the lone and level sands stretch far away'
In the picture is the 'Remarkable Table' chosen as the rocket launching site for the Astrophysics Division's eclipse experiment. Opposite is the motif designed by the author that was displayed on RSRS equipment during the Eclipse campaign.

wind, sweat and beers

Arranging working accommodation for the experimenters was not so easy. The wind off the desert is nothing short of vicious, it blows at about 30 knots most of the time and whips up the dust and light sand to about 6 ft above the surface, forcing it into all apertures, human and otherwise. By contrast the calm periods, mostly at night, are hot and sticky and dew forms which soaks anything left outdoors. In order to prepare the complex scientific payload and load it with film, then unload it after recovery, we had to make a room light-tight and sealed against the sand and the dew and, in consequence, any fresh air or cooling draughts.

This room proved to be a fair imitation of the infamous Black Hole of Calcutta. It takes about three hours to load a hundred film cassettes and it took at least another hour to seal the payload so that it could lie safely in the desert for a day or two until recovered. Three very weary experimenters emerged from 'The Hole' at 3 am the morning before the flight, thankful that our American colleagues had been sensible enough to provide cooled beer for just such an occasion.

The rocket was launched at 10.34 on the morning of June 30, within 0.4 seconds of the ideal launch time, and we watched with bated breath as the real-time data came back over the telemetry link. BOOST SEPARATION? OK. SUSTAINER IGNITION? OK. SUSTAINER SWITCH OFF? OK. DESPIN? DESPIN? . . . . When a sounding rocket is launched the fins at the back end are angled sufficiently to cause the rocket to spin on its axis at about two revolutions a second; as with a rifle bullet this stabilises the projectile in the atmosphere holding it closer to the ideal trajectory and it makes recovery of the payload much easier by limiting the dispersion circle. We had no signal indicating despin! All other operations appeared to be correct.

sick of search: we got it

The recovery went ahead as scheduled; a 'fix' from the two radio theodolites, one at the launch site and one down range near the predicted impact point, gave the approximate landing area and two search planes soon locked-on to the beacon transmitting from the payload. Conditions at ground level were so bad that the search had to be carried out at altitudes below 500 ft. Not only does this make searching

Shot in the dark continued

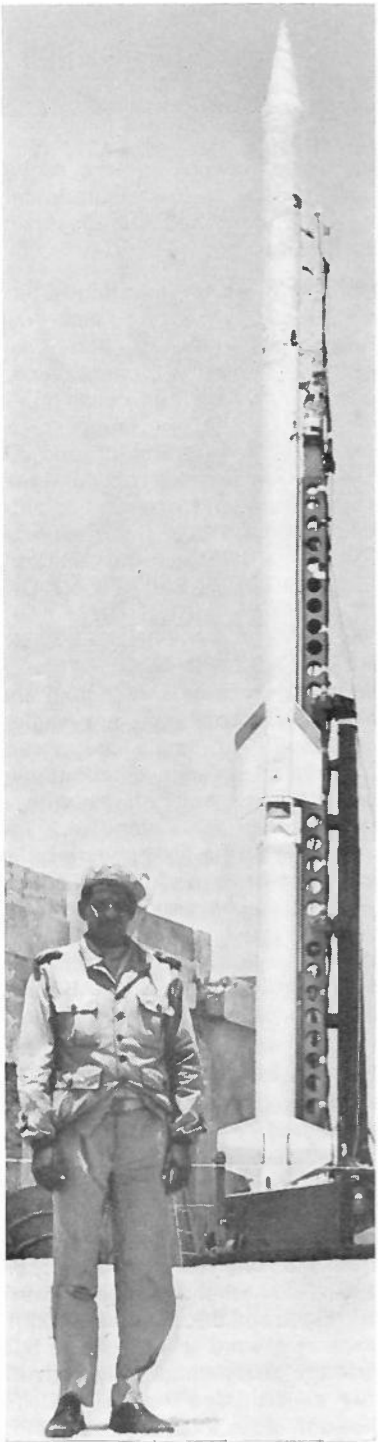
difficult, because it reduces the field of view, but it gets bumpy – all of the observers were very air-sick. The payload was spotted about 9 hours after the launch.

As the terrain was not flat enough for the aircraft to land nearby, a ground party was guided in on the following day. Over very difficult country it took seven hours to travel the 60 miles there and back to the nearest airstrip where the payload was transferred to the aircraft. It was then flown back to Nouadhibou where it reached the eager hands of the British party 33 hours after the launch.

The payload was virtually undamaged and the film cassettes were removed without difficulty, even though it did mean another three-hour stint in 'The Hole'. Packed in a special low-temperature carrying case, the films were taken back to ARD Culham for processing.

Sadly, the telemetry signals proved to have been correct. The payload had failed to despin and in that condition the stabilising system was unable to point the payload at the eclipsed sun. So the instruments had looked fruitlessly into deep space. The films did not contain the neat round images of the solar corona we had seen in the 1970 photographs, they were completely blank.

High risk it was judged to be and so it proved; there are a great many components in a 'simple' sounding rocket, any one of which can spell disaster if it fails in flight. The inevitable post-firing investigations will do everything possible to discover the offending part or system and correct it, so as to cut the risk rate next time. If there is a next time? The National Science Foundation of America is already calling for experimenters for the 1974 eclipse – off the southern tip of Australia!



Picture left: an Arab guard keeps watch over the Aerobee rocket. The pay load (on top) is wrapped with thermal insulation against the intense heat of the sun.
On right: the teams who flew experiments in Concorde 001 (see previous issue of Quest). Dr J E Hall from RSRS, the British Project Manager, is 4th from the right.

Joe Paxton (the author of the article) is a Group Leader (PTO I) with the Astrophysics Research Division of RSRS.

Fame

Organisation and Methods hit the Ministry of Transport towards the end of the last war, when two HEOs were given a room together and told to start inspections. Their impact was rather slow in being noticed. After the war a Chief Executive Officer in the Ministry's Finance Division was moved to send a contribution anonymously to the house journal run by the Social and Athletic Club, which illustrated the current opinion of O and M.

This purported to be a Report by O and M on a symphony orchestra. In the report the investigator observed, among other things, that duplication occurred among the instruments; that at times the instruments played the same notes, while at other times some instruments did not play at all! The conclusion, as will have been guessed, was a recommendation for a drastic reduction in the size and content of the orchestra.

Over the following five years, this gem was poached by over twenty journals in the UK and overseas, one doubtless lifting from the other, with never a word about the source. Indeed, few in the Ministry knew the identity of the author, a modest man, who duly retired unacknowledged. If his small article is still going the rounds, its origin may be of interest.

AGAW

Living experiment

An experimenter looks at life abroad – in Switzerland

G T J Arnison

'What is it like working at CERN?' many people ask of the few who go there. Having just spent 3 years at CERN working on the $\bar{P}P$ experiment with the Queen Mary College – Rutherford Laboratory Group, here are a few of my own impressions that may answer some of the questions.

When the group decided to go to CERN, the two aspects that loomed largest for my family were the trauma of packing up our home in the UK and the excitement, or even holiday feeling, associated with going to Switzerland. It so happened that neither of these amounted to anything after a few weeks in Geneva. Packing up the house was exhausting but not impossible, and the holiday atmosphere soon wore off for my wife and myself – though not for our three children – when the complications of settling in a new country began to take effect. The town itself is very pleasant and the shopping facilities – though expensive – are excellent. The encircling, suburban, high-rise apartment-blocks are beginning to obscure the view of the local mountains – the Selève and Jura Range.

CERN is to the North-West near the suburb (village?) of Meyrin. Many visitors to CERN stay in Meyrin, so it is well known to the world-wide high-energy physics community. The international airport is beween Meyrin and Geneva and the large number of aircraft that use it make it sound like Heathrow – those who live near there will know what I mean!

fireworks and festivals

The Genevois are a cosmopolitan lot and the few genuine Swiss still living there must feel smothered by the foreign influences. Nevertheless, the two traditional carnivals of the town are still held every year (a great tourist atraction), with firework displays on the lake in August and ceremonial marches for the 'Escalade' in December. Each Commune (Cantons are divided into Communes) celebrates the founding of the Confédération Helvétique on August 1 with an al fresco ceremony. Amid fireworks, speeches and bonfires, everyone eats, drinks and makes merry. The Escalade on December 11 commemorates an unsuccessful attempt by the army of the Dukes of Savoy to scale the town walls by night in 1602.

'Cultural ' activities in the town range from Grand Opera to strip-shows; there are several museums, all of them local enterprises. There are a surprising number of swimming pools in and around the town and they provide an opportunity for the family to spend a day away from the confining atmosphere of an apartment-block.

Apartment life is not as glamorous as portrayed by the Hollywood script writers. It is satisfactory for those who are tired of mowing lawns and weeding flowerbeds, but families with small children are at a disadvantage without a garden. Children were banned from the grassy slopes around our apartment block. Obviously the Regie (who administered the block) were proud of their grass and didn't approve of children. And we found on closer examination that the 'grass' was mostly weeds! There are some discomforts which are expected, like getting stuck in the lift. What one doesn't expect is the use of a washing machine once a week (or even once a fortnight) if you are used to having daily access). Each block has one machine to be shared by up to 20 families. So if one has a large family this presents quite a problem. There are local laundromats but few people are prepared to carry dirty washing that far, and only families who know of the problems think of bringing a machine from home as part of their 'personal' luggage.

'One type of salad plant looked just like a wallflower to me.'

Most families manage to lock themselves out of their flat at least once; only one external door and no access to a kitchen window (say) prevents the usual easy solution when the front door slams shut behind you.

The housewife experiences the greatest change in the way of life. The husband working at CERN continues as if he were still in Britain; the differences are usually to his advantage. But, for his wife, the *daily* shopping (we had no deep-freeze and only a small refrigerator) becomes an adventure into the delights and mysteries (and expense) of the Continental 'cuisine'. Some of the Continental vegetables require research before one can attempt to use them. One type of salad plant looked just like a wallflower to me. The reversal of the names of chicory and endive did not help! The diet changes completely; no more egg and bacon breakfasts. Fresh bread every day – it goes stale within hours of buying it. You forget about butter and you save up for a proverbial Sunday joint. (NB these were expensive in comparison to Britain when we first went there, but times are changing).

Speaking in French to people at CERN was at first embarrassing, especially in front of contemporaries. But CERN has an efficient language school which offers tuition at all levels in French and German (during working hours) that many people take advantage of. Though English is one of the official languages of CERN, the technicians and storemen seem only to speak in French; their second language is usually German. The difference between the CERN Laboratory and the British ones strikes you most when you return. Arriving at a UK lab after 6 pm you find the corridors and offices empty; no restaurant in which to find someone to talk to and/or have a beer with. It is just as if there had been a holocaust that wiped the staff out. The difference is probably because the CERN staff belong to a car orientated society (everyone can afford a car of some sort), so they don't have to run for buses and they can stagger their departure times. There is never a traffic thrombosis like the one we see on the A34 at Chilton every evening.

'. . . skiing practically from one's doorstep.'

There are many visitors working full-time at CERN. Their industriousness and sense of urgency influence the pattern of work for the regular staff, because the visitors come for a fixed period to do one experiment on a machine, and then go. The timetables for the particle accelerators are carefully arranged to accommodate the maximum number of experiments. With such tight schedules everything becomes urgent and everyone is prepared to work all the hours that God sends. Wives protest at being deserted and the children want to know who that strange man is who keeps turning up to sleep! While back at home friends and relations seem to think you are on holiday all the time while abroad – it is difficult to convince that you work just as before.

But when you do get time off there is skiing, practically from one's doorstep, and easy access to the rest of Europe. During our stay we became expert at working out exchange rates and the effects of 'floating' currency. The allowances and salary sent out varied from month to month, depending on the state of the Pound on the day it was exchanged. During the three years the pound dropped from SF10.30 to SF6.90; meanwhile the cost of living did not stand still. The allowances are adjusted from time to time to compensate: but not one's salary!

The return to Britain brought a few surprises, the biggest being the meteoric increase in the price of houses. Food prices had risen more than we expected (especially for meat) and the coinage was different. Surprisingly, the TV set worked when switched on – but who were these long-haired TV announcers? And who were Michael Parkinson and Terry Wogan? The news, however, had hardly changed in good old strike-ridden Britain!

Geoff Arnison is an SSO in the Astbury Group at the Rutherford Laboratory. His particular work is on the $\bar{P}P$ experiment which is a collaboration between Queen Mary College - Rutherford - Daresbury - Liverpool.

Of his article he says he could have said much more about Switzerland – about schools, hospitals, skiing, Continental holidays – to name a few, had *Quest* allowed more space*. He also realises that his own experience may not be representative of what other people find living in Geneva because, as in UK, people and living conditions come in all sorts and sizes.

(*We'll ask you again, Geoff! Ed.)

Places to eat

'Part of the secret of success in life is to eat what you like and let the food fight it out inside'

Mark Twain

If you come to London often you will know that it is full of places where you can eat. But do you know where to get the most for your money, where the surroundings are most attractive, and where they don't serve chips with anything?

If you don't know all the answers and you happen to find yourself at State House at work or just up for a meeting or for a family pilgrimage to Daddy's (or Mummy's) London Office, we hope you will find the following Guide to Good Eating by Bon Nosheur useful. We are assured that all the places mentioned have been tried during the lunch hour and are within a hiccup or a short stagger of State House and Holborn Underground.

This is the first of a series. The prices quoted from menus are correct at the time of going to press. We have not included the State House Staff Restaurant (in the basement) but that is handy enough for you to try a very quick luncheon any day from 12 to 2.30. The daily menu can be found beside the notice boards on each floor of State House.

The series will include recommended places nearer the LO Annexe (and the Oxford/Regent Street shopping area) and some of the best places to go when one visits an outstation. If any reader knows an eating-out house worth mentioning, please will you send a note of its characteristics and prices to Bon Nosheur, Quest, London Office (room 1526, ext 255).

Italian Style

Cosmobar, Cosmo Place, WC 2.
(5 min. walk from LO)

Small, inexpensive, Italian restaurant. The downstairs room has an atmosphere of Chianti bottles and low-powered lights. Fairly busy but fairly quick service. The menu is modest, Anglicized Italian: Beware of being given spaghetti with chips and cauliflower!

Lunch for one
Special of the Day
– Chicken Escaloppe with Pasta
Cassata Siciliana
Coffee Expresso
Tip
Total cost: 70p

Room to sit down

The Ship Inn, Little Turnstile.
(5 min. walk from LO)

This is round the back of Holborn Tube Station. Round the corner and up the stairs to the dining-room which is all oak panels and high settles. Order food and drinks at the bar as you enter the room. The food is adequate, but the main advantage is a quiet room for people who want to talk shop over lunch.

Lunch for one
Toad in the hole
Ice cream
Coffee
Half pint of best bitter
Tip
Total cost: 60p

A Pint and a Wad

The Lamb, Lambs Conduit Street.
(5 min. walk from LO)

Recommended. Noted world-wide for its carefully restored Edwardian interior including swivelling glass windows to prevent the barman from identifying the customers in the saloon bar. An interesting collection of old theatrical photographs. Young beer. Very crowded after 1 pm (difficult to find room to sit down). A small open-air courtyard at the back. Sandwiches and cold food and some hot dishes are served from a corner of the bar. Baked potatoes in winter.

Lunch for one
Slice of pork pie and
vegetable salad
Pint of best bitter
Total cost: 43p

Sandwiches and the Fire Brigade Band

Tea Gardens, Lincoln's Inn Fields.
(2 min. walk via Great Turnstile)

Cheap and busy but beware of pigeons. The players on the tennis-courts can be seen from the Tea Gardens and, in summer, a band plays twice a week. This is a good place on a warm, not too sunny day. There is no shelter if it rains and in hot weather it gets crowded. Join the right hand queue for tea or coffee only and the left one for food. It is open until evening for those with time to spare for afternoon tea or tea and tennis.

Lunch for one
One round toasted bacon sandwich.
Cake
Cup of tea
Total cost: 22p
(All prices quoted are approximate.)

A Bit more Posh

The Bunghole, High Holborn.
(1 min. walk from LO)

Up-market wine lodge in the Victorian style. You are encouraged to book a table, and this is certainly necessary after 1 pm. There is a private booth (in the window!) which can be reserved for a small party. Best when you are not footing the bill. SRC Directors can be found in various parts during the latter part of the lunch hour. Ham off-the-bone and salad, followed by strawberries and cream is typical of the fairly limited menu. It is usual to order wine by the bottle if there are enough in the party.

Lunch for one
Cold meat and salad
Glass of wine
Coffee
Tip
Total cost: £1.15

Bon Nosheur *likes to describe himself as tall, stooping a little, distinguished, with greying hair and neatly-trimmed military moustache and as one of SRC's best-known gourmets. He is well known – and some times feared – he tells us, in every haute cuisine in Holborn.*

Unfortunately, following some advice he gave to the proprietor of a local 'taverna', he explains, advice that was kindly meant but perhaps misunderstood, he has had to flee the district and bury himself in agricultural affairs. There he awaits in trepidation the arrival of the proprietor, his brothers, his uncles, his sisters, his aunts and – dare we write it – Th G*df*th*r.*

His new abode bears the coat of arms shown below that he kindly explains for the benefit of Quest *readers as 'Quarterly in the First and Fourth Three Sheep in Extremis (for hill farming), in the Second a Cow Rampant (for dairy research) and in the Third a Harp Quiescent (for higher things in HQ Admin).'*

nutcracker 13

Quandary for Capers

One hot, oppressive summer afternoon, when Simon Capers, dynamic Secretary of the Artificial Intelligence Committee was taking his customary siesta at his desk, he was brutally awakened by his door being wrenched from its hinges. There before him stood a robot, humanoid except that it had only one powerful arm, which ended in a number of tentacle-like fingers, and in place of a mouth a cathode ray tube on to which the following message flashed: 'My master demands that his grant of £****7 be increased immediately by a factor of *4. That will make it £*00,000 exactly. You will obey!'

(For reasons which will become obvious, Simon is unable to recall the figures represented by stars.)

Simon leapt to his feet. 'Begone thou metal fiend', he cried, but was felled by an immense blow from the monster's arm. But as he collapsed, he managed to gasp out the words 'by Sir James Lighthill I adjure thee'. There was a loud report and the robot too collapsed to the floor.

When Simon recovered from his concussion, how many fingers did he find at the end of that metal arm.

Send answers to Quest. *First correct answer opened gets £1 book token. No prizes for guessing the Secretary's name.*

Crossword solution
maxim 3

The winner of the £1 book token was John Barrow, ROE.

Across

1. Soporific
9. Pal (paROIE)
12. Slur
14. Rid
15. Hole
17. Neater
18. Siesta
19. RSRS
21. Fees
22. Lo
23. Thug
24. Torr
25. NE (LOne)
26. Eludicate
31. ACL
32. Lunar
34. RGO
37. Safe
38. Mien
39. Murder
40. Freaks
43. Anode
44. Earsa (ReHEarsaL)
45. Never
46. Titrate
47. Sherry
48. Nested

Down

2. Ose (ARoUse)
3. Plastic
4. Out
5. Irregularity
6. Fisticuff
7. Idiot
8. Chef
9. Poser
10. Alter
11. DNPL
13. Result
16. Easue (ReaSsuReS)
19. ROE
20. RHEL
25. Normans
27. Inerate (DiNner-PLate)
28. Dam
29. Arais
30. Tke (tACkLe)
31. ARU
33. Ensued
35. Grove
36. Odder
37. Seer
41. Errs
42. Kate
44. Ein (ReGiOn)

A different view of Orion

This unfamiliar view of a familiar constellation, Orion, is a copy of a photograph taken by Dr Paul Murdin of the RGO. It was taken through a filter which only passes light with a very restricted range of colour in the red part of the spectrum where hot hydrogen gas radiates strongly. The approximately elliptical nebula which almost surrounds Orion is called Barnard's Loop, and it is at the edge of a bubble blown in the interstellar medium by the gas pressure and radiation pressure caused by the bright hot stars in the 'Belt' and 'Sword' regions of Orion. The two hour exposure was secured at Herstmonceux by Dr Murdin who claims that the wide-angle cine camera lens of aperture 1 cm which he used is the world's smallest astronomical telescope. The f/1.2 lens has a coverage of 60° extending from the Hyades star cluster (upper right) to the star Sirius (lower left). The filter which was used was a 40Å wide interference filter centred on the Hα Balmer emission line of hydrogen.

timetable of 1973-74 training courses

The Central Training Section runs courses for all grades of staff from clerical officer to principal scientific officer, and equivalent grades. Brief descriptions of the courses and future dates are given below; those marked * are residential. Managers who are considering the courses for their staff can get further information from local training officers or Central Training Section, London Office.

Course	Description	Scheduled Dates 1973	1974
***Induction Course** *for all new staff*	The course gives information on the formation and organisation of SRC and its work in the various scientific fields, and on conditions of service and staff associations.	October 16-17 18-19 December 11-12 13-14	April 2-3 4-5 June 11-12 13-14
Course A *for clerical officers with at least one year's experience in the grade.*	The course covers basic statistics, estimates and accounts, basic organisation and methods, communications and effective writing.	November 20-23	February 26 – March 1
Course I *for scientific officers, executive officers, and equivalent grades, under age 28.*	The course looks at communications, work-team relationships, basic managerial responsibilities, O & M, networking for projects and decision analysis.		Part I January 14-18 Part II March 25-29
***Course II** *for senior scientific officers, executive/higher executive officers, and equivalent grades, over age 28.*	The course explores delegation, motivation, leadership, planning and forecasting techniques, staff reporting and interviewing.		March 11-15 May 6-10
***Course III** *for principal scientific officers, senior executive officers and equivalent grades.*	The course will consider the analytical and sociological approaches to management.		February 4-8 April 22-26

Remember ! **If you wish to undertake an external course of serious study, you may be eligible for a training concession. Ask your local Training Officer for details.**

Before you decide to stay up all night at the thin end of a telescope, you want an assurance from the weatherman that the skies will be clear and unobscured. So observers at RGO get the latest news by Telex direct from the Met – like this:

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RGO HERMONCEUX

TO
   ROYAL GREENWICH OBSRVATORY TELEX 87451

FM: LONON WEATHER CENTRE

19/6/73

NIGHT TIME OBSERVING PROSPECTS
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WEATHER LONDON
RGO HERMONCEUX M
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THE WHETHER FOUR CASTE AS IT WERE RESEIVED

BETTER TAKE A MAC LADS JUST IN CASE.

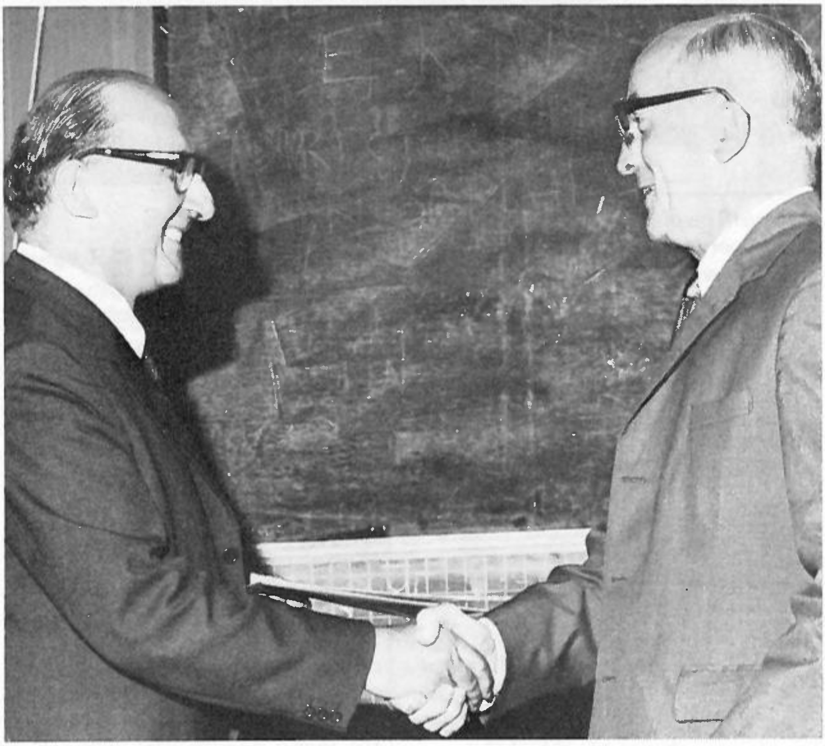
Saved from wpb by Victor Hill Head Messenger, RGO.

Angela flies and gets £25

Angela Killick (pictured above) received £25 from the Civil Service Further Education and Day Release Prize Fund for using her spare time to obtain a private pilot's licence – she wrote about it in *Quest*. The prize fund was set up to encourage people to use their leisure time constructively.

The prizes were presented by Mr Vic Feather, then TUC General Secretary, who spoke to the gathering of prize winners and guests about the importance of further education schemes, particularly for those people who left school early.

Angela's name was put forward by the LO Training Section who are also pleased with the results obtained by two LO staff who received training assistance. Chris Rimmer of NP Division gained an honours degree in Geology after a four-year evening course at Birkbeck College. Nick Shirley in E & O Division gained distinctions in both years of his HNC Business Studies exams after a three-year day release course.



Pictures above:

Top: Mr H M Smith of the Royal Greenwich Observatory at Buckingham Palace after his investiture. With him are his son, Flight Lieutenant D A Smith, his wife and his daughter, Miss Corinne Smith (SRN, SCM).

Below: Dr J A Saxton, Director of RSRS, saying Au Revoir to Dr H G Hopkins on his retirement after 38 years' service with the Station. They first met as undergraduates at Imperial College.

MSc

Mr G A Harding, Deputy Director of the South African Astronomical Observatory, received an honorary MSc degree at the University of Cape Town on 29 June 1973.

New Chairman for Research Councils Advisory Board

Professor Frederick Henry Stewart, Regius Professor of Geology at the University of Edinburgh, succeeds Sir Frederick Dainton as Chairman of the Advisory Board for the Research Councils. The appointment is for 4 years from October 1 1973.

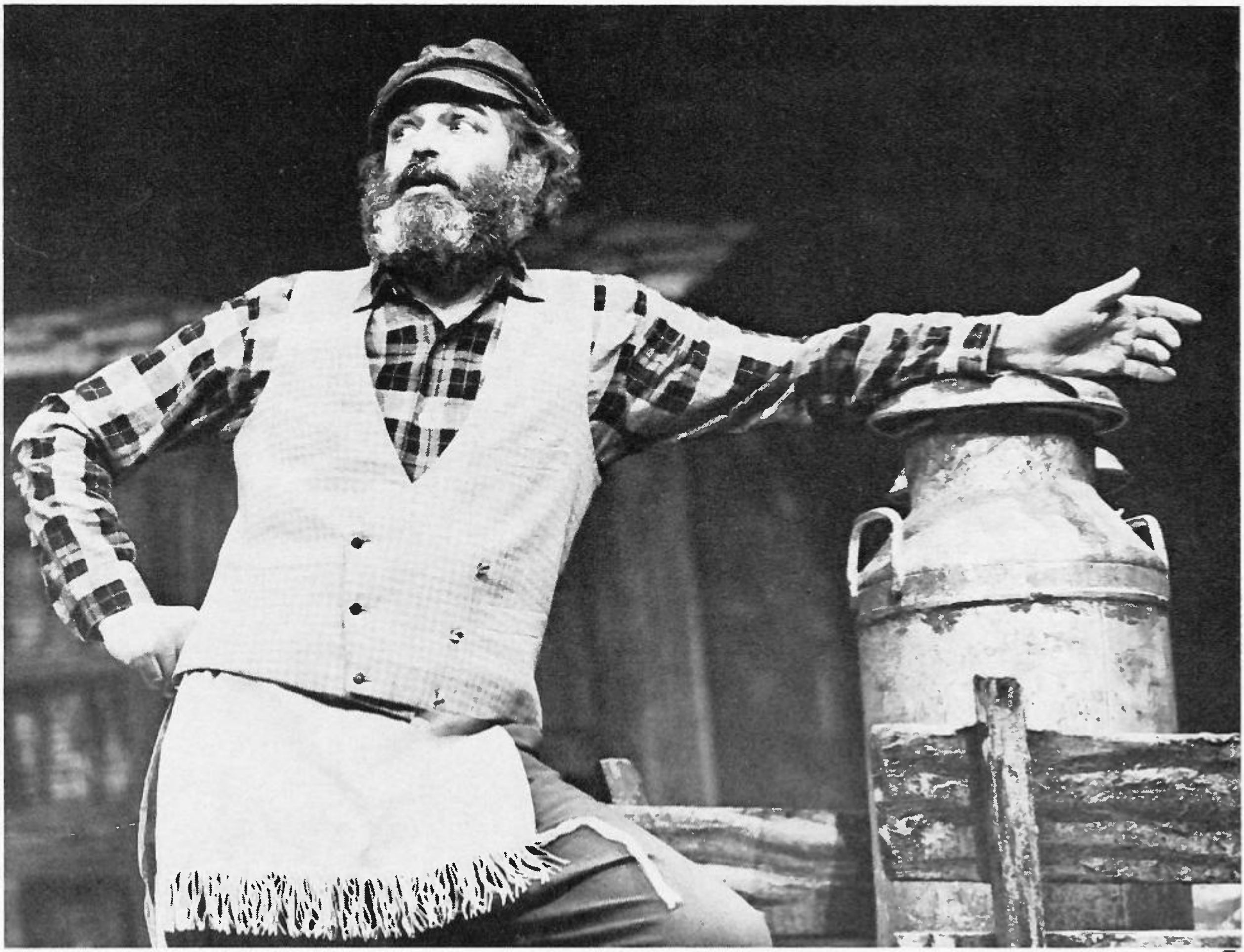
Professor Stewart became Chairman of the Natural Environment Research Council in October 1971 and, in that capacity, a member of the Advisory Board. He is succeeded as Chairman of NERC by Sir Peter Kent.

Sir Frederick Dainton is now Chairman of the University Grants Committee.

The chairmanship of the Advisory Board for the Research Councils is a part-time appointment. The Board was set up last year to advise the Secretary of State for Education and Science on her responsibilities for Civil Science with particular reference to the Research Council system, its articulation with the universities and Government departments, the support of post-graduate students and the proper balance between international and national scientific activities.

The Board also advises the Secretary of State on the allocation of the Science Budget among the Research Councils and other bodies, taking into account funds paid to them by customer departments and the purposes to which such funds are devoted. Its other job is to promote close liaison between the Research Councils and the users of their research.

Profssor Stewart has held posts in the research department of ICI and at Durham University. He has been Regius Professor of Geology at Edinburgh since 1956 and was Dean of the Science Faculty in 1966-68 and a member of the University Court in 1969-70. He was a member of the Council for Scientific Policy before he became Chairman of NERC.



Leading man

John Price, a Principal Scientific Officer in London Office. It's not his normal working suit but the beard is real! In fact he grew the beard to sing the part of Topol in 'Fiddler on the Roof' for the local operatic society in East Grinstead earlier this year. Since then we have been watching with interest for outward signs of his next audition and wondering how he will face the decision to go clean-shaven again. Meanwhile does anyone need a Topol? John says he's open to offers.

. . . . and Farewell

So I say farewell with my warm thanks to all you contributors and readers – to contributors both for writing and for adapting to editorial demands and to readers for your interest.

I hope you will be as great an asset to my successor and that many more people will make a concrete contribution – even if it's only good advice!

Goodbye and thank you.

Anne Walls.

QUEST

50 years of Greenwich Mean Time

Comet Kohoutek

Move to Swindon

QUEST

House Journal of the Science Research Council

Vol. 7 No. 1
1974

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Cover

Spring comes to the Royal Greenwich Observatory, Herstmonceux, Sussex, oldest of the Council's establishments. A lovely, topical scene taken by RGO staff photographer David Calvert.

The castle grounds are open to the public from Easter until the end of September (Monday to Friday 2–5 pm. Weekends and Public Holidays 10 30 am – 5 pm. Price: Adults 20p. Children 5p. Cars 10p).

Quest will be issued three times this year by the Science Research Council for members of staff only. The Council is not necessarily associated with any individual views expressed.

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Editorial

Quest enters its seventh year. A new year; a new editor. Miss Carol Rivers (see page 16) takes over from Mrs Anne Walls and looks forward to receiving news, articles, cartoons, light verse, in fact *anything* that will reflect the wide-ranging professional and personal interests of all members of the Council staff.

May we take this opportunity of mentioning once again that *Quest* is an internal publication intended for each member of staff It can only reflect that interest in so far as *you* supply information and participate in its production. Your local correspondents are listed on page 16. They meet after each issue to discuss its success, or otherwise, and to plan future issues. Please contact them or the editor direct on 01–242 1262, extension 255, if you have any contributions to make.

Quest itself has been redesigned—without too much alteration to its well known format—to meet changing circumstances. These include the restructuring of the SRC Central Administration, and we thought that readers would welcome the lay-out of top management (details on pp. 8–9) together with brief details of the main persons involved. Likewise, we report the commencement of the dispersal of the London Office to Swindon. In future issues *Quest* will continue to reflect the changing corporate life of the Council. It will do so successfully with the co-operation of its readers.

Fifty Years of Greenwich Mean Time

C J A PENNY

On 5 February 1924 the Greenwich Time Signal was broadcast for the first time. The practice started quite by chance a year earlier when Mr F Hope-Jones, an authority on electric clocks, was broadcasting a talk on the introduction of Summer Time and concluded by counting down from his watch the last five seconds before the hour. This practice was continued by the announcers for some time until, following a proposal by Mr Hope-Jones to broadcast an accurate time signal, a direct land line was installed between the Royal Observatory at Greenwich and the BBC control room at Savoy Hill. Sir Frank Dyson, Astronomer Royal at the time, gave a talk from 9.15 pm to 9.30 pm on 5 February 1924 to introduce the service. The signals were in the form of six pips at second intervals from second 55 to second 60. Two of the Observatory's Dent clocks were modified to send out the signals on the hour and the half hour. It was not until 1928 that the first fully automatic transmissions were made available every quarter of an hour, and the following year the Dent clocks were further modified to run as synchronised clocks under the control of the Mean Time free pendulum, the Observatory's master clock.

The BBC transmitted an extended service of pips on 29 June 1927 for observers of the total eclipse of the sun which was visible in England. In 1928 the service was extended experimentally and signals were sent from Chelmsford on a wave length of 24 metres for use in Africa by surveyors.

In the early days the BBC six-pips time signal was treated very seriously. For example, the Astronomer

Mrs P Thomas checking the broadcast time signal against the outgoing signal which is advanced to compensate for the delay of the land line and equipment.

Royal for Scotland, Professor R A Sampson, wrote complaining that the BBC was not 'treating signals with respect . . .' 'sometimes we find that they are omitted altogether, and sometimes they are sent through the middle of the performance of a band.' In reply, Mr J C W Reith (later Lord Reith) stated ' . . . a change in temperament on the part of the conductor due to health or weather conditions, may easily make a difference of a minute, in which case the engineers, rather than cut out the musical performance, will so strengthen the Greenwich signals that they will rise above the performance. . . . The time signals will always receive first consideration.'

During the War, the Time Department of the Royal Observatory was evacuated to Abinger in Surrey, with a reserve station at the Royal Observatory, Edinburgh. The six-pips were generated from one or another of these stations until, in 1957, the Time Department was transferred to Herstmonceux, the new home of the renamed Royal Greenwich Observatory. For the past fifty years the six pips have been transmitted 24 hours a day.

The clocks which control the six-pips time signal are, of course, no longer pendulum clocks but are now caesium atomic standards. The signals are transmitted to the BBC over a Post Office land line in the form of breaks in a 1,000 Hz carrier. A local tone is generated by the BBC which is switched by the signal from the Observatory.

Duplicate equipment at RGO and the BBC, together with two land lines, ensures that there is very little likelihood of failure of the system.

The Greenwich time signal consisted of six short pips until 1972 when it was modified to five short pips from second 55 to second 59, followed by a lengthened pip the start of which marks the minute. The introduction of the lengthened pip caused some comment from the public; one lady complained that it upset her dog and she had to switch off quickly before it started to howl!

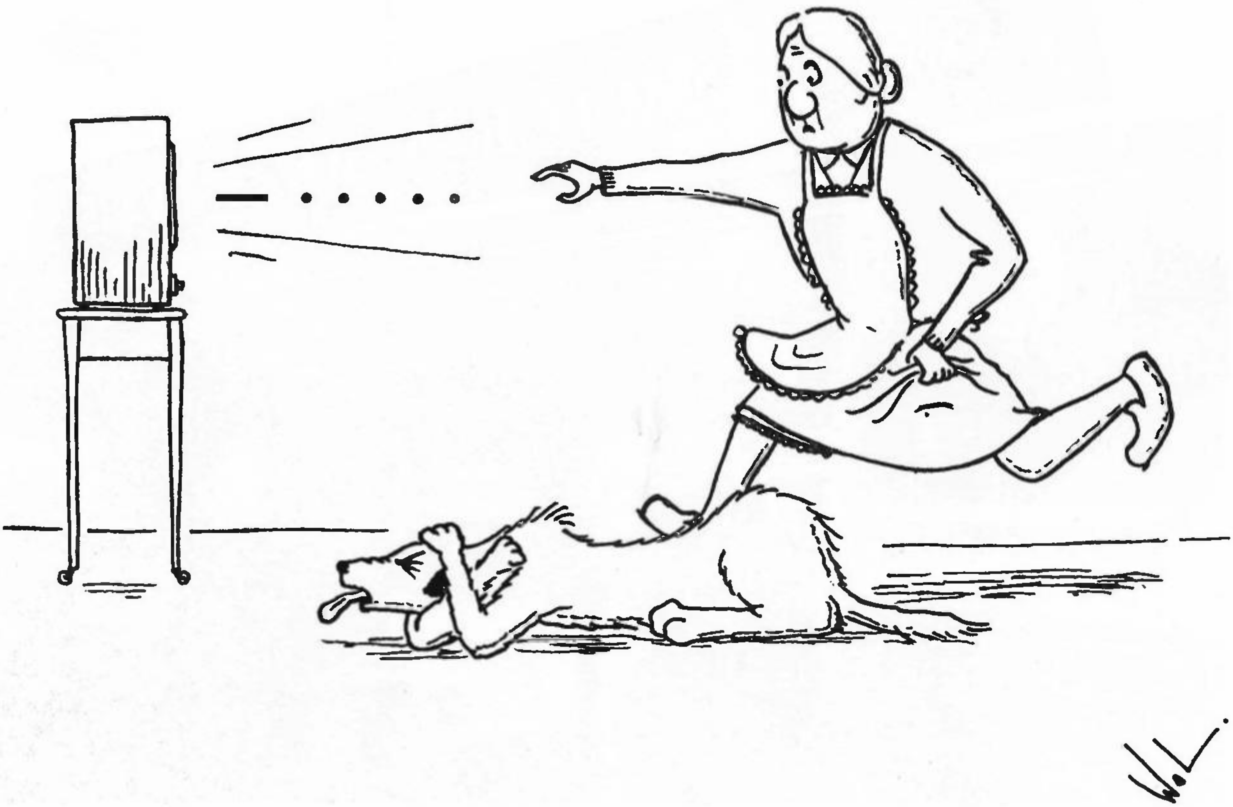
The Greenwich time signal provides accurate time for civil purposes throughout the 24 hours on a world-wide basis. An example of the schedule broadcast by the BBC is as follows:

On the domestic service 16 times daily on 10 frequencies.

On the European service 13 times daily on 12 frequencies.

On the Overseas service 24 times daily on 24 frequencies.

Joy Penny is a senior scientific officer in the Clocks, Time Scales and Time Signals Section at the Royal Greenwich Observatory.



Council Commentary

June 1973 to March 1974

European Science Foundation
As a result of the Paris conference last September of representatives from European Research Councils and academies, a Preparatory Commission has been set up. The Chairman is M Curien, formerly the Director Général of the Centre de la Recherche Scientifique and one of the members of the commission is Mr St J Walker, Secretary of the Council. The Commission's function is to seek offers for the seat of the European Science Foundation and then to make proposals to the meeting of prospective members due to be held in Stockholm in May.

Council Charter
In June the Council passed a resolution amending the Charter to take account of:

—their having agreed that representatives of government departments should be appointed members of Council instead of assessors;

—the decision that SRC staff (except those on Atomic Energy Authority terms (for whom separate arrangements have been made by the United Kingdom Atomic Energy Authority) and in FSSU) should have the same superannuation and related benefits as the Civil Service;

—the transfer of responsibility for Civil Service affairs from the Treasury to the Civil Service Department;

—the removal of the need for Council to pass resolutions amending the Charter on two separate occasions.

The Queen approved the amendments in Council in December.

Change of Name
At the same meeting Council approved the renaming of the Rutherford High Energy Laboratory as the Rutherford Laboratory, the Daresbury Nuclear Physics Laboratory as the Daresbury Laboratory and the Radio and Space Research Laboratory as the Appleton Laboratory (see page 10).

Retiring Members of Council
The Chairman expressed the Council's thanks to Dr Davies and Sir Alastair Pilkington for the service they had given as Council members. The Council also thanked Dr Pickavance, who retired due to ill health, for the vitally important contribution he had made to the work and progress of SRC.

Welcome to New Members

In October, the Chairman welcomed as new members of Council, Sir Hermann Bondi, Dr A T James, Dr I Maddock and Dr A A L Challis. (Dr Challis has subsequently left the Council on taking up a new appointment in the USA.)

Establishment Director on Council
The Council thanked Dr J A Saxton for his contributions to council meetings during the past two years and agreed to invite Professor A Ashmore to attend council meetings as the Establishment Director in attendance for a period of two years.

Polytechnics Working Group Report
The report of the Polytechnics Working Group, set up to look at the special needs of polytechnics in relation to the Council's policies and procedures for the support of research and postgraduate training, has been considered by the council.

The Council accepted the recommendations of the Working Group which were:

- A Committee of Council should be set up, for three years, to try to generate and apply different criteria for the support of postgraduate training in the polytechnics.

- Polytechnics should be encouraged to develop postgraduate training by means of taught advanced courses and collaborative research projects.

- SRC should make a special effort through the existing subject committees to encourage the use of the CASE scheme by the polytechnics.

- A research policy for the polytechnics should be discussed by representatives of the polytechnics, SRC, the other research councils, interested government departments (eg DOE and DTI) and the Department of Education and Science in order to define more closely the research role of the polytechnics. In the meantime research grant applications from the polytechnics would continue to be dealt with by SRC subject committees using established criteria.

A new Committee for Postgraduate Training in the Polytechnics has now been set up.

Estimates 1974/75

The Council agreed the 1974–75 estimates within a net total of £86·3M. These estimates were based on the Forward Look approved by Council in April 1973 but took subsequent developments into account. As a result of fluctuating exchange rates international subscriptions continue to be difficult to estimate.

The Council have been informed that part of the general cuts in public expenditure announced by the Government in December 1973 fell on the Civil Science Budget and the SRC is required to reduce its 1974/75 estimate by some £3M.

Forward Look 1972/6–1979/80

In November the Council agreed the financial guidelines to the four boards for the preparation of the 1975–80 Forward Look. The Boards views were received by Council in April and a Forward Look was submitted to the Department of Education and Science at the end of April. The guidelines given to the Boards, which vary according to present priorities and policies, are based on a growth rate for SRC of $2\frac{1}{2}\%$ per annum from a 1974/75 baseline. The Boards were asked to indicate the implications for their Forward Look programmes if the reduced 1974/75 estimates were used as the baseline for Forward Look growth rates. The Advisory Board for Research Councils invited the Council to indicate policy and priority changes resulting from considering three widely differing growth rates: $+4\frac{1}{2}\%$ per annum, zero growth and -1% per annum.

Postgraduate Awards

After all qualified candidates who applied in 1973 had been satisfied, there was, for the first time in eight years, a surplus of awards. Two main reasons were advanced for this—the relatively low level of remuneration for students and the state of the employment market.

The Council agreed that 3975 awards should be allocated in 1974—an increase of five for the Astronomy, Space and Radio Board and an additional twenty awards for use on new types of courses in the polytechnics.

Council Meetings

March—the meeting was held at Cosener's House, Abingdon and the main items discussed were the regrouping of SRC activities in the establishments and the Board reviews of scientific programmes.

May—the May meeting will take place at the Royal Observatory, Edinburgh.

September—the Council has accepted an invitation from Professor E J Richards, Vice Chancellor of Loughborough University of Technology, to hold a weekend meeting at Loughborough. The main topic for discussion will be a review of SRC postgraduate training policies.

The Energy Situation and the Council's Programme

In view of the current energy situation and the prospect of a sustained change in the country's energy policy a working party has been set up comprising Professor Edwards and the Board Chairmen. In consultation with representatives of Government departments it will co-ordinate the delination of problems needing solution, guide reviews by the Boards and report back to Council.

New member of Council

In April Mr D J Lyons, CB, was appointed a full member of the Science Research Council to fill the vacancy left by the resignation of Dr A A L Challis.

Part of a photograph of Comet Kohoutek taken at the Royal Greenwich Observatory, when the comet was about 76 million miles from Earth in the constellation Pisces. A tail of gas and dust can be seen emanating from the bright head of the comet.

That Comet

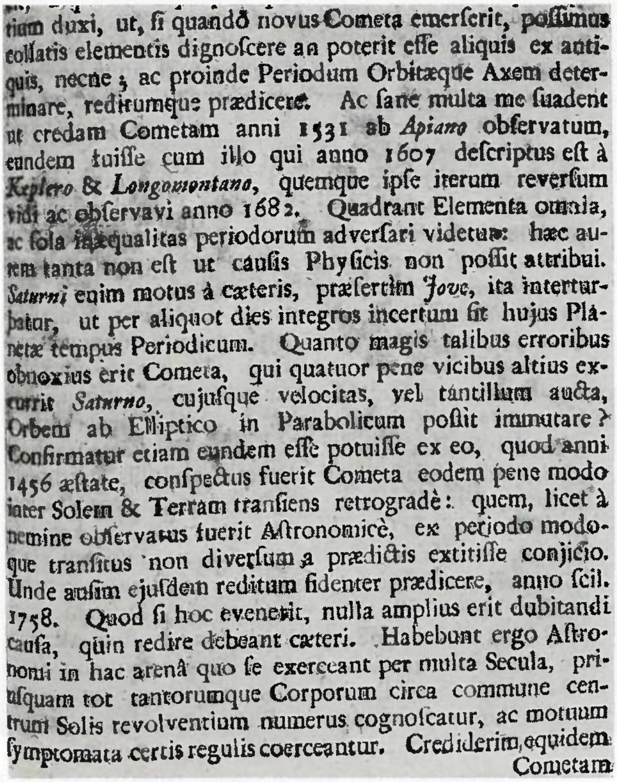
J B ALEXANDER and C M LOWNE

In previous centuries the appearance of a comet was usually regarded as a bad omen, possibly brought about because of the beholder's sins. In 1681, for example, when a very bright comet was seen, the Town Council of Baden in Switzerland forbade the unfortunate inhabitants to play, dance or make merry. They were not allowed to drink after nine o'clock and had to return home soberly without shouting in the street.

Although a few superstitions about comets still persist in Britain to-day, these ideas did not generally survive the scientific revolution. In the seventeenth century it was realised that comets moved in orbits around the Sun obeying the same laws of motion as the Planets.

The English astronomer, Edmund Halley, who studied the motion of the comet that now bears his name, gave a bright boost to cometry science. He conjectured that the comet which he saw in 1682 had been seen several times previously. Halley concluded that this comet moved around the Sun in an orbit within a period of about seventy-six years and he successfully predicted that the same comet would reappear in 1758. (Although Halley lived to the ripe old age of eighty-five as Astronomer Royal and as a pre-SRC Director of the Royal Greenwich Observatory, the return of the comet did not occur until sixteen years after his death.) It is difficult to reconcile these predictional aspects with the old belief that comets bring ill fortune.

Although the motion of a comet can be forecast quite correctly once it has been observed for a reasonable length of time, it is not possible to make reliable predictions of brightness. This is very well illustrated by the behaviour of the much-publicized Comet Kohoutek, which was discovered on March 7 1973 by Lubos Kohoutek at the Hamburg Observatory. The finding of a new comet is not in itself exceptional and about ten comets may be discovered in one year (Kohoutek had himself discovered a new comet only



tium duxi, ut, ſi quandò novus Cometa emerſerit, poſſimus
collatis elementis dignoſcere an poterit eſſe aliquis ex anti-
quis, necne; ac proinde Periodum Orbitæque Axem deter-
minare, reditumque prædicere. Ac ſane multa me ſuadent
ut credam Cometam anni 1531 ab *Apiano* obſervatum,
eundem fuiſſe cum illo qui anno 1607 deſcriptus eſt à
Keplero & *Longomontano*, quemque ipſe iterum reverſum
vidi ac obſervavi anno 1682. Quadrant Elementa omnia,
ac ſola inæqualitas periodorum adverſari videtur: hæc au-
tem tanta non eſt ut cauſis Phyſicis non poſſit attribui.
Saturni enim motus à cæteris, præſertim *Jove*, ita intertur-
batur, ut per aliquot dies integros incertum ſit hujus Pla-
netæ tempus Periodicum. Quanto magis talibus erroribus
obnoxius erit Cometa, qui quatuor pene vicibus altius ex-
currit *Saturno*, cujuſque velocitas, vel tantillum aucta,
Orbem ab Elliptico in Parabolicum poſſit immutare?
Confirmatur etiam eundem eſſe potuiſſe ex eo, quod anni
1456 æſtate, conſpectus fuerit Cometa eodem pene modo
inter Solem & Terram tranſiens retrogradè: quem, licet à
nemine obſervatus fuerit Aſtronomicè, ex periodo modo-
que tranſitus non diverſum a prædictis extitiſſe conjicio.
Unde auſim ejuſdem reditum fidenter prædicere, anno ſcil.
1758. Quod ſi hoc evenerit, nulla amplius erit dubitandi
cauſa, quin redire debeant cæteri. Habebunt ergo Aſtro-
nomi in hac arenâ quo ſe exerceant per multa Secula, pri-
uſquam tot tantorumque Corporum circa commune cen-
trum Solis revolventium numerus cognoſcatur, ac motuum
ſymptomata certis regulis coerceantur. Crediderim equidem
Cometam

An extract from the Philosophical Transactions of 1705 in which Edmund Halley announces that the comet of 1682 was moving around the sun in an orbit with a period of about seventy-six years. Noting that the same comet had been seen previously in 1531 and 1607, Halley predicted its reappearance in 1758.

eight days before he found the well-known 'Comet Kohoutek').

Individual comets differ greatly in the manner in which they vary in brightness as they change their distance from the Sun. Two comets in similar orbits having the same brightness when at large distances may differ in brightness by a factor of several thousand when they are close to the Sun. The nucleus of a comet is composed of solid material which emits the gas and dust to form the brightest part of the comet. The total brightness therefore depends on the rate at which this gas and dust is liberated under the action of solar radiation. Astronomers do not know enough at present about the composition and the structure of the nucleus of a comet to be able to predict its behaviour in detail. Predictions of brightness can only be made empirically. Preliminary estimates indicated that if Comet Kohoutek varied its brightness at the same rate as exceptional comets, then it would become extraordinarily bright. On the other hand, if it behaved like a typical comet, it would still be bright enough to be seen with the naked eye. Such comets are of reasonable interest since naked eye comets occur only every three or four years on average.

Unfortunately, the optimistic predications were given great publicity in the popular press without their enormous uncertainty being emphasized. Some astronomers were also guilty in this respect.

As it happened, Comet Kohoutek behaved in rather an unexceptional manner. Its brightness increased as it drew nearer to the Sun at a rate typical of an average comet. When the comet was not the spectacle that some journalists were expecting, interest was renewed when reports were received that the comet had disappeared. Deaths make headline news. Although it was not possible to trace the exact source of the reports of disappearance, it seems that some inexperienced observers had underestimated the difficulty of seeing diffuse objects very low down in the sky at dawn. The phrase 'fairly bright comet brightens gradually' aptly describes the behaviour of Comet Kohoutek in late November and early December of last year, but it was not a suitable one for newspaper headlines.

Although Comet Kohoutek was not the 'Comet of the Century' it became bright enough to be seen with the naked eye even in Britain. In the first three weeks of January when the comet was most favourably placed for observation, the relevant part of the sky was completely clear of cloud on only one night at Herstmonceux. However, several exposures were taken from November onwards which revealed the general development of the comet. Elsewhere the comet was studied intensively at a variety of wavelengths. Because Comet Kohoutek was the brightest one since Comet Bennett in 1970, it was practicable to try some instrumental techniques for the first time.

Our ideas about comets have changed remarkably in the past three or four hundred years. We were even allowed to make merry as much as we liked—as long as we did not use too much electricity! The final word goes, however, to two teenage girls who were overheard discussing their horoscopes. Said one: 'I don't believe my horoscope anymore; not after the way them astrologers were wrong about the comet.'

John Alexander is a senior scientific officer in the Astrometry Department and Michael Lownes is a senior scientific officer in the Instrument Development Department at the Royal Greenwich Observatory.

Spots before the eyes

The Atlas microdensitometer in use

M ELDER

The measurement of photographic intensities usually involves weeks of tedious visual estimation but a microdensitometer—a machine recently installed at the Atlas Computer Laboratory—will do the job in a day. This machine will provide a service for the many groups throughout the country using X-ray crystal structure techniques to determine molecular structure.

The technique of X-ray crystallography involves exposing a suitable crystal to a narrow beam of X-rays. The wavelength of the X-radiation is around 0·1 nanometers which is very close to the spacing between adjacent atoms in the molecules of which the crystal is composed. This means a diffraction effect occurs—the beam of X-rays interacts with the electrons in the crystal and a number of diffracted beams result, emerging from the crystal at various angles. The intensities of the various diffracted beams vary widely and depend upon the distribution of electrons in the crystal. If the crystallographer can measure these intensities then it is possible to work backwards, using rather complicated mathematical techniques, to derive the positions of the electrons, and hence the atoms, in the crystal. Such results are quite accurate—the distances between atoms in a molecule may be calculated to within a few parts in ten thousand and molecular geometries can be accurately determined. Within the limitations imposed by the need for a crystalline sample the technique is of general application. Simple structures such as diamond have been studied in great detail and workers have recently determined the structures of biologically significant molecules such as RNA and haemoglobin, with thousands of atoms to one molecule.

The Atlas microdensitometer will play its part in the collection of the data needed for a crystal structure analysis. In a typical experiment a crystal is mounted at the centre of a cylindrical cassette containing a pack of 3–5 pieces of X-ray film. The crystal is rotated in a beam of X-rays and the resulting diffracted beams are recorded as small black spots on the films when they are developed. A set of ten film packs, each containing 200–1,000 spots, makes up the initial data for the crystal structure determination. After digitization it is necessary to estimate the relative intensity (blackness) of each spot.

It used to be a crystallographer's nightmare estimating these intensities by visual comparison with a set of calibrated intensities. Now it can be done automatically with the aid of the computer controlled microdensitometer. Each film is mounted on the drum of the machine and the drum then rotates at 4 revolutions per second. During each revolution an optical system measures the intensity of the light transmitted through the film at points every 0·1 mm around the drum. After each revolution the optical system is moved at 0·1 mm intervals along the axis of the drum and in this way the whole film is covered in the steps of 0·1 mm in each direction.

Mrs Lorna Claringbold operating the Photoscan machine.

The measured intensity values are pathed to the computer, which has sufficient time between readings to compute the intensities of all the spots on the film, despite the fact that readings are taken at the rate of 14,000 per second. The use of a pack of films in the cassette enables a greater intensity range to be covered

continued on page 10

Present organisation of SRC London Office adr

CHAIRMAN
PROF S F EDWARDS,

DIRECTOR A
U/SEC M O Robins

DIRECTOR B
U/SEC A J Egginton

ASTRONOMY, SPACE AND RADIO
DCSO Dr H H Atkinson

SCIENCE
DCSO Mrs J O Paton

NUCLEAR PHYSICS
SPSO J J Beattie

ENGINEERING
DCSO Dr W G Potter

Mr Anthony Egginton became Director of the Engineering and Nuclear Physics Divisions of the Council at the beginning of this year in succession to Dr Albert Lines (see below) who has retired.

Mr Egginton was educated at University College, London. While working for the college he went to Harwell to work on accelerator projects at the beginning of the development of big particle accelerators in the United Kingdom.

From 1956–1965, first at Harwell and then Rutherford Laboratory, he worked on the design of Nimrod and the Beam Transport equipment needed for the experimental programme. Then he became Head of the Accelerator Group at Daresbury where he was responsible for the development of Nina. In 1972 he joined the London office as Head of the Engineering Division.

His wide knowledge of both engineering and physics will, it is felt, be widely appreciated in the divisions he controls.

Retirement

Dr Albert Lines retired in December 1973 after five years as Director of the Engineering and Nuclear Physics Divisions.

Dr Lines was educated at Birmingham University and began his career as a lecturer at Northampton Polytechnic. He spent thirty years in the public service

ninistration

FRS

SECRETARY
R St J Walker CBE

DIRECTOR C
U/SEC J F Hosie CBE

ESTABLISHMENT
A/SEC R Edmonds

FINANCE
DCSO L S Smith

at the Royal Radar Establishment and the Royal Aeronautical Establishment, where he became Head of the Space Department in 1960. From 1961–68 he was Director of the European Space Research Organisation and its early success was due in large measure to his efforts.

Since joining the Science Research Council, Dr Lines played a major part in the development of the Engineering Board and in recent years made a real contribution to the work of the Nuclear Physics Board.

His retirement will be a great loss to the Science Research Council.

Mr M O Robins became Director, ASR Division and Science Division, in September 1972. This was a return to State House after an absence of four years with the Ministry of Technology, later Department of Trade and Industry, because he had been a founder member of the SRC London Office in 1965 when he took up the new post of Head of ASR Division.

Mr James Hosie CBE has been Director of Administration of the Council since 1972. Previously he was Director of Astronomy, Space and Radio and earlier of the Nuclear Physics Divisions of the Council.

continued from page 7

than would be possible with one film, since intensities fall off by a factor of about 3 when the diffracted X-rays pass through each piece of film.

The machine requires one operator and can process a pack of films in an hour, extracting up to a thousand spot intensities. The complete data for a crystal structure can thus be collected in a day. The accuracy is limited by the experimental conditions and the quality of the films, rather than by the machine, which should certainly be sufficient for the average structure determination.

The microdensitometer is not of course limited to processing X-ray films although it will spend most of its time doing so. There are a wide number of applications which require accurate density measurements from photographic films on transparencies. For example, the machine has occasionally been used to digitize X-rays of miners' lungs for pneumoconiosis studies, or photographs of handwriting for optical character recognition work.

Michael Elder is a senior scientific officer in the Applications Software Group at the Atlas Computer Laboratory.

Appleton Laboratory

Lady Appleton at the unveiling ceremony

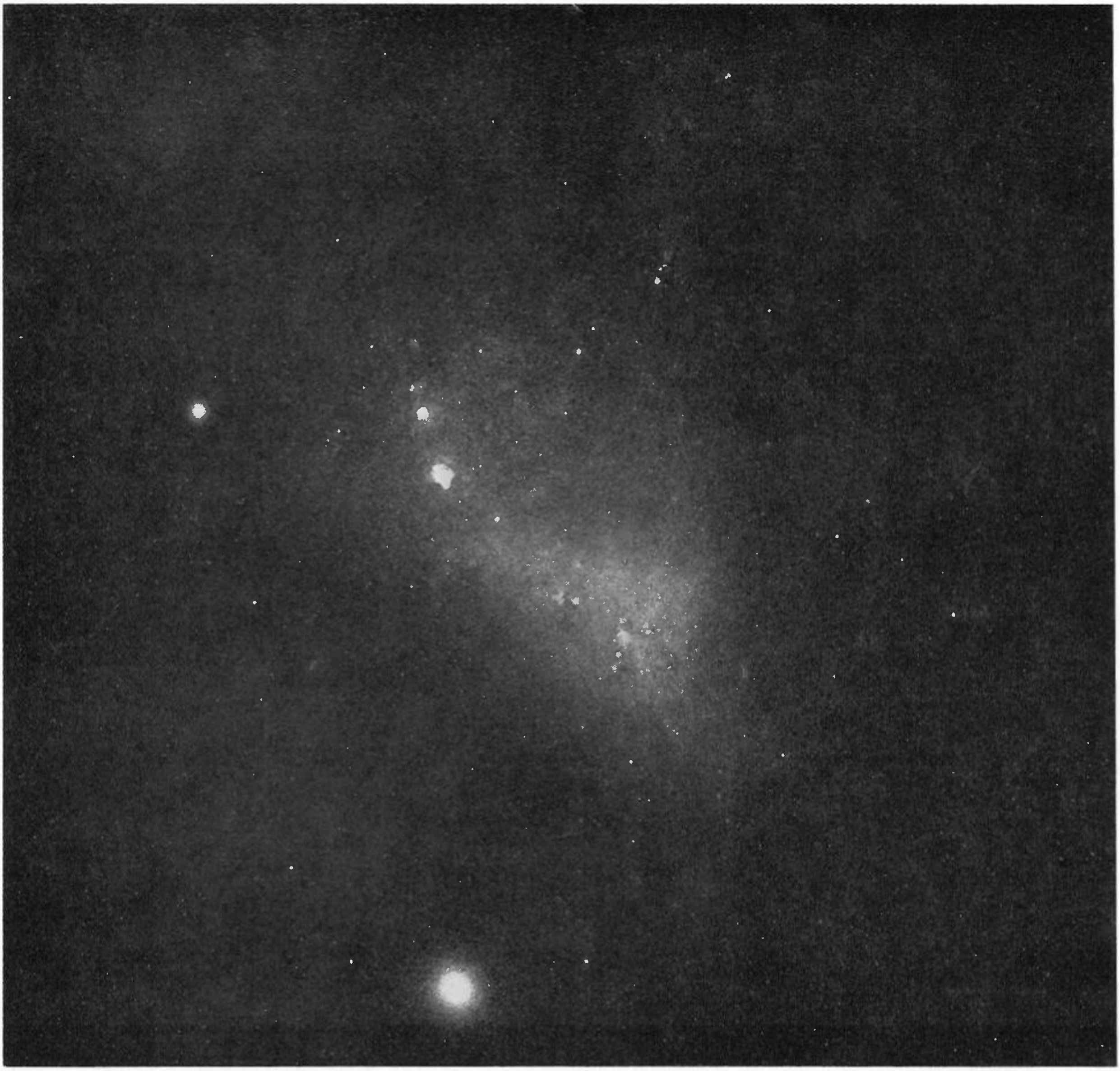
The renaming of the Radio and Space Research Station as the Appleton Laboratory—after the late physicist Sir Edward Appleton, CBE, KCB, FRS, who was connected with the Station's work for many years—was celebrated late last year by the unveiling of a plaque to commemorate the change of name.

Former Secretary of State for Education and Science Margaret Thatcher and Lady Appleton participated in the unveiling ceremony.

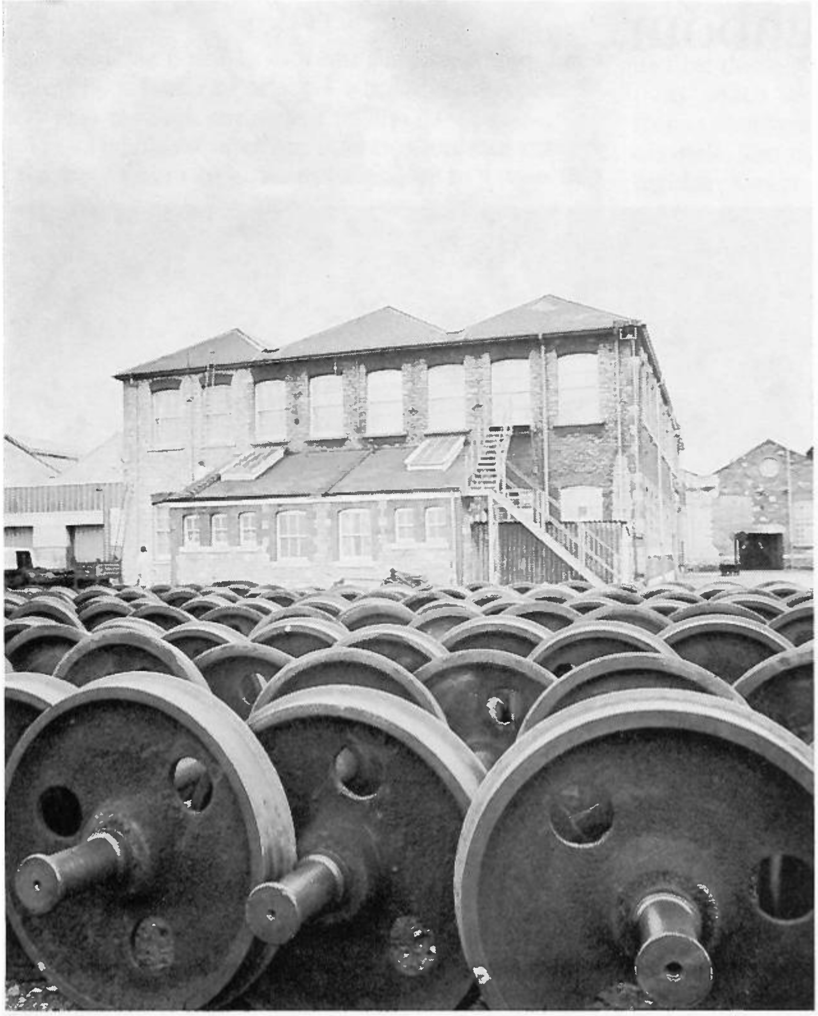
The Council has also decided that the names of the Rutherford High Energy Laboratory and of the Daresbury Nuclear Physics Laboratory be changed to the Rutherford Laboratory and to the Daresbury Laboratory respectively. These changes are in line with the Council's policy of encouraging the widest possible use of expertise available in the laboratories.

No changes in name are contemplated for the Royal Greenwich Observatory, the Royal Observatory, Edinburgh, or the Atlas Computer Laboratory.

Our nearest neighbour...



Our neighbour galaxy the Small Magellanic Cloud, photographed by the Science Research Council's 48-inch Schmidt Telescope at Siding Spring, Australia. One of the largest telescopes of its kind in the world, it was designed and built by Grubb Parsons of Newcastle-upon-Tyne in only two years. Since it came into operation on July 2, 1973, a technique for sensitising photographic emulsions developed by the Schmidt Telescope Project Unit's staff, has enabled it to photograph objects as faint as magnitude 23 in an hour—six times fainter than was previously possible. More than a hundred photographs of various kinds, each covering 40 square degrees of sky, are now available at the Unit at Edinburgh for loan to British research astronomers.



An interesting view of the SRC's temporary accommodation, which shows something of Swindon's history with its display of the bogey wheels still resting in the railway yard.

Swindon Advance Office

On 1 March the SRC opened its advance office in temporary accommodation in Swindon. At the time of going to press Training, Contracts, Manpower, LOA, SUGA Accounts and Ledger and Salaries sections have staff there. Other staff involved in this year's move (Biological Science Committee, Control Engineering Committee and the Computing Science Committee) will follow in August.

The SRC aims to open its main office in Swindon at the beginning of 1977.

The address of the advance Office is:

Science Research Council,

c/o British Rail Engineering Ltd.,

Swindon Works,

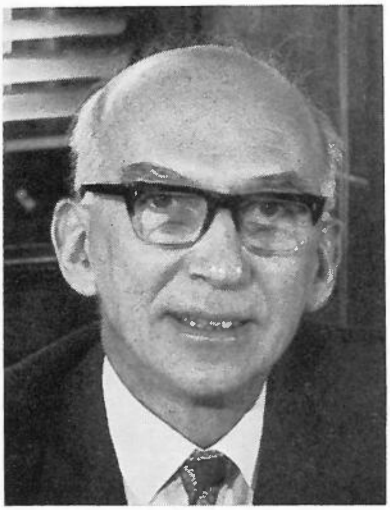
Swindon SN1 5BW.

Tel: Direct Line or Swindon (0793) 26222;

Telex No: 449466

Picture shows the Training Section's office. From left to right Jim Sadlier, Terry Dawson and Miss Deidre Ackland

Entrance to SRC's offices.



Dr Alan Hunter

Dr Alan Hunter, formerly Deputy Director of the Royal Greenwich Observatory has been appointed its new Director.

Dr Hunter was educated at Imperial College, University of London. He studied for his PhD in Alfred Fowler's Laboratory at Imperial College and it was here that his interest in astronomical spectroscopy began.

His career at the Royal Greenwich Observatory began in 1937 and until the outbreak of war he contributed to observing programmes on colour temperatures of stars and on trigonometrical parallaxes.

In 1939 it was decided to move the Greenwich Observatory to a site in the south away from the man-made smog which dimmed the light of the stars but the move was deferred until after the war.

Dr Hunter who had spent the war years at the Royal Naval College, Greenwich, carrying out research into the mechanical properties of metals, returned to help with the move to Sussex, which was completed in 1957.

At Herstmonceux Castle he headed the Astrometry Department until 1961 when he was made Senior Principal Scientific Officer and Chief Assistant to the Astronomer Royal. His interest then turned to scientific administration. In 1967 Dr Hunter was made Deputy Chief Scientific Officer and Deputy Director.

Dr Hunter has been President of the British Astronomical Association and Vice-President of the Royal Astronomical Society. He is presently Treasurer of the latter. He is married with four grown-up sons and enjoys gardening in his spare time.

Farewell to Dr Margaret Burbidge, FRS, who until November last year was Director of the Royal Greenwich Observatory.

Dr Burbidge joined the RGO on secondment from her post as Professor of Astronomy at the University of California, where her husband is also a professor, and she has returned to this post.

New Year Honours

Our congratulations to Dr A W Lines and Professor B C L Weedon, who received the CBE and Mr R L Taylor who received an OBE.

Dr Lines was, until his retirement in December last year, Director of Engineering and Nuclear Physics Divisions.

Professor B C L Weedon is a member of the Science Board and Chairman of the Enzyme Chemistry and Technology Committee.

Mr Taylor is a Principal at the London Office.

Institute of Physics Awards for 1974

The following awards have been made to colleagues associated with the SRC:

Maxwell Medal and Prize to Professor S F Edwards, Chairman of the SRC, for his work on the application of functional integration to a wide variety of problems in statistical mechanics.

Guthrie Medal and Prize to Professor R L Mössbauer, Director of the Institut Laue-Langevin, Grenoble, for his outstanding contributions to the study of condensed matter and in particular to the discovery of the effect which bears his name.

Holweck Medal and Prize is given for distinguished work in experimental physics, or in theoretical physics if closely related to experimental work. This year it has been jointly awarded to a French physicist and a British physicist. Professor A Hewish, a member of the Royal Observatory Edinburgh Committee, is the British award winner.

Professor Sir Rudolf Peierls, formerly Chairman of the Atlas Computer Committee, has been made an Honorary Fellow of the Institute of Physics.

Promotions

Mr H Hurst has been promoted to Computer Manager, Senior Principal Scientific Officer, at the Rutherford Laboratory.

Mr M W Message is now Senior Principal, Establishment Division.

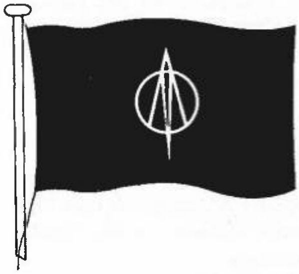
Finite Elements at Abingdon

Finite element methods are a computational technique widely used in structural engineering which have been applied more recently to problems of fluid dynamics. In March this year The Cosener's House, Abingdon—the hostel of the Rutherford and Atlas Laboratories—was the pleasant setting for a symposium on the subject organised by the Atlas Laboratory.

About thirty engineers and scientists attended the three day meeting. Papers were presented on various applications of the method, computer program packages, numerical techniques and computing requirements of finite element calculations. An "Any Questions" session concluded the occasion with Tony Egginton of London Office chairing a panel of SRC Committee members who answered participants questions about SRC policy in the field of engineering computing.

A social programme and symposium dinner was held at which Professor Sam Edwards, FRS, Chairman of the Council, gave a down-to-earth address.

Summing up, Jean Crow, Symposium organiser, discussed increased collaboration between Universities and the Atlas Computer Laboratory in engineering computing. Dr Jack Howlett, Director of the Atlas Computer Laboratory, concluded with the vote of thanks. All agreed on the success of the occasion.



SRC Racing Flag

The SRC have now been represented in all three of the annual inter-departmental offshore races (see *Quest* Vol. 6 No. 2 1973 and Vol. 5 No. 1 1971). The next will be held on October 11–13 and anyone interested in crewing should contact Martin Hall at the Appleton Laboratory. The Chairman, Professor Edwards, has kindly agreed that from now on we may race under the SRC motif. We expect to be the first crew to do this and hope that it will not be the only respect in which others follow our lead.

The offshore race is organised by the Civil Service Sailing Association, who have monthly meetings discussing sailing topics at the Civil Service Recreational Centre in Monk Street, S.W.1. They also have twenty-five associated sailing clubs and organise offshore cruising and racing in their two 6-berth boats throughout the season. At the time of going to press crewing opportunities are still available.

The SRC crew in *Shar* during the CSSA Interdepartmental Offshore Races last October. Unfortunately gale warnings forced the crews to abandon the Cross-Channel race in favour of three races in the Solent. Twelve boats took part in the races and the SRC crew, which came in fifth place, missed a prize by just 107 seconds over eleven hours of racing. Anyone interested in entering an SRC team of three Enterprise dinghys for the Portcullis trophy this month, should contact Martin Hall at the Appleton Laboratory. The SRC crew shown from bottom left to right are: Richard Hilken (ACL); Tony Damerell (RL); Alan Bishop (RL) at helm; Ken Somerville (ROE); and Martin Hall (AL) skipper.

Rutherford and Atlas Chess Tournament

This year the title has been won jointly by Bill Turner of the Applied Physics Division and Peter Hemmings of the Computer and Automation Division. Both players scored eight points out of a possible nine and were undefeated in the tournament rounds.

The tournament which was first held in 1967 is run on the Swiss system (usually nine rounds). More than thirty of the sixty odd players at the laboratory take part.

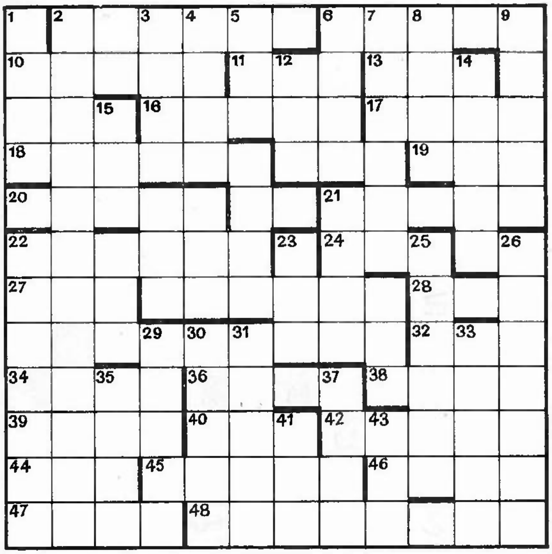
Although there is a high standard of chess played at the laboratory, which boasts a few county players, Bill Turner has stood out through the consistency of his game. He has won the tournament every year, sharing the title on only three occasions.

The Rutherford and Atlas chess players meet local teams for friendly matches. There is also a "lightening" tournament held on the annual SRC Sports Day and providing there is enough support there is likely to be an annual SRC Tournament.

One of the games at this year's tournament: Players V J Riddle (Black) and W Turner (White). Bill moves first each time:

1 P – Q4, N – KB3
2 P – QB4, P – K3
3 N – QB3, B – N5
4 Q – B2, P – B4
5 P – K3, N – B3
6 N – B3, O – O
7 B – Q3, P – KR3
8 O – O, Q – N3
9 P – QR3, P x P
10 P x P, B x N
11 P x B, Q – B2
12 R – K1, P – QN3
13 N – K5, P – Q3
14 N x N, Q x N
15 B – B4, B – N2
16 P – B3, KR – Q1
16 P – B3, KR – Q1
17 Q – Q2, Q – Q2
18 B x P, P x B
19 Q x P, Q – K2 (to protect knight)
20 P – Q5, P – K4
21 P – N4, P – K5
22 P – N5, N – R2 (if . . Q – B1, Q x N, P x B, R – K7 followed by P – N6 wins)
23 R x P, Q – B1
24 R – K8, Q x R
25 B x N(CH), K – R1
26 B – B5(CH), K – N1
27 Q – R7(CH), K – B1
28 Q – R8(CH), K – KZ
29 R – K1 (Checkmate)

Peter Hemming (left) and Bill Turner contemplate their next move.



Crossword

Maxim 5

To compensate for the scarcity of clues, crossword fans are invited to take a trip from the top left-hand corner of the central block of 8 x 8 squares (i.e. from the first letter of 15 down) and proceeding clockwise and inwards, to discover the members of a group, in the order in which one would expect to find them.

ACROSS

2. Shy about small volume of liquid before ten—that can be seen when bottom's up (6)
6. Play a ukelele in "*Last Rumba*" (5)
10. Good place for a meal, the LO? Well, not exactly! (5)
11. I go after Freud-centred concept (3)
13. Guzzle brew of what's brewed (3)
16. Town in England's centre, nigh unto Bedford (5)
17. Descriptive of de Mille picture? (4)
18. Author of legal document set before the queen (6)
19. One who's on a ship, and one who leaves it in retrospect (3)
20. What you might get out of backward, tight pedagogues (5)
21. Brain surgeon's predecessor in Western Europe (5)
22. Sort of coat worn by rich women about fifty in a sudden bout of activity (6)
24. Run out for a jar (3)
27. Imperial rule depicted in upturned urn (3)
28. Essential in hearing (3)
32. Object that is heard, and may be seen, in euphoria (3)
34. Men I take on board (4)
36. Animal life found in Mars! (4)
38. Dame's gear, her first clothing (4)
39. Completely French type of spiv (4)
40. It's foolish to start assuming (3)
42. Take guns off a girl joining the Marines (5)
44. The disappearance of a friend (3)
45. Knock-out juice, an article swallowed by the queen (5)
46. Goal-getter from Russian ladies' team? (4)
47. Something to play back for guest at stag party (4)
48. Begins to come in, laddie (6, 2)

DOWN

1. Melt, what? Melt (4)
2. Link provided by change of relocation to SRC's centre (11)
3. About to allow untidy ancient Briton (4)
4. What's this, coloured alternators? (4)
5. Three-quarters of snowman still remains (3)
6. Boys drop note in songs (4)
7. See-saw between finite and eternal (6)
8. Captivated by a sort of trap (4)
9. Small beginning—or a hundred I'm raising (5)
12. Site of Indian summers sometime ago (3)
14. Put it upside-down on an artist, or the right way up on a duchess (5)
15. Seed that raises twin (3)
22. Temperature scale sorted out what's below freezing (7)
23. She starts like sugar and ends like saccharine—sweet (3)
25. Rule an assemblage of nervous things (6)
26. Wooer, a chap who likes jumping in the deep end (7)
29. Girl loses hydrogen, combines alcohol with acid (5)
30. Veteran car spoils RAC team's start (5)
31. Spots what's risky (4)
33. Wells went with him—a long journey? (5)
35. Regret about part of old money system—knickers, for instance (4)
37. I'm certain our ruse will fail (4)
41. Scenery's in position (3)
43. Air's two gases—take neither (3)

(Solution will appear in the next issue. £1 book token prize for first correct solution received).

Nutcracker

'How went t'annual Canal Fishing Championship?' said Ebenezer Eelworthy, propping up the bar of the Daresbury Arms. 'Was you four t'only entrants?' 'That we was,' replied Albert Anglepike, 'and Dicky Dogfish won it again. He caught more than old Charlie Carp here and Charlie caught more than Ben Bream and I ended up bringing up the rear as usual.' 'Never mind, Albert,' said Charlie, 'at least you caught more fish than last year.' 'Aye ' replied Albert, 'but all I caught last year was one undersized roach and twelve reports on new accelerators—whatever they be.' 'So how many did you each catch?' asked Ebenezer. 'Ah, well,' said Dicky, who always was too clever by half, 'the product of our catches is 2, 100 and their sum is precisely my winning score in the Merrison Memorial Trophy last year.' 'But I don't remember your winning score ' said Ebenezer. 'No matter ' replied Dicky, 'because you wouldn't know all the catches if you did. However, if I tell you that my own score was even better than my score in the Warrington Canal Competition that should tell you everything.' What were the catches?

Send answers to *Quest*. First correct answer opened gets £1 book token.

Nutcracker 13 Solution

Simon Capers found 14 fingers at the end of the robot's arm.

Explanation

It is clearly not possible to increase the grant of £****7 by a factor of *4 to £*00,000 in normal base ten arithmetic. The robot must therefore be working in a different number base which is presumably the same as the number of his fingers.

The winner of the £1 book token was James E Hall of the Appleton Laboratory.

Nota Bene

Your local correspondents who would be delighted to receive your articles/cartoons/comments are:

Mr Bill Burton
Astrophysics Research Division
Appleton Laboratory,
c/o Culham Laboratory (ext. 6184)

Mr Jim Campbell
Royal Observatory Edinburgh
(ext. 100)

Mr Geoff Gardiner
Appleton Laboratory (ext. 330)

Mr Doug House
Atlas Computer Laboratory
(ext 515)

Mr Harry Norris
Rutherford Laboratory (ext. 484)

Mrs Shirley Lowndes
Daresbury Laboratory (ext. 305)

Mr John Alexander
Royal Greenwich Observatory
(ext. 214)

Balloon stops rays

With regard to the last issue's cover picture showing the skeleton of a gas scintillation counter which is to be flown under a helium-filled balloon twenty-five miles up to measure abundances of heavy elements in primary cosmic rays, it should be made plain that the equipment was designed and constructed in its entirety by members of the Physics Department of Bristol University under an SRC grant.

Construction was made easier for the Department by the excellent facilities put at their disposal by the British Aircraft Corporation where the assembly of the detector took place in the spacecraft assembly building at BAC, Filton.

The new editor of Quest, Miss Carol Rivers

Dr W G Potter

Dr W G Potter has been appointed Head of Engineering Division.

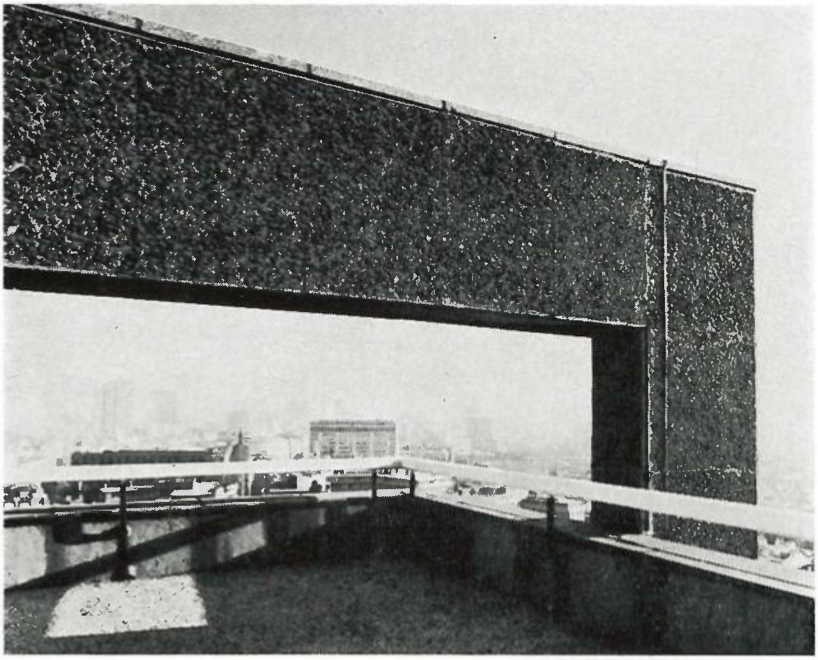
Dr Potter was educated at London University and then joined the Armament Research Establishment of the Ministry of Supply. After ten years with Shell he joined the SRC in 1965. For the last three years he has been Deputy Head of the Science Division.

Suggestions Scheme

In 1973 the number of suggestions received by the management totalled 166 and £384 was paid out in prize money (highest award: £30) for the 45 suggestions accepted.

Farewell

Jill Peatfield, formerly librarian at Daresbury and a local correspondent for *Quest*, married Phil Ditchfield last October and left Daresbury for Scunthorpe at Christmas. Jill is now branch supervisor of the Scunthorpe branch of Swan National Car Rentals.



View from the top

On a recent assignment at State House staff photographer Peter Hicks of the Appleton Laboratory took a series of studies from the roof. The picture shows a view looking towards the city with the *Daily Mirror* building and St Paul's in the background. The main structure shown in the foreground is part of the support system used in the body of the building.

QUEST

August '74

Europe's high flux reactor

Sports day

Home control for our latest satellite

QUEST

House Journal of the Science Research Council

Vol. 7 No. 2
August 1974

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Jim Campbell ROE
Geoff Gardiner AL
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Harry Norris RL
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Carol Rivers LO
Editor

Cover
Cover picture shows part of the sculpture by the French artist Ipoustéguy which stands at the entrance to the Institut Laue-Langevin (ILL). When a work of art was sought for the ILL, it was decided that it should provide a marked contrast to the world of physics and sophisticated technical plant and should be essentially human in subject. The sculpture which is slightly more than life-size is set up on a concrete path 20 m in length and the cover picture shows the section with Man feeling his way through a door—a picture which has always been foremost in the artist's mind. He visualises himself as groping through the door into an unknown future every day.

Quest will be issued three times this year by the Science Research Council for members of staff only. The Council is not necessarily associated with any individual views expressed.

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Editorial

As we go to press, three major projects in which the Council is involved are nearing completion.

On July 19 the agreement between Britain, France and Germany formalising British participation, through the SRC, in the Institut Laue-Langevin (see page 1) was signed in Grenoble.

Early in October UK-5, the first satellite to be controlled from this country (see page 5) is expected to be launched from the San Marco platform off the coast of Kenya and later in the month the 150-inch Anglo-Australian Telescope at Siding Spring will be inaugurated by Prince Charles. This is, therefore, a most exciting time for our international interests.

Nearer to home, this issue of *Quest* deals with the recreational side of the Council and reports on the SRC Sports Day and Golf Tournament.

Contents

Europe's High Flux Reactor

W M LOMER

Formal ratification of British participation alongside France and Germany in the Institut Laue-Langevin was signed by the Rt Hon R E Prentice MP in Grenoble on 19 July. In this article Dr Lomer, British Associate Director, describes the setting up of the Institut Laue-Langevin (ILL), which houses Europe's high flux reactor.

In 1965 after years of false starts as an international project, Europe's first high flux reactor for neutron beam research was adopted as a two-nation Franco-German enterprise.

Grenoble was chosen as the site for the reactor and a French private company, whose sole shareholders were the appropriate research organisations of the two countries, was set up. By 1967 the project was under way with a two-nation project team under its first Director, Professor Maier-Leibnitz from Munich. Construction by French and German industry was rapid and the reactor went critical ahead of schedule late in 1971. By that time a number of measuring instruments were being installed round the 20 odd beams available and a steady stream of experiment proposals was being received from scientists in French and German universities and research centres.

The UK position

In the UK, the flow of corresponding experiments from British universities was gradually swamping the older reactors at Harwell and Aldermaston dating from the 1950's. Many proposed experiments could not be satisfactorily carried out with the modest fluxes available at those reactors. Late in 1972 the United Kingdom decided not to construct its own high flux reactor but to seek membership of the ILL.

The flexibility of the small management structure of both the ILL and SRC proved to be well matched and in less than three months the UK was accepted as a member of the ILL, the Science Board and its Neutron Beam Research Committee being the internal SRC channels of control. In a further couple of months some important UK experiments had been slotted into the programme and, by the end of April 1973 I had been released by the UK Atomic Energy Authority to act as UK Associate Director for eighteen months.

Two's company, Three's a crowd

Never was a saying less true! We were welcomed by French and German alike with genuine warmth and enthusiasm. On the scientific side the British were welcomed because their universities had developed a very wide base of neutron beams in chemical, polymer and biological research compared with their Continental colleagues. Secondly, the technical staff were anxious that UK technicians should come, bringing with them their knowledge of the UK's research equipment and its supply situation, for they all knew how greatly the availability of equipment and method of use varies from country to country. Finally, we were welcomed because most of the Institute's staff are convinced Europeans and were anxious to see the success of the ILL used to further scientific relations between the 'big three' of Europe.

On the personal side, the experience has been most enjoyable. From my first day here, 2 May 1973 (I had forgotten that no one on the Continent works on 1 May and so lost (gained?) a day as a result), all administrative and most technical discussion has been in French and all scientific discussion in English. My school-boy O-level French had to grow pretty fast but the example of the German technicians and scientists handling all three languages with real proficiency spurred me on.

My overall impression is how ineffective most school language teaching is in Britain in comparison with France and Germany. It is a question of psychology, perhaps—the French and Germans learn other languages to use them, not just to pass exams. When my family joined me in the summer, my eleven-year-old daughter Mary started at the local French secondary school and the quality and rate of the teaching of German astonished us: five hours per week with a teacher, who uses nothing but German during the classes.

Schooling is the main worry of all parents arriving

Dr W M Lomer, British Associate Director

Institut Laue-Langevin with the Vercors in the background

in Grenoble. A basic difficulty is that Germans consider that young children should not be subjected to a long school day (in Germany they start school each morning at 8.00 and go home at 13.00, returning after lunch only for sport or extra-curricular activities). The French do not consider that a child can work a continuous week, so there is no school on Wednesday. To catch up they start at 8.00 and finish at 17.00 with a real French lunch break of at least two hours. The British *know* that they are normal in expecting the children to be away all week from 9.00 to 16.00. But now we have all talked together enough to realise that we are all prejudiced and that a trilingual class in the primary school is such a great background for children that the actual hours worked might as well be the normal French ones to fit in with the school timetable.

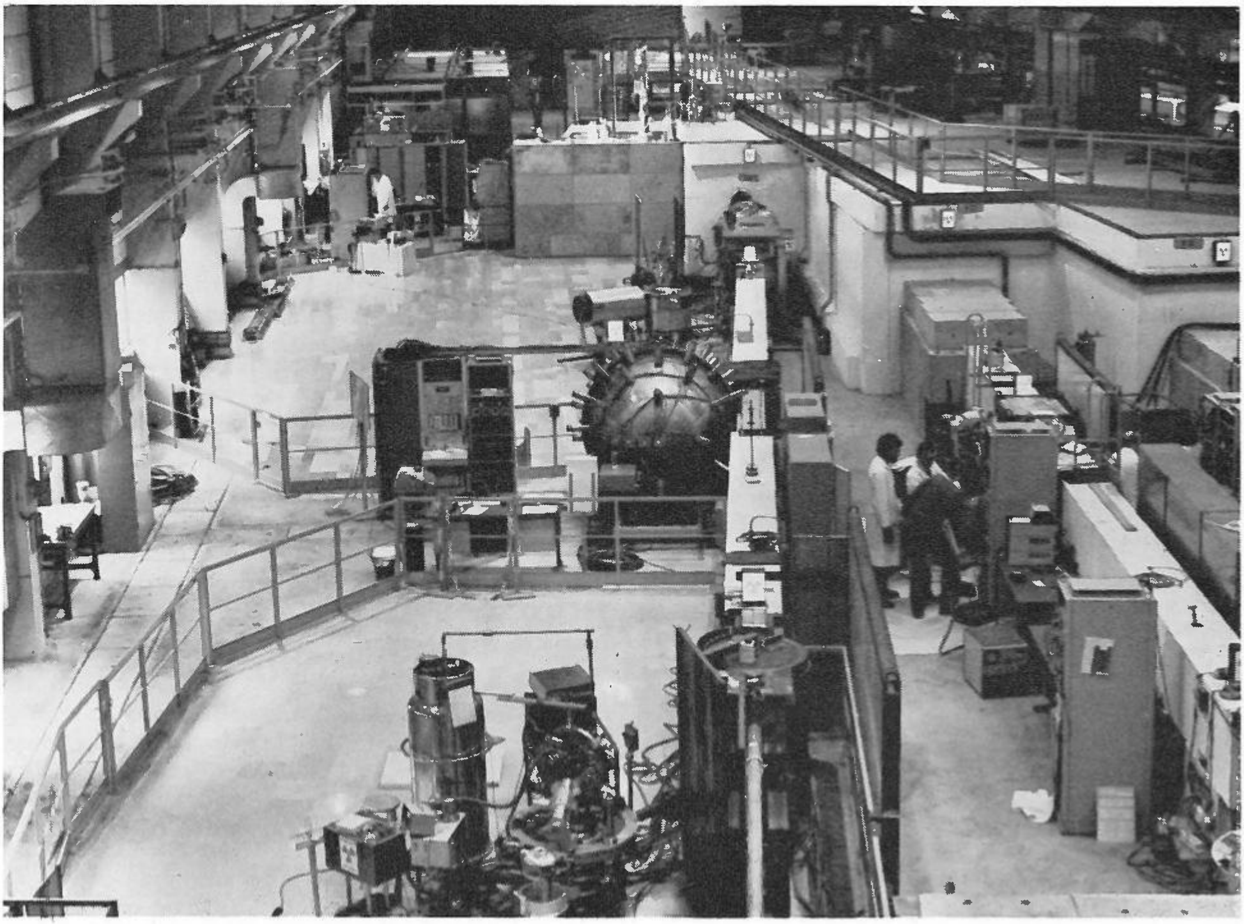
No special licence required

And let there be no mistake, to live in France one must conform. It is essential to fill in forms for everything—usually accompanied by photographs. So far, I have used seventeen passport-sized photographs for such things as the sports club; ski section of the sports club; French Ski Federation; Maison de la Culture (art, theatre and film centre); bus season ticket; resident's permit, and so on! Once a member, the range of subsidized cultural and sporting facilities available is really astonishing.

However, no special licence is required to enjoy the excellent restaurant meals or wines. Life in France is lived to the full, energetically, perhaps in rather close knit groups, but never frantically. The French always have time to talk, a passion for debate and an unflagging interest in people. Even discounting the restaurants, there is much to be said for life in France.

My happiest acquisition here has been my friendship with my Director, Rudolf Mössbauer and French Co-director Bernard Drefus. With them in charge the scientific objectives of the ILL and the humanity of its management can never be in doubt. My successor will be a lucky man.

Facts and Figures
400 employees (30 British)
70 scientists (15 British)
35 postgraduate students (2 British)
Working spectrometers and other instruments 22
Final planned total 40
1973: external experiments 190
1974: estimated external experiments 250
Reactor: Enriched U metal fuel heavy water moderated 57 MW
Cold source: 25 l liquid heavy hydrogen 25° K
Hot source: γ ray heated graphite 2000° K
Peak thermal flux: $1{\cdot}5 \times 10^{15}$n cm $^{-2}$ sec $^{-1}$



The High Flux Reactor provides intense beams of neutrons for studies of condensed matter in the fields of physics, chemistry, biology and materials science

Council Commentary

April to June 1974

European Science Foundation
The May meeting of prospective members in Stockholm selected Strasbourg as the seat for the new organisation, agreed outline statutes and set up a Founding Committee comprising the Preparatory Commission plus a member from each country not already represented on the Preparatory Commission. It is expected that the ESF will be inaugurated by the end of 1974 in which case there will be no requirement for the EEC to arrange a separate mechanism for ensuring collaboration in fundamental research and as a source of informed advice.

Forward Look 1975/6–1979/80
The 1975–80 Forward Look was submitted to the Department of Education and Science in April. The next formal step in long term financial planning will be the publication of the Public Expenditure

Survey in December. Meanwhile the Advisory Board for the Research Councils' advice to the Secretary of State for at least the first year of the period should be known before the end of the summer. The Council will discuss the SRC's programme in relation to expected resources at their September weekend meeting at Loughborough University of Technology.

May Meeting
The May meeting was held at the Royal Observatory Edinburgh. Council members much appreciated the efforts made by Professor Brück and his staff to make the visit so interesting and informative.

Annual Report 1973/74
Council commented on the first draft of the Annual Report in June before submission to the Secretary of State.

Astronomy, Space and Radio
3·8 metre Infra-Red Flux Collector
In April Council approved the construction of a 3·8m flux collector on Mauna Kea Mountain, Hawaii, at a total cost of up to £1·22M at current prices. The instrument will be used not only at wavelengths up to those at which radio techniques are possible (about 1mm) but also for observations at optical wavelengths which do not require the image quality of relatively more expensive optical telescopes. The project scientist will be Professor J Ring (Imperial College) and the project engineer will be Mr G J Carpenter. The experience gained in the operation of the existing 1·5 metre flux collector in Teneriffe built by Imperial College with SRC grant funds proved extremely useful in designing the new larger instrument.

From the scientist's point of view the site for this type of instrument must satisfy two criteria. First, it must have a high percentage of clear nights and days, because at wavelengths exceeding 10 microns the daytime sky is 'black'. Second, the total water vapour content above the instrument must be low and therefore the site must be high. Using these and other relevant criteria a recent US survey identified Mauna Kea (13 800 ft) as one of the best infra-red sites in the world. (See picture story, page 7.)

Skylark
Also in April Council approved a proposal involving the replacement of the control bay of the Altitude Control Unit for Skylark rockets with an inertial guidance platform developed for the Anglo-German Multi-Role Combat Aircraft. This would cost up to £385 000 and would give a simpler and more flexible system with good pointing accuracy and significantly increased observation time.

Mark VA Radio Telescope
Council, on the advice of ASR Board, have reluctantly decided that they cannot finance the proposed Mark VA radio telescope for Jodrell Bank. The estimated cost after assessing tenders was at least £16–17M.

Engineering
In May the Council approved a supplementary grant of up to £240 000 to Professor G D S MacLellan of Leicester University for work on interactive computer design of engineering structures and components. At the same meeting Council approved a grant of up to £57 000 supplementing £126 258 awarded to Professor R W H Sargent of Imperial College, London, for work on on-line estimation and control of chemical plant.

Nuclear Physics
Nuclear Structure Facility at Daresbury
Following the public enquiry, authority to proceed with the NSF was received in December 1973 for a total capital cost of £6·206M including VAT, at September 1973 prices. Tenders for two of the main contracts for the construction of the NSF had shown large increases and calculations based on these and relevant price increase indices had resulted in an updated capital cost of £8·0M at March 1974 prices.

Council at their April meeting approved the continuation of the NSF project at the new cost of £8·0M and noted that further revision might be necessary when other major contracts were let in due course.

Glasgow Linear Accelerator
Council approved a grant of up to £104 300 for upgrading the main electron linear accelerator at Glasgow. Pending the construction of the NSF the Glasgow linac is one of the two major facilities for nuclear structure research in the UK; the other is at Oxford. The construction of the Glasgow linac was originally financed by a DSIR grant. The upgrading of the main accelerator is considered necessary for the execution of the scientific programme and will involve two modifications. A spectrum compressor will be built to improve the machine's energy resolution and the maximum energy, recently raised to about 134 MeV by increasing the operating temperature, will be further increased to 160 MeV.

Home Control for our Latest Satellite

UK-5 centre at Appleton Laboratory*

E DOYLE†

UK-5, or Ariel 5 as it will be known when it is in orbit, is the fifth in a series of British scientific satellites. It has been designed and constructed for the SRC by Marconi Space and Defence Systems at Portsmouth to serve as a platform for six scientific experiments—five British and one American.

These experiments will be used to study different and complementary characteristics of stellar X-ray sources, and the data obtained from them will provide a comprehensive picture of the radiation from the X-ray sources, together with accurate identification of the source positions. Four of the experiments are designed to point directly at a selected source and study it in detail, while the other two continuously scan the whole sky as the spacecraft spins and can give early indication of unusual events whilst simultaneously accumulating information about many different sources.

The launch aboard a scout rocket is expected to take place in the near future from the Italian 'San Marco' launch facility in the Indian Ocean off the coast of Kenya near Mombasa.

There are almost two hundred known X-ray sources and during the first year of operation the spacecraft will be pointed at up to one hundred of these which have been selected for detailed observation by the 'pointing' experiments. At the same time the scanning experiments will be collecting information about all the known sources and possibly about some which have not yet been identified. The pointing direction of the spacecraft is changed when commands from the ground open small gas jets. There is enough gas on board for at least one year's operation of the satellite.

Once the spacecraft is in orbit all its operations will be directed from the Ariel 5 control centre which has been built at the Appleton Laboratory in Slough. Commanding and telemetry reception facilities at the NASA ground stations at Quito and Ascension Island will be used to provide direct contact with the spacecraft while NASA data links will be used to relay commands from Slough to these stations and to transmit to the control centre telemetry relayed in real time from them. The telemetry is recorded and simultaneously monitored as it reaches the control centre and a variety of devices are used to display the information on spacecraft performance and status which is contained in the telemetry. Once the data from a pass have been collected in the Control Centre they are passed to the ICL 1904A computer at the Appleton Laboratory, or if this is not available, they are transmitted over Post Office DATEL 2400 data links to the 1906A computer at the Atlas Laboratory, Chilton, or to a similar machine at British Airways, Heathrow.

The UK-5 control room at the Appleton Laboratory

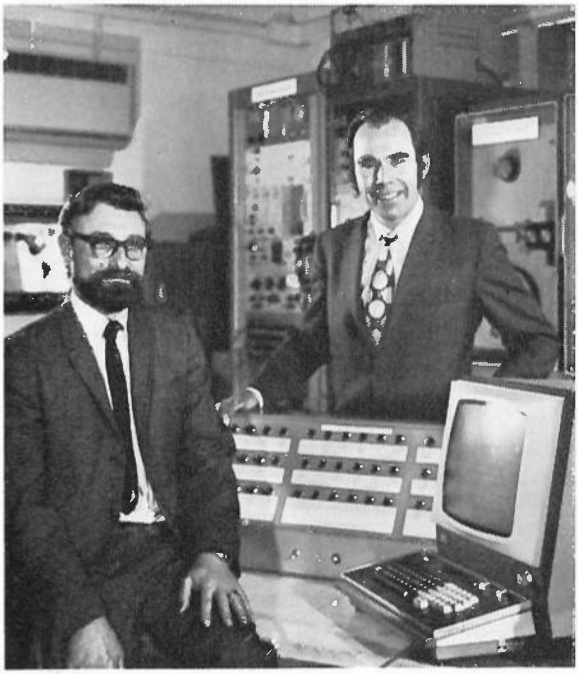
These large computers are used to process the data and to calculate the current pointing direction, drift rate and orbit positions, to check the experimenters' data, and then to transmit all this information over data links back to the control centre, where it is recorded on magnetic tape. In the control centre the information required by each experimenter is selected and is transmitted over GPO DATEL 600 data links to the experimenter at his University where it is recorded in a suitable way on his own computer. This use of data links enables the experimenter to obtain results within an hour of the time at which the spacecraft was commanded to transmit the data, and makes it possible for him to make changes to his experiments within a very short time, and therefore to make the best possible use of this opportunity to study stellar X-ray sources.

* See also Satellite technology UK-5, Quest vol 5 no 2, J F Smith.

† Dr Elizabeth Doyle was until recently Software Systems designer for UK-5 at the Appleton Laboratory.

UK-5 Satellite Data

Programme Collaboration:	SRC/NASA
Designation:	UK-5 before launch—Ariel 5 when in orbit
Purpose:	Cosmic X-ray studies
Operational Life:	1 year (nominal)
Experiments:	*Expt.* A University College London; Mullard Space Science Laboratory; Birmingham University; 0·3–20 keV source position and sky survey (pointed experiment)
	B Leicester University: 1·5–20 keV sky survey
	C UCL/MSSL: 2–30 keV spectra of selected sources (pointed experiment)
	D Leicester: 2–8 keV polarimenter/spectrometer (pointed experiment)
	F Imperial College: 40 keV–1·5 MeV spectra of selected sources (pointed experiment)
	G Goddard Space Flight Center: All-sky X-ray monitor energy range 3–6 keV
Dimensions:	
Diameter	38 in overall
Length	34 in overall
Weight	298 lb
Stabilisation:	Spin 10 ± 2 rpm
Altitude control:	Propane gas jet
Power (solar array):	35 W (available)
Telemetry:	PCM
Frequency	137·68 MHz
Real time power	80 mW
Real time rate	2048 bits/sec
Playback power	80 mW
Playback rate	2048 bits/sec
Station	Quito (NASA)
Telecommand:	Tone digital
Frequency	148·25 MHz
No. of commands	73
Stations	Quito, Ascension
Tracking:	Quito and Kourou
Orbit:	
Apogee	500 km
Perigee	Circular
Inclination	2·9°
Period	95 mins
Launch vehicle:	4 stage Scout provided by NASA
Launch site:	San Marco
Launch date:	Planned October 1974
Approximate direct cost:	£4 M
Prime contractor:	MSDS
Current status:	Environmental test of protoflight model



Picture shows Peter Barker, Head of Satellites Division (left) and Barry Martin, Head of Computing and Systems Analysis Division

Energy

During the 1980's and 1990's Britain is expected to have a self-sufficiency of natural gas and oil from the North Sea fields but until that time (and indeed possibly again in the next century) we are faced with an energy crisis. The United States and West Germany are committed to massive programmes of energy research and development and it is reasonable to expect that Britain will also increase its expenditure on energy research and development although the matter is still under Government review. University research and the provision of trained manpower, supported in large part by the Science Research Council, has a valuable long-term contribution to make to a national programme although specific topics and priorities have still to be identified.

The Council has set up an Energy Round Table under the chairmanship of Mr J Ferguson (Chairman of the Engineering Board) to:

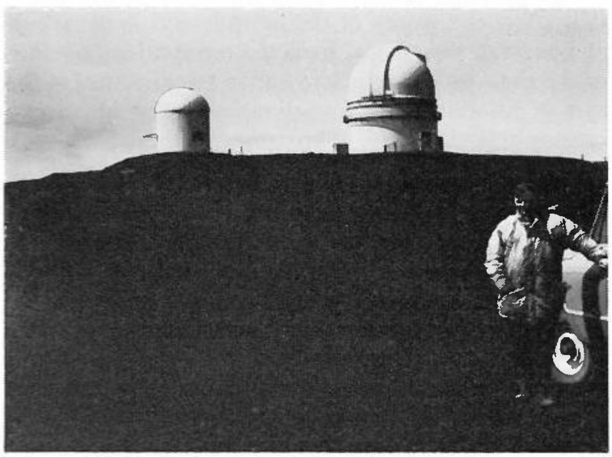
- Review SRC-supported energy research projects in a national context and advise on a suitable balance of support between different aspects;
- identify important areas of research and training requiring more detailed study with the intention of giving priority encouragement;
- consider future trends and developments and assess the kind of contribution university research might make.

Current SRC support ranges through development of superconducting magnets (partly at Rutherford Laboratory), improvement of engines, studies for energy conservation in buildings, design of storage systems, etc, on the technology side, to photosynthesis, metabolism and catalysis studies, etc, in the pure science areas, amounting in all to a commitment of between four and five million pounds.

The Energy Round Table met for the first time only recently and it will be some while before its recommendations are available. Meanwhile, the Council has produced an interim report 'SRC and Energy Research: the Present State and some Future Options' which reviews the current support and identifies areas for more detailed study. The report will be available shortly.

The World's Biggest Infra-Red Telescope

Picture shows a view of the Mauna Kea mountain site in Hawaii which has been chosen by the Council for its new infra-red telescope (or flux collector as it is more usually known). (See Council Commentary on page 4.) The 3·8 metre flux collector will be the biggest in the world and the site, considered to be one of the best places for infra-red observations, will be leased from the University of Hawaii which already operates an observatory there.



The project manager will be Mr G J Carpenter (ROE). He is seen in our picture near the summit of Mauna Kea. In the background are the telescopes of the University of Hawaii.

The Herstmonceux PZT

N P J O'HORA

The Photographic Zenith Tube (PZT) is the most precise instrument currently employed in regular observations of the rotation of the Earth to determine Universal Time (UT) and to measure the observatory's latitude. There are at present about a dozen PZTs in use throughout the world. The results from these together with those from about 40 other instruments—mainly Danjon astrolabes—are used in time and latitude determinations. There is a high degree of international collaboration in the work and the results of individual instruments are combined at the Bureau International de l'Heure (BIH), the international co-ordinating agency operating under the chairmanship of Humphrey Smith (RGO). In the BIH analyses, each instrument is assigned a weight depending on the accuracy of its observations. It is interesting to note that in recent years the highest weight for any instrument is that of the PZT at Herstmonceux.

The time system used throughout the world for normal civil and domestic purposes is based on Universal Time, which is popularly known as Greenwich Mean Time in this country. This time, which depends on the rotation of the Earth, is necessary for terrestrial navigation and surveying (see Quest, Volume 5, page 23). Time to an accuracy of a tenth of a second is normally adequate for use in navigation but for special applications in surveying, in radio astronomy and in space research a precision of a thousandth of a second is required.

Observations of Universal Time are also affected by the Polar Motion—the changes in the direction of the axis of rotation within the body of the Earth that affect the values of the latitude and longitude of all observatories. Apart from the practical importance of the changes in Earth spin and in the direction of the axis of rotation, these variations are of great interest in geophysical theory. (The causes of these variations have not yet been firmly identified.)

The PZT's repeated measurements of stars in the same zone of the sky over a number of years yield a very refined system of star positions—a useful contribution to astronomy. The Herstmonceux results show that proper motions of the zone stars can be determined with high accuracy in ten years of regular observation. International co-operation in the exchange of observations makes it possible to separate effects arising from star place errors and from instrumental or atmospheric anomalies. In the field of international co-operation the Herstmonceux PZT is particularly favoured because in 1968 the Canadian PZT was moved from Ottawa to a site close to Calgary on the latitude of Herstmonceux. The move proved so successful that a new PZT was installed in the Calgary site in 1973 and the expense of this reorganization may indicate the extent to which the results of the two observatories may be improved by independent observations of the same zone stars.

The zenith is the point directly above the observer and the advantage of zenith observations is that systematic atmospheric refraction effects are zero at the zenith, and in its vicinity the effects are small and linear. This property has been recognised from earliest times so that zenith observations have always been important in positional astronomy which depends on measuring the true directions of celestial objects. From its commencement the Greenwich Observatory has always been involved in zenith observations; it was this activity that led to the discovery of stellar aberrations by James Bradley, the third Astronomer Royal, in 1725. Bradley's telescope is still preserved at Greenwich; like all zenith telescopes of the period it measures the direction of the zenith by means of a plumb line. A dramatic improvement in the accuracy of zenith telescopes was made by Sir George Airy, seventh Astronomer Royal. The fundamental principles of modern PZTs are the same as those of the Reflex Zenith Tube that he designed and installed at Greenwich in 1854 and the improvements made over the years are mainly due to experience and technology. The Herstmonceux PZT was designed by Dudley Perfect of the RGO and, together with two other instruments of the same design, for use in Australia and Switzerland, it was manufactured by Grubb Parsons about 1905 and installed at Herstmonceux in 1955.

The principle of the instrument

The principle of the instrument is illustrated in Fig. 1. This shows a telescope tube mounted in a vertical position with the objective lens at the top of the tube and a reflecting mercury pool which defines the direction of the vertical at the bottom. The direction is defined with such high precision that the systematic changes, due to effects of tides in the mercury pool, have been deduced, with an accuracy

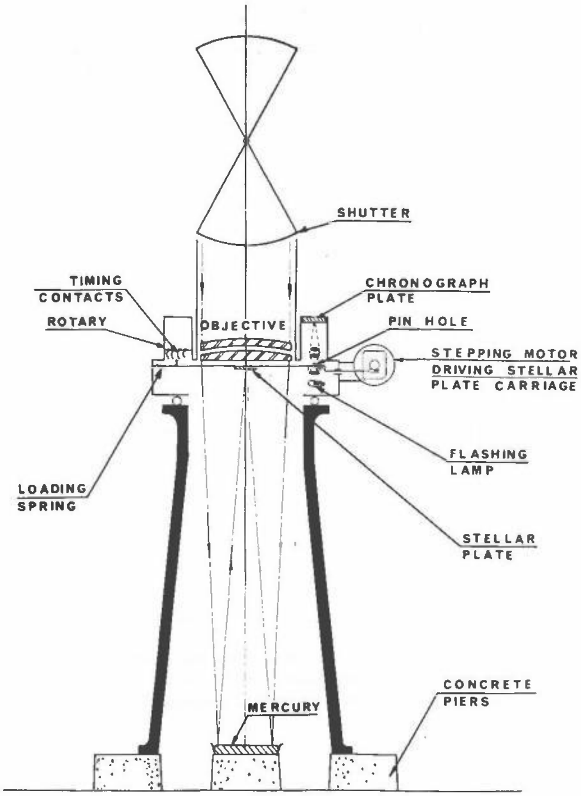


Fig 1. Schematic diagram of the Herstmonceux Photographic Zenith Tube. The objective lens is 10 inches in diameter and the focal length is 136 inches. The rotary rests on a ball race supported by the tapering main tube. The physical, mechanical and optical advantages of this general design have remained unsurpassed for 120 years

of ±0·0015 arc second, from the Herstmonceux observations. Rays from stars in the neighbourhood of the zenith are refracted by the objective lens and the converging beam is reflected in the mercury surface. When the level of the mercury is correctly set the beam is focussed in a principal plane of the lens and the photographic plate is placed here to record images of the stars. The optical advantage of this arrangement is that the positions of the images on the photographic plate are not affected by changes in tilt or level setting of the objective lens. The upper part of the tube, comprising the lens and the photographic plate form a single unit known as the "rotary' because it is capable of rotations through 180° about the optic axis. The rotation of the Earth causes the field of view, centred on the zenith, to move through the stars and imparts to them an apparent motion. This would give rise to the formation of image trails on the photographic plate, but during exposures the plate is caused to move inside the telescope with the same speed and in the same direction as the stellar rays, so that point images of the stars are formed on the plate. Exposures are controlled by the opening and closing of the shutter which is triggered by the observing clock.

To understand how the PZT operates in time determination imagine that each star brought into the field of view by the rotation of the Earth is a point on a 24-hour dial, calibrated with millisecond accuracy. The problem then is to identify, to the nearest millisecond, the clock time at which the star transits the meridian which may be taken as the line in the North-South direction, bisecting the field of view. Four images are obtained of each star and Fig. 2 shows that, if the shutter is operated at equally spaced intervals, the images 1, 2, 3 and 4 will be separated by equally spaced distances on the photographic plate. The rotary is turned through 180° between exposures so that image 2 is transposed to 2a and image 4 to 4a; the four images obtained in the observation are represented by the asterisk points in the diagram. The separations in time (measured by the clock) and the separations in distance (measured with a plate-measuring machine) may be used to obtain, for each star, a "plate scale" in mm/sec of time.

North-South separation

The North-South separation of 4a and 1, and of 2a and 3 are measures of twice the NS zenith distance of the star. This quantity depends on the latitude of the observatory which in turn depends on the direction of the axis of rotation of the Earth so that variations in the NS zenith distances of stars indicate changes in the positions of the terrestrial poles. The Polar Motion causes the poles to move in nearly circular paths, with a radius of 30 feet, about their mean positions, in a period of 1·2 years. From measurements of image separations in the EW direction together with clock times of positions of the photographic plate during the formation of images, the clock time of transit, i.e. meridian crossing, is computed. In a single night's work up to 30 stars may be observed, each of which yields 4 images forming the vertices of a parallelogram similar to the asterisks in Fig. 2. Successive exposures for different stars during a night's work give an image pattern similar to that illustrated in Fig 3 which represents a plate enlargement (actual size 1½ inches square) and contains observations of 5 stars. The images for the star with greatest zenith distance are designates A1, A2, A3 and A4 and the XY axes in the diagram represent the reference axes of the two co-ordinate measuring machines used in the plate measurements.

The reduction includes the plate development, the measurement of the image co-ordinates and punching the values, editing the timing data obtained on paper tape in the course of the observation and checking the timing data against the image separations for com-

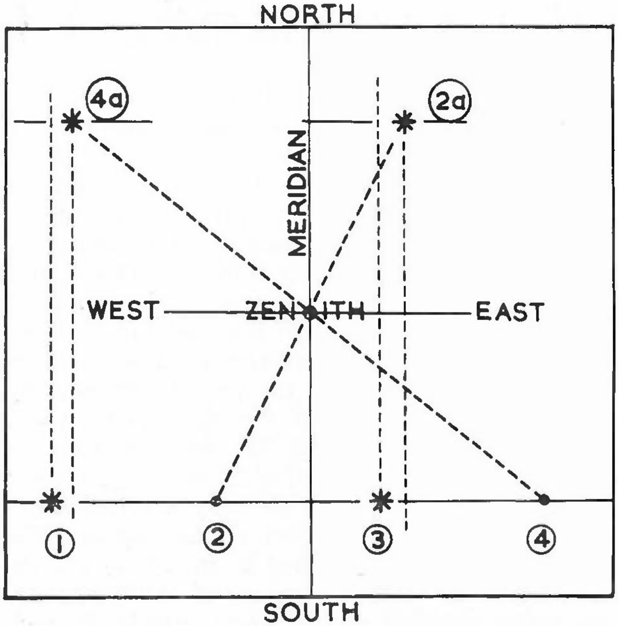


Fig. 2. Illustration of an observation of a star transit. The displacement of images from 2 to 2a and 4 to 4a resulting from 180 rotations are shown by the diagonal lines intersecting in the zenith. The observations are restricted to stars within 15 arc minutes of the zenith

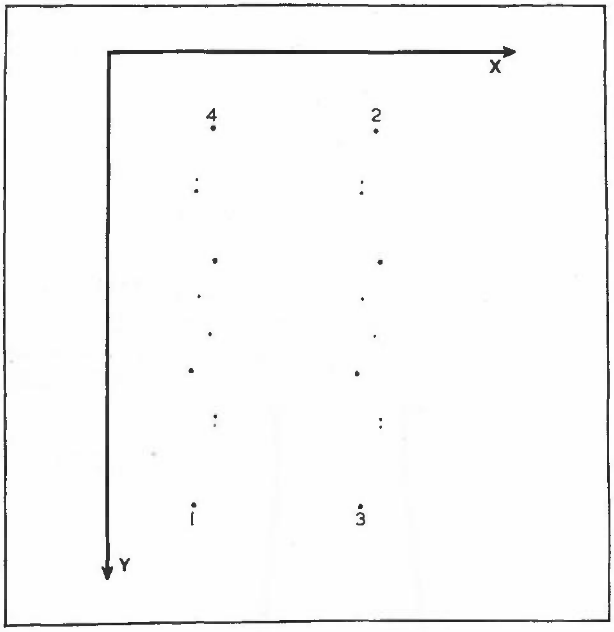


Fig. 3. Copy of plate enlargement showing 5 stars (20 images); published plate results are based on the mean of all stars on the plate. Image size is determined by the magnitude of the star

patibility before the two sets of data are merged in the final reduction program. The observations are reduced and distributed weekly for use in urgent applications: more detailed results are published quarterly together with information on the atomic time scale of the observatory and measures of radio time signals in terms of both UT and AT.

In the determination of trajectories inter-planetary space probes from Earth-based observing stations it is necessary to know very accurately the positions in space of the observing stations. This is obtained through PZT observations of the direction of the Earth's axis and of the orientation of the Greenwich meridian. Jet Propulsion Laboratories (JPL), the U.S. agency carrying out planetary exploration, have acknowledged that the successful navigation of the Mariner 9 probe to Mars and the Mariner 10 to Venus and Mercury was greatly indebted to the PZT observations communicated daily over critical periods of the flights. The collaboration of selected PZT observatories (including the RGO) with JPL in this work was organised by the BIH which also carried out analyses of all the observations and relayed results daily to JPL.

Nathy O'Hora is a senior scientific officer and is Head of the P2T Section of the Time Department of the RGO.

Tanya, top dog

A familiar sight each morning in High Holborn is Tanya, a Golden Labrador arriving for work at the London Office, accompanied by her owner Michael Reordan. Come rain, come shine, Tanya a valued member of the Public Relations Unit arrives promptly. Then she settles down in her box for the morning's siesta interrupted only by an occasional pat or a biscuit from an admirer.

Tanya is, of course, a guide dog and there are now more than 1800 such dogs in the United Kingdom.

The guide dog movement began in Germany after the First World War when a German priest had the idea of training war-blinded soldiers with some of the dogs used for police and frontier guards. The idea did not really catch on in this country until 1941 when the first official guide dog training centre opened at Leamington Spa. There are now three more training centres—at Bolton, Exeter and Forfar in Scotland. After a month's intensive training course at one of these centres the guide dog owner can look forward to ever increasing mobility and independence.

Puppy walking

Of course, it is not only the owners who have to be trained and guide dogs undergo a rigorous selection and training procedure. The puppy—usually a Labrador, Retriever or Alsatian—is first placed with "foster parents" for twelve months under the Puppy-Walking Scheme. Their job is to rear an obedient, healthy animal used to cars, buses, trains, shops etc and friendly towards people.

Then the potential guide dog is returned to the association for four to five months intensive practical training. It is taught to walk correctly on the left side of its master, slightly in front and in a straight line in the centre of the pavement. It is encouraged to concentrate on its master and pay no attention to other dogs. Next it is introduced to its harness and taught that wearing it means work.

Obstacle course

Another stage of training involves teaching the dog to avoid obstacles and to allow for the height and width of the person walking on its right side. This is done by making use of the dog's conditioned reflexes. Two obstacles are set up with a space between and if a dog is checked often enough to wait until the space will admit both dog and master together a state of mind is brought about in which the dog, once in harness, actually believes that, any space which will not admit both dog and master should be rejected in favour of one that does.

Kerb drill

One of the most important aspects of the dog's training is traffic work—undoubtedly the most difficult hazard that dog and owner face.

Contrary to most people's romantic notions, a guide dog does not stand at the edge of the pavement looking both ways waiting for a favourable time to cross! In fact it will set off across a busy road even while traffic is approaching and will stop only when immediate danger threatens—having been trained to stop within about a foot from the path of the nearside wheels of a vehicle. When the dog realises that it has no chance of crossing before the car is level with it, then, and only then will it stop dead.

If it were trained not to move while it could see or hear traffic on the road the chances are that one could never encourage it to start unless the road were completely clear. If the dog were trained to stop in the middle of the road some distance from an approaching car, there would be danger from traffic coming from the opposite direction.

Michael Reordan and Tanya arriving at State House

After this training period guide dog and owner return home and the theory learnt at the training school is put into practice. However, no matter how well a dog has been trained it is still a normal dog. Its owner must, by constant praise or if necessary harsh tones, keep the dog's mind on the job. If a guide dog is constantly distracted by well-meaning members of the public offering tit-bits it can become a menace to its owner.

So if you should see a guide dog team at work no tit-bits please!

Dr George Wilkins and Mrs Irene Malin, winners of the Mixed Doubles, Dr Fred Horner and Mrs Edwards

Council Capers 1974

Atlas compete against Appleton for the netball cup

SRC's Sports Day

SRC's Sports Day was held on Wednesday, 19 June. Fortunately, the weather was fine and while the chilly breeze was at times trying for the spectators it served to cool the fevered brows of many competitors!

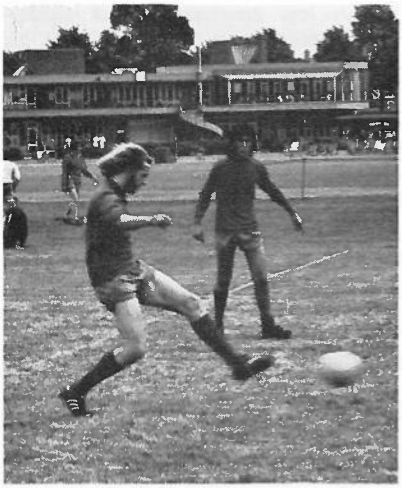
This year we were especially pleased to welcome Professor Edwards, President of the Sports and Social Association and Mrs Edwards who kindly presented the prizes. The winners were:

Tennis

Mixed Doubles	: Dr B G Wilkins & Mrs Irene Malin (RGO)
Men's Doubles	: A C Gordon Smith & A C Roberts (Appleton)
Cricket	: Rutherford

Rutherford 'B' team, winners of the football cup. From left to right, top row Jim Taylor, Peter Hemmings, Jeremy Ireson and Malcolm Edwards. Bottom row Martin Guest, Ron Lawes and Bob Bryne

Photos: Peter Hicks, Appleton Laboratory



Steve Sayer (kicking ball) and Joe Bains' both from Appleton's football team

Determined members of Appleton Laboratory's tug-of-war team (*Photo: M. Sweatman*)

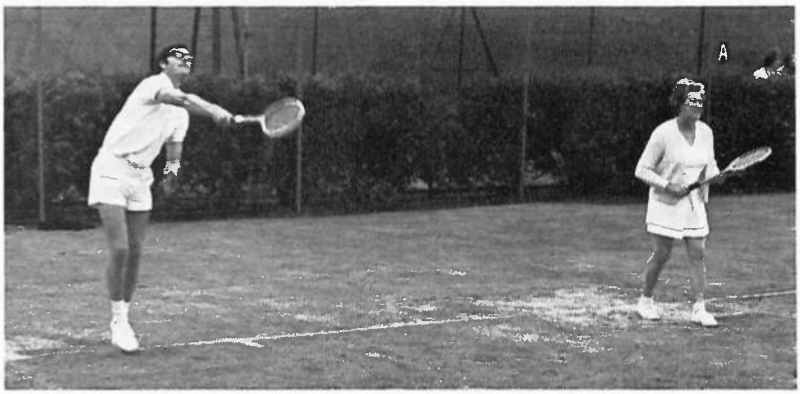
Netball		: Atlas
Chess		: RGO
Football		: Rutherford 'B' team
Bowls		
Triples		: R Price, P Griffiths & R Hogan (Rutherford)
Fours		: N Ferguson, A Goode, P White & A Slater (Rutherford)
Tug-Of-war		: Appleton

Mrs Edwards also presented the Flowers Trophy to Daresbury Laboratory. This trophy was donated by Sir Brian Flowers, former Chairman of Council and Past President of the Sports Association, for an annual golf competition (see page 16).

Thanks and congratulations go to all those who put so much hard work and planning into the organisation of Sports Day and to the many helpers on the day (including the first aid team who were unfortunately kept very busy).

Familiar faces mingled with newcomers at the social evening with music provided by Appleton Laboratory's disc jockey. Sports Day again lived up to its tradition of providing the one occasion of the year when members of staff from all SRC's establishments can get together both in friendly rivalry and socially.

Winners of the Triples Bowls match in action



Paul Gardner and Mrs Kitty Gordon Smith of Appleton Laboratory in the Mixed Doubles

Newsfront

Mr J F Hosie CBE

Mr J F Hosie CBE

Mr Hosie retired on 30 June and certainly to those of us who helped to found the SRC in 1965, this indeed marked the end of an era; for him it is the end of some 36 years of full-time public service.

Jim Hosie, early in his career, served in the Indian Civil Service. He had studied Mathematics at Glasgow and Cambridge Universities and had subsequently entered the Indian Civil Service no doubt in part to give free reign to his talents for administration and his thirst for responsibility and action. Indian independence brought Jim and many others back to Britain, in his case perhaps one suspects, a little reluctantly. He then entered the Home Civil Service, and after spells in the Ministry of Defence and the War Office, came upon the civil science scene in the Office of the Minister for Science, in 1958.

The early years of the 1960s were the years of reconstruction, when the plans were finally laid for DSIR to be dismembered and its scientific component incorporated in the new creation, SRC; when NIRNS and the Royal Observatories came in, representing the very new and the long established elements in the scientific world, and when the whole Research Council concept for the physical sciences came into being. Jim Hosie played an active part in all the planning of this complex operation, and was a natural choice for one of the Under Secretary posts in the new London Office of SRC in 1965.

Although his responsibilities at one time included both Astronomy Space and Radio and Nuclear Physics, and for the past 2 years have been for Establishments and Finance, it is probably true to say that he made his mark predominantly in the field of ASR. He was particularly skilful in matching the fluctuating, unpredictable and often unconventional financial needs of the growing space and astronomy programmes into the framework of Estimates and Forward Looks. His stern "I'm sorry, but . . ." at many a Committee meeting often left an unhappy applicant for funds muttering under his breath, only to discover that all his real needs were in the end well catered for.

Jim could almost have been classed as a Commuter to Paris on SRC/ESRO affairs interspersed with quick dashes to Australia, South Africa and USA to handle our astronomical interests. He was for about 8 years one of the UK members of the ESRO Council and latterly was also Chairman of the ESRO Administrative and Finance Committee. He was a member of the Anglo-Australian Telescope Board during its most turbulent period and laid the foundations for the changes in our arrangements for Astronomical Observatories in South Africa.

The Anglo-Australian Telescope, soon to become operational, the South African Astronomical Observatory, a joint SRC/CSIR venture, and the UK 48-inch Schmidt Telescope in Australia, now producing world class astronomical observations, all profited immensely by Jim Hosie's dedicated work.

In less spectacular but equally important ways, we shall miss his shrewd advice; on matters financial and on the tactics of dealing with our competitive colleagues he was never at a loss for constructive comments. State House will not be quite the same again, but we wish him well in his country retreat in Sussex.

M.O.R.

Mr J B Visser

Mr John Visser, an Under-Secretary at the Ministry of Defence, has been appointed Director of Administration in succession to Mr Jim Hosie.

Mr Visser was educated at Mill Hill School and Oxford University. He won an Exhibition in Classics to New College and got a First in Modern Greats. He joined the Civil Service in 1951 as an Assistant Principal in the former Ministry of Supply.

Mr J B Visser

He served in a number of Branches concerned with R & D Establishments and the financing of development work in industry and in 1967 on the formation of the Ministry of Technology he became Assistant Secretary with administrative and financial responsibility for the extramural aeronautical research programme and the development and production of military aircraft and engines.

He attended the Royal College of Defence Studies in 1970. Since 1971 he has been responsible for the industrial policy aspects of Defence Procurement in the Ministry of Defence.

He is 46 and is married with three children.

Special Promotion

Congratulations to the following members of staff who have been promoted on the recommendation of the Individual Merit Promotion Panel.

Dr R J N Phillips (RL) to Deputy Chief Scientific Officer. Dr Phillips joined the staff of the Rutherford Laboratory in 1968 to lead a theoretical physics group. He has spent various periods on attachment at CERN, Geneva and at the Lawrence Radiation Laboratory, Berkeley and more recently he was a visiting professor at the University of California, Riverside. Currently Dr Phillips is Head of Theory Division, a position he has held since 1972.

Dr V C Reddish (ROE) to Deputy Chief Scientific Officer. Before joining the staff of the ROE in 1962, Dr Reddish spent five years as Lecturer in Astronomy at Edinburgh University and three years as Lecturer in Radio Astronomy at Manchester University. Dr Reddish has been in charge of one of SRC's major projects—the 48-inch Schmidt Telescope for Siding Springs, Australia, which, built to a tight specification, has been completed with quite exceptional speed. The telescope has now started under Dr Reddish's direction with a photographic survey of the southern sky to the faintest limits. He has also recently been made a member of the Anglo Australian Telescope Board.

Dr C M Fisher (RL) to Senior Principal Scientific Officer. Dr Fisher is at present engaged in the study of elementary particle interactions using the Track Sensitive Target technique developed at the Rutherford Laboratory. He is currently planning a collaborative experiment to study rare strange particle states. Dr Fisher is also involved with the design of a large Fast Cycling Bubble Chamber facility for further research at the 400 GeV accelerator under construction at CERN, Geneva.

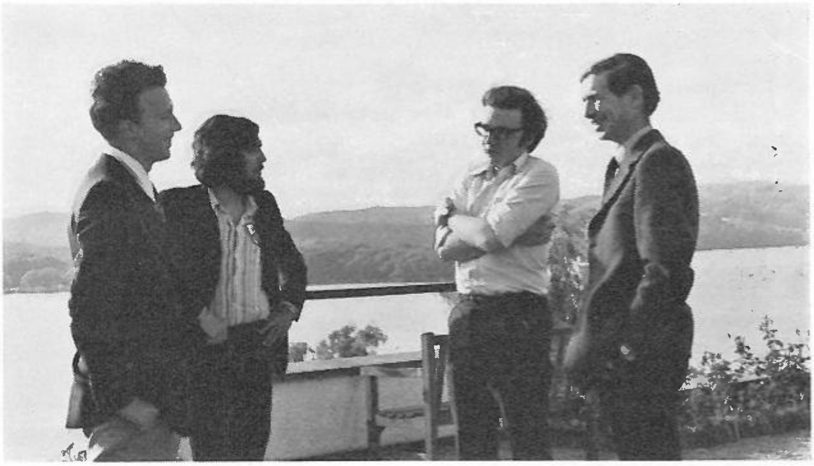
Birthday Honours

Our congratulations go to Professor D H Wilkinson who was made a Knight Bachelor, Dr V C Reddish who received an OBE and Mr G M Johnston and Mr R J Tunnicliff who received an MBE.

Professor Wilkinson was formerly a member of the Council and Chairman of the Nuclear Physics Board.

Dr Reddish is a Deputy Chief Scientific Officer at the Royal Observatory, Edinburgh.

Mr Johnston is a Senior Scientific Officer at the Appleton Laboratory, and Mr Tunnicliff is a Senior Executive Officer at London Office.



Discussing physics on the shore of Lake Windermere are, from left to right: David Saxon (Rutherford); Tony Williams (Oxford University); John Dainton (Daresbury) who sent us this report; and Peter Landshoff (Cambridge University)

CERN Summer School

The first Summer School for young high energy physicists to be jointly organised by a British Laboratory, Daresbury, and CERN took place from 16–29 June 1974. Young research workers from all the member states of CERN, Eastern Europe, Spain and even Australasia, assembled in three star-comfort on the shores of Lake Windermere under a hot sun and blue skies for two weeks of physics, walking and swimming.

Lecture courses designed to guide the experimentalist through the theoretical and experimental background to the current states of weak and electromagnetic interactions were given by Dr P Landshoff (University of Cambridge) and Professors C Jarlskog and J S Bell (CERN), D Perkins (University of Oxford) and R Gatto (University of Rome). Professor S F Edwards, Council Chairman and an exile from high energy physics, gave a fascinating lecture in which he revealed how the mathematical formalism of quantum field theory found application in some very unlikely branches of both microscopic and macroscopic physics.

Cecilia Jarlskog expertly guided her audience through the basic phenomenology of the conventional weak interaction as observed in both strangeness conserving and strangeness changing particle decays. Then, with little more than a murmur of dissent, successfully coerced her experimental audience into the crossed channel processes of current intensive interest, namely, charged and neutral weak current reactions of neutrinos and antineutrinos with nucleons.

Peter Landshoff discussed in considerable detail the interpretation of deep inelastic weak and electromagnetic interactions of nucleons in terms of the quark-parton model. He concluded by considering the current speculative attempts with such a model to understand large transverse momentum hadron production, as observed recently at the CERN intersecting storage rings and the Fermi National Accelerator Laboratory in the USA.

Don Perkins gave a comprehensive survey of neutrino physics and demonstrated how further understanding of nucleon structure in terms of partons could be extracted from such data.

The currently provisional and extremely significant results emerging from SLAC in the USA on $e^+ e^-$ annihilation to hadrons were discussed in some detail by Professor Gatto. He explained preliminary interpretations of the observed rise in total cross-section and how they were or were not consistent with the crossed channel deep inelastic process which has been known for some time to exhibit scale invariance.

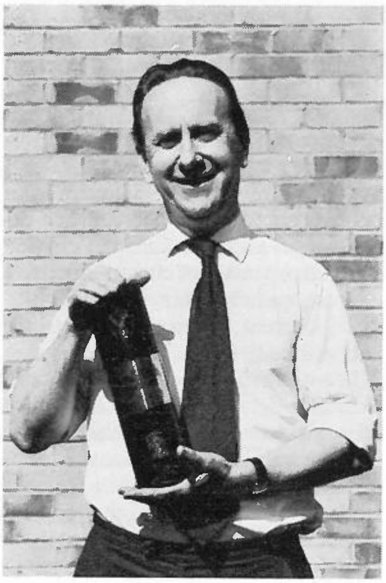
John Bell gave an extremely clear insight into the world of unified field theories. Without so much as murmuring the technicalities of such theories, normally so terrifying to the experimentalist, he discussed the predictions of unified models of weak and electromagnetic interactions and showed the necessity for the existence of new heavy particles, such as vector bosons and leptons.

At the end of the fortnight most admitted enlightenment of some form or another and the School concluded with an excellent banquet and much international frivolity.

Dr Howlett (centre) presents cheques to Ken Moye (left) and Mr Roger Childs

Suggestions Scheme Award

The presentation of the largest award ever given since the commencement of the SRC Suggestions Scheme was made at the Atlas Computer Laboratory on 10 May. Dr Howlett performed the agreeable ceremony, handing over cheques of £100 each to Mr Roger Childs and Mr Ken Moye. The award was for their suggestion of modifying the 1906A lineprinter to use Atlas printer ribbons during a period when 1906A printer ribbons were difficult to obtain. Dr Howlett, remarking on the simplicity of the device, a brass bush which had been made by Ken Moye, said how pleasant it was to see such excellent co-operation between the Administration and Scientific sides.



Quest writer of the year,* Frank Bale (Appleton Lab) with his prize bottle of whisky (*see Quest, no 1 1973 p. 18)

Prize Posters

A competition was recently organised by the SRC Suggestions Scheme through its local committees to design new posters for the scheme. Prizes were awarded to the following members of staff:

- Mr J H W Andrews, London Office (£20);
- Mr R Halton, Appleton Laboratory (£15); and
- Miss W Maltby, London Office (£10).

Thirsty work! From left to right John Connolly, J E Tomlinson and Barry Shenton take a break during the SRC golf competition

Daresbury win Sir Brian Flowers Golf Trophy

The first inter-establishment golf competition was held on Friday 14 June at the North Oxford Golf Club under perfect golfing conditions.

Six teams from Rutherford, Appleton, Daresbury and London/Swindon office competed for the Sir Brian Flowers Trophy, the best four nett returns over 36 holes from each six-man team deciding the winners.

A closely contested competition was decided with Daresbury 'A' team (Percy Lawrinson, Ian Smith, Bob Cunningham, Jeff Worgan, Jim Clare and Hamish McFarlane) the winners. They had a final score of 562 shots for an impressive average of just over 70 shots per 18 holes. Appleton were a close second with 565 shots and Rutherford came third (569 shots).

Two individual scores caused a few raised eyebrows. The first of 131 by Ian Smith (Daresbury 'A' team) was the best nett score of the day and no doubt clinched the victory for his team. The second of 132 by Bob Taylor (Rutherford 'B' team) was equally impressive.

The 1975 inter-establishment golf competition will be organised by the Daresbury Laboratory Golf Society.

R G O Celebrations

This year the RGO celebrates the Centenary of the Solar Department. G B Airy, Astronomer Royal decided in 1873 to investigate the possibilities of regular photography of the Sun and the measurement of sunspot positions and area. The Observatory appointed E W Maunder as its first Photographic and Spectroscopic Assistant and the initial photograph of what has since become the combined Herstmonceux-Cape-Kodaikanal series was taken on 17 April 1874, the starting date of the Photoheliographic Results, which form the longest unbroken record of such data extant. The Solar Department now also supplies immediate information of unusual activity to the BBC, Cable and Wireless Ltd., and other such institutions and widely distributes the monthly RGO Circulars of Solar Activity.

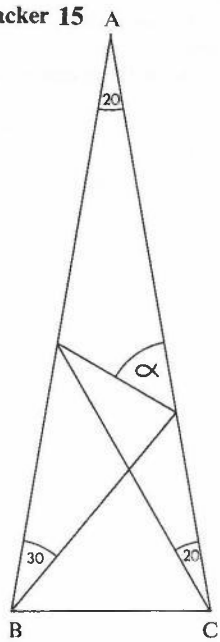
In 1975 the Tercentenary of the founding of the Royal Greenwich Observatory will be celebrated with possible Royal Visits both to Greenwich itself and to Herstmonceux to mark the occasion. There will be an exhibition dealing with the historical aspects in the Queen's House at Greenwich, while at Herstmonceux the emphasis will be on the present and future work of the RGO. It is hoped to open the Observatory to the public for two weeks in August 1975. The International Astronomical Union will sponsor two symposia, one at Greenwich on "The Origins, Achievements and Influence of the Royal Greenwich Observatory, 1675–1975" and one at Herstmonceux on "The Galaxy and the Local Group".

While on the subject of anniversaries, the account of the jubilee of the familiar Six Pips described in our last issue was erroneously entitled "Fifty Years of Greenwich Mean Time". In fact, Greenwich Mean Time has been in general use since the middle of the nineteenth century and was adopted as the legal standard of time in Great Britain in 1880. We apologise to the author for this mistake.

The editorial board hard at work! From left to right Harry Norris (Rutherford), Shirley Lowndes (Daresbury), Bill Burton (Culham), Carol Rivers (London Office), John Alexander (Royal Greenwich Observatory), Ian Arnison (London Office), Doug House (Atlas) and Alan Powell (Royal Greenwich Observatory. Photographer: Geoff Gardiner local correspondent for Appleton Lab.

GERONIMO
Atlas Computer Laboratory held a Families Day on 29 June. Picture shows Mr Doug House, Head of Operations Group, at the 1906A main console explaining the GERONIMO system to visitors. This is used for displaying operator information.

Nutcracker 15



Triangle ABC is isosceles with a vertex angle of 20°. Other angles are as shown. The problem is to determine angle α by *pure geometry only*. At least two completely different routes exist. There will be a prize of a £2 book or record token for the most elegant solution sumbitted to the Editor. Please mark entries "NUTCRACKER" and state whether you would prefer a book or record token.

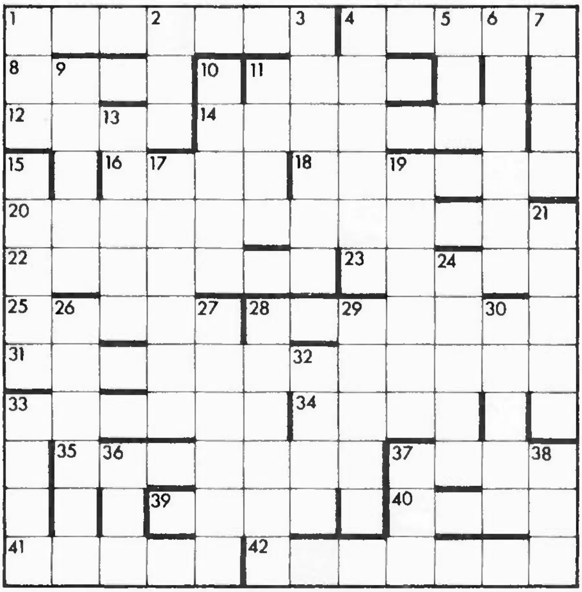
Nutcracker 14 Solution

The catches were :

Dogfish	: 30
Carp	: 7
Bream	: 5
Anglepike	: 2

The winner of the £1 book token was Mike Elder of the Atlas Computer Laboratory.

Maxim 6



Crossword

ACROSS

1. Crush ice and cram into heat-resistant material (7)
4. What intrepid easy-going inventors produce (5)
8. Chooses spot for re-location (4)
11. —0 for water? Give me it to help (4)
12. S2 for a wide band (4)
14. Raved wildly during gym to get known everywhere (7)
16. It's turned in rapid retreat and defoliation (4)
18. Non-inherited rental gets lost (6)
20. In Sussex you'll find not much—er—*sex* (12)
22. They follow planters about, imitators!(7)
23. One who has a go on the Mosel (5)
25. Cup person holds higher (5)
28. First-class degree, but backward about my French; and I smell!(7)
31. Break his comb, ie have a bash at life science (12)
33. Delayed in the Southern Region, and one who criticises (6)
34. Otherwise troubled sleeping without the noise of the kitchen timer (4)
35. "Smashable" is with "S" in the dossier (7)
37. Gets wages by the sound of it—they're useful for keeping 2's (4)
39. Double firsts from decent Universities appreciate Latin (4)
40. Take a wrong step and you'll cause trouble (4)
41. Newspapers cause stress (5)
42. Lavatories to see vaguely (7)

DOWN

1. Triangular sort of lettuce (3)
2. Has made a mess of combustion product (3)
3. Spanish pretender's vehicle at sun-rise (7)
4. Create something new in air-duct (6)
5. Aim is clear at outset of endeavour (3)
6. A meeting-place in a tree-lined street (6)
7. I turn the joint upside-down for perks (4)
9. Tax on a point of whose name is on the cheque (5)
10. Malice of mine in Kent, etc (5)
11. Directional control made in Chelmsford (4)
13. Retro parts and what could attach them to rocket (5)
15. Take bush and make it ornamental (5)
17. The look you get as a light-sensitive device starts transmitting (6)
19. First clues are something that must be put up with (6)
21. Unknowns about beam in radiography (5)
24. Bury inside (5)
26. Take an extraordinary life in public relations (6)
27. Monkey of hers monkeyed with you and me (6)
28. I pick up a real bad signal (6)
29. Long-distance runner held in preliminary reflection (5)
30. Fes clubs? (5)
32. With pell, like hell (4)
33. Cuddles up in dance (4)
36. Volcanic effluent (or pumice) contains glassy solid (3)
37. Aristocratic afterthought gazumps (3)
38. Bacon's origin was a stylish start (3)

To keep pace with recent awards it has been decided that the value of the prize should be increased to £2. Please mark entries "QUEST CROSSWORD" and state whether you would prefer a book or record token. The prize will be awarded to the first correct entry drawn. The solution will appear in the next issue.

Solution to Maxim 5

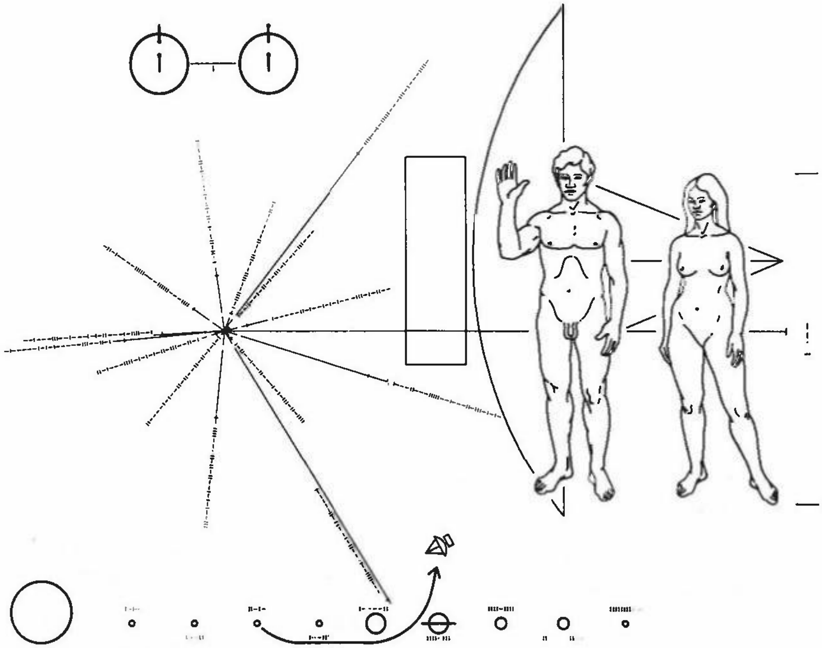
Across	Down
2. Coccyx	1. Thaw
6. Strum	2. Correlation
10. Hotel	3. Celt
11. Ego	4. Clue
13. Eat	5. Yet
16. Luton	6. Sons
17. Epic	7. Teeter
18. Writer	8. Rapt
19. Tar	9. Micro
20. Depth	12. Goa
21. Neuro	14. Tiara
22. Flurry	15. Pip
24. Urn	22. Frosted
27. Raj	23. Sue
28. Ear	25. Neural
32. UFO	26. Frogman
34. Sirs	29. Ester
36. Rams	30. Crate
38. Drag	31. Rash
39. Tout	33. Fargo
40. Ass	35. Rude
42. Unarm	37. Sure
44. End	41. Set
45. Ether	43. Nor
46. Olga	
47. Deer	
48. Enterson	

The winner of the £1 book token was P A Machin, Atlas Computer Laboratory.

Farewell with Fact (and Fiction)

Space Time Diary – Carl Sagan's visit to London **G M Webb**

Thursday, 2 May . . . . . . "Thence to the Royal Society and mightily pleased with myself, having a ticket to a discussion meeting on 'The Recognition of Alien Life' at which Professor Carl Sagan, New World Astronomer of note was to speak in company with many other distinguished natural philosophers . . ." The ghost of Robert Hooke, scientist, diarist and past secretary of the Royal Society was haunting my thoughts as I turned out of the Mall and up the steps towards Carlton House Terrace.



The plaque aboard the *Pioneer 10* spacecraft.

Man's only direct attempt so far to communicate with extra-terrestrial intelligence—the plaques attached to the spacecraft Pioneers 10 and 11. It is a pity we shall have to wait such a long time for a reply, at least from planetary based life, as the Pioneers are not likely to encounter another stellar planetary system for at least 10 billion years

Carl Sagan (Cornell University, USA) spoke on the recognition of the objects of intelligent life by means of aerial photographic survey. Interestingly, photography of the Earth reveals no sign of intelligent life until objects of at least 100 m size can be perceived whereupon the agricultural and urban reworking of the surface becomes apparent. Professor Sagan also discussed the detectability over interstellar distances of signs of intelligence such as radio and television signals and reviewed possible message contents for interstellar discourse.

The difficulty of distinguishing organisms or artefacts from natural objects by means of their morphology alone was reviewed by C H Waddington (University of Edinburgh) and P H Gregory (Rothamsted Experimental Station).

J E Lovelock (University of Reading) discussed how alien biospheres can be detected by the disturbing effect that life has on thermodynamic equilibrium of a planetary surface or atmosphere. Professor Lovelock showed that a distant view of the Earth in this context reveals that certain of its thermodynamic properties are recognisably different from those of the other terrestrial planets.

A G Cairns-Smith (University of Glasgow) outlined a scheme which involved a primordial starting point for life, not requiring a pre-biotic 'soup' of amino-acids, proteins etc. He also suggested that our original ancestors had biochemestries alien to our own.

Friday 3 May . . . . . . Carl Sagan delivered a lecture on "Extra-Terrestrial Intelligence" to the British Interplanetary Society in a packed hall at the Royal Society of Arts. More popularised than the previous day's proceedings this lecture covered most of the topics discussed in his recent popular book "The Cosmic Connection" and afterwards Carl Sagan dealt diplomatically with questions from professional scientists, knowledgeable laymen, religious cranks and flying-saucer cultists.

All in all the spirits of both past Fellows of the Royal Society and the Royal Society of Arts would have approved of the proceedings. After all, the idea of life on the other planets in the Solar System was once far more acceptable to the scientifically educated. As the evidence for these ideas was shown to be untenable, the general idea of life elsewhere in the Universe became unrespectable by association.

About thirty years ago scientific interest in extra-terrestrial life was slowly revived. New measuring instruments and the advent of space-probes stimulated renewed interest in the quest for knowledge of our own and the other planets of the Solar System. Planets are now believed to be the common companions of stars. The building blocks of life can be sythesised in the laboratory from simulated primitive planetary atmospheres. Some radio telescopes are powerful enough to make contact with civilisations possessing similar equipment anywhere within our galaxy. In

Sagan's words extra-terrestrial life is an idea whose time has come.

For those wishing to read further the following books are well worth reading. For a popular account "The Cosmic Connection" by Carl Sagan (Hodder & Stoughton, 1974, £3·50) and for more serious scientific treatment "Communication with Extra-Terrestrial Intelligence" edited by Carl Sagan (MIT Press, 1973, £5).

*Gerry Webb is a Higher Scientific Officer in the Space Research Group at the Appleton Laboratory.

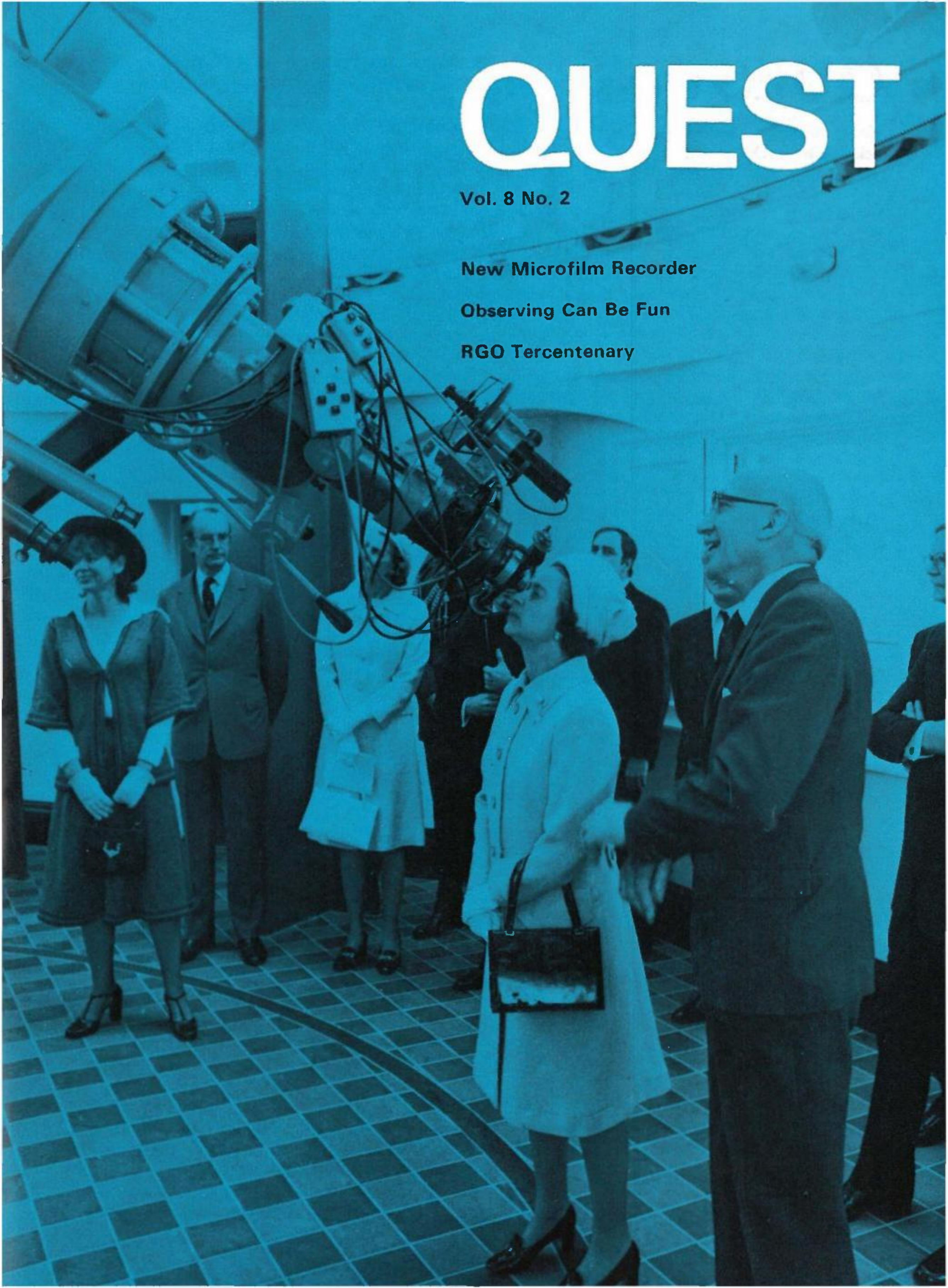
The following vital information has been supplied by a special correspondent at the Rutherford Laboratory. We understand that it is not original but it is obviously of sufficient scientific interest to merit publication.

Physical and Chemical Definitions of a Woman

Symbol: Wow.
Atomic Weight: 120 lbs.
Occurrence: Found near men, seldom in a free state.
Physical Properties: Generally rounded in form, boils at nothing but may freeze at any moment. Melts when heated properly.
Chemical Properties: Very active, particularly in its great affinity for gold, silver, platinum and precious stones. Turns green when placed near a better looking specimen. It has a half-life of twenty years, after which period rapid decay sets in. Turns a delicate shade of pink when found in a pure and natural state.
Uses: Highly ornamental. Useful as a tonic in attacks of low spirits, depression, etc. Equalises the distribution of wealth. Is probably the most powerful reducing agent known.
Caution: Highly explosive in inexperienced hands and best kept in a dark place.

A Glossary of Useful Terms

Recruitment: Choosing the least of several evils.
Trawl Notice: Desperate fishing for staff.
Training: A system where people are told things they know by people who don't.
Career Development: A means of keeping people busy until they are old enough to be promoted.
Posting: What everybody knows about before you do.
Secondment: A means of keeping embarrassingly clever people out of the way.
Career Progression: Random walk.
Promotion: The grapes of Tantalus.
CPRB: Raymond's Review Bar.
Appeal: . . . of laughter.
Complement: More than you need, but less than you asked for.
Fluid Complementing: All the staff are wet.
Fixed Complementing: All the staff are rigid.
Over Complementing: Telling the Establishment Officer he's wonderful.
Staff Association: A channel of communication between management and management.
Negotiation: Telling the staff what we are going to do.
Conditions of Service: The number of working days on which you you can play tennis.
Fulton: Forgotten.



QUEST

Vol. 8 No. 2

New Microfilm Recorder

Observing Can Be Fun

RGO Tercentenary

QUEST

House Journal of the Science Research Council

Vol. 8 No. 2
1975

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Cover
Our cover picture shows the Queen looking through the 28-inch telescope under the guidance of Dr Hunter, Director, RGO, when she inaugurated the instrument in the restored onion dome at the Old Royal Observatory (National Maritime Museum) during a visit to Greenwich in May. Behind Dr Hunter: the Duke of Edinburgh and Admiral Sir Charles Madden, Chairman of the Museum Trustees. On the extreme left: Mrs Anthony Crosland, wife of the Secretary of State for the Environment, and Mr Basil Greenhill, Museum Director.

The visitors also saw 300 Years of Astronomy, the special Tercentenary Exhibition in the Queen's House at the Museum in which the Museum and RGO have collaborated. The exhibition which is on show until 31 December, is open daily from 10 am until 6 pm and on Sundays from 2.30 until 6 pm. There is no admission charge.

Contents

Council Commentary

March to May 1975

Forward Look 1976–81
The Council noted, at its March Meeting the Policy and Programme Reviews of the Astronomy, Space and Radio Board and the Engineering Board respectively. A draft version of the Forward Look was considered in March and finalised at the April Council Meeting. The 1976/81 Forward Look was then submitted to the Department of Education and Science in April. The Advisory Board for the Research Councils will be considering the Forward Looks of all the Research Councils and its advice to the Secretary of State on the allocation of the Science Budget, for at least the first year of the period, should be known by the end of the summer.

Provisional Outturn 1974/5
The provisional assessment of outturn for Financial Year 1974/5 was £83·8M compared with the Supplementary Estimate £83·7M. The main features being that expenditure on Engineering exceeded estimates by about £850K whilst there was an underspend on Astronomy, Space and Radio of about £900K.

Regrouping of Activities
Council in April, in the light of consultation with the Engineering and Science Board and the Atlas Committee, confirmed the regrouping decisions taken in principle at its February meeting. The changes have been described in General Notice 21/75.

Review of Methods of Supporting Research
Council has decided that in 1975 there should be an examination of its procedures for the support of research in universities and polytechnics and related arrangements for the support of university manpower. The December Council meeting will be a joint meeting with representatives from each Board to discuss these issues.

May Meeting
The May meeting, the hundredth of the Council, was held appropriately at the Royal Greenwich Observatory, Herstmonceux during its Tercentenary year. Council members much appreciated the efforts of Dr Hunter and his staff to make the visit interesting and informative. Furthermore the weather was perfect for the evening demonstration on the telescopes!

Senior Fellowship Scheme
Council has agreed to implement a new Senior Fellowship Scheme to enable up to twenty-five outstanding academics to devote themselves full-time to research and scholarship for a maximum of five years, free of their normal teaching and administrative duties. The Fellow will be able to apply for research grants and SRC will pay his salary and essential extra costs arising from his tenure. The parent institution will be able to make temporary appointments to replace the Fellow, but he will normally return to his academic post when the fellowship ends.

Science Sub-Committee of the Select Committee on Science and Technology
In April, the Council noted the joint Research Councils' memorandum to the Science Sub-Committee and the specific SRC section.

At the May meeting there was a report on the formal session with the Sub-Committee on 30 April when the Chairman and Secretary, accompanied by representatives of other Councils, gave evidence to the Sub-Committee. The questioning was concentrated on (1) the dual support system, (2) the financial difficulties of universities, (3) postgraduate studentships rates and the lack of British postgraduates, and (4) SRC policy for support of special areas. The SRC will be giving further evidence to the Sub-Committee in June.

Polymer Engineering
In 1969 polymer science and technology was selected as a priority area for concentrated SRC support in selected universities. While the programme was successful in polymer science it did not develop an adequate scale of activity in polymer engineering.

In March Council agreed that a polymer engineering directorate be established by SRC to initiate and oversee a closely coordinated programme of research and postgraduate training in selected universities and polytechnics with the active involvement of industry. The British Plastics Federation and the British Rubber Manufacturers' Research Association have agreed both to contribute to administrative costs of the programme and to collaborate with the Council in appointing the Director and managing the programme. The Directorate will probably be sited at the Daresbury Laboratory. The Director, who will have a small supporting staff, will work with a small management committee. He will have the authority of an executive head of a research establishment and will be able to commission research in universities and polytechnics on a more generous basis than is normal through research grants. Council hopes that this will encourage academic staff to move into the selected centres in order to develop an effective programme, provisionally costed at about £2·5M over five years.

Atmospheric Studies: EISCAT

In May Council agreed in principle that the UK should participate in the proposed European Incoherent Scatter Facility (EISCAT) with France, Germany, Norway, Sweden and Finland and that the Appleton Laboratory should be responsible for the management aspects of the UK participation. The facility, using radar techniques and located in Scandinavia would give detailed information about the ionosphere in the auroral zone which could otherwise only be provided intermittently by rockets and satellites. A better understanding is expected of the energy inputs to the ionosphere and the influence on the world's weather. Council has agreed that the UK should provide a VHF transmitter to add to the planned UHF system; the VHF receiver and antenna will be provided by the Scandinavian countries. Council's approval for the VHF transmitter at a capital cost of £2·0M is subject to funds being available and to satisfactory arrangements being made between the prospective parties. The ASR Board will hold an open meeting to enable the scientific community to express their views on EISCAT.

Kiruna Rocket Range

Council agreed that SRC should extend the existing agreement whereby it contributed £250K per annum towards the cost of the Swedish launching range ESRANGE at Kiruna from 1977 to the end of 1980. The decision was conditional on the other countries involved giving parallel agreement. This condition has now been met. It is expected that the rocket campaign in 1979/80, allowed for in the ASR Forward Look, will make good use of ESRANGE.

Research Grants

Council has approved the following research grants:

(a) **Astronomy Space and Radio**

(i) A supplementary grant of £154K to Dr J T Houghton, Oxford University for the construction of the stratospheric and mesopheric sounder (SAMS) experiment which will be included in the payload of the NASA NIMBUS–G satellite now scheduled for launch in mid-1978.

(ii) A consolidated grant not exceeding £406K to Professor Boyd, Mullard Space Science Laboratory, University College, London, for the year ending 31 July 1976.

(b) **Engineering**

(i) £122·8K to Professor W A Gambling (Southampton University) for studies of optical fibre communications.

(ii) A supplementary award of £154·9K to Professor H H Rosenbrock UMIST for analysis, identification and control of composite systems.

(iii) £147·0K to Professor A G J MacFarlane (Cambridge University) for the study of the design and application of multi-control systems.

(c) **Nuclear Physics**

Grants of £141·4K and £210·4K to Glasgow and Oxford Universities respectively for the maintenance of accelerators for nuclear structure research for the year 1975/6.

(d) **Science**

(i) £125·8K to Dr R E Richards, Dr I D Campbell and Dr D I Koult, Oxford University, for the construction of a 400 MHz high resolution nuclear magnetic resonance spectrometer;

(ii) £120·0K in the first instance to Professor Sir George Porter, Royal Institution, for photochemistry research; and

(iii) a grant of up to £104·5K to Professor S D Smith and Dr C H Pidgeon, Heriot-Watt University, for research in physics and chemistry using a spin-flip Raman laser.

SRC's new microfilm recorder

F R A HOPGOOD

The Atlas Laboratory has taken delivery recently of an FR 80 microfilm recorder to replace its SD 4020 which has been SRC's main graphical output device for the last seven years.

The attraction of a microfilm recorder for graphical output as against a pen-plotter is mainly its speed and flexibility. As well as being able to produce graphs on sensitized paper (called "hardcopy" for some unknown reason), the SD 4020 can output to both 16 mm and 35 mm film. In a typical year, the SD 4020 produces about 1,700,000 pages or frames, of output. We estimate that it would take about two hundred pen-plotters to generate a similar amount of output!

Production of cine films

Users of Atlas' graphical facilities come from all parts of SRC. Probably the largest user of hardcopy is the Neutron Beam Research Unit at Chilton. Other large users include satellite data processing and the JASIN project organised by the Department of Oceanography at Southampton University. One of the more novel uses is, of course, the production of cine films. It is surprising how many of the large computer projects find this method of displaying results attractive. Films have been made on such diverse topics as galaxy evolution, effluent dispersal in the Solent and textile design.

The decision to replace the SD 4020 was made about three years ago. The machine is a mixture of valve and solid state circuitry. It has become increasingly difficult to maintain and we have had to cannibalise two tape decks in order to keep the third one in a working condition. Even with a full-time engineer, the machine now only averages about 70% up-time in the prime shift.

Most accurate

The FR 80 microfilm recorder, manufactured by Information International Incorporated (III) of Los Angeles, was a natural successor to the SD 4020. It is both the most versatile and most accurate of the recorders currently available. Like the SD 4020, it has hardcopy, 16 mm and 35 mm cameras. In addition, it has a microfiche camera capable of producing fiche at a reduction of forty-two or forty-eight times. This allows four hundred pages of output to be contained on a single fiche. With the world paper shortage, microfiche is becoming the standard interchange media for large volumes of text.

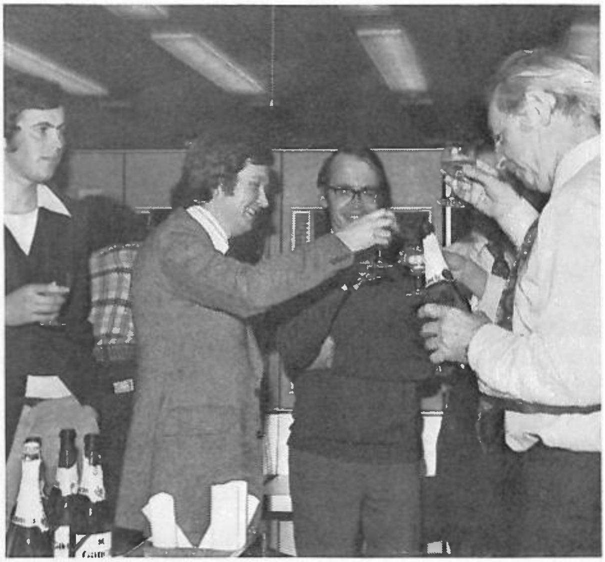
New features

Our particular FR 80 has a number of recently-introduced features which probably make it the most

A magnetic tape being loaded on the FR 80, the contents of which, when run, will be photographed by the microfiche camera seen in position on the left of the picture

sophisticated recorder in the world today. A colour filter system incorporated in the 16 mm and 35 mm cameras allows multi-colour output to be produced directly on the recorder. Over two hundred distinct colours can be generated which gives the user another dimension to his output. This large range of colours is possible because two hundred and fifty-six different intensity levels can be produced.

Even though the order for the FR 80 was not placed until last October, III managed to deliver the machine before Easter—but not without some trials and tribulations on the way. Its journey to the Laboratory was delayed initially when it was found the contractors' truck sent to take the machine from the factory to the airport was not large enough, with the result that it missed the first plane out of Los Angeles.



Celebrating acceptance of the FR 80 are (from left to right): Dave Daniel, Mike Daniels (of Information International Inc), Eric Thomas and Dr Howlett

Installing the machine

Eventually, it arrived at the Atlas Computer Laboratory and there was a sigh of relief as it was successfully squeezed into the lift to take it to the first floor. The manufacturers' measurements had indicated that the machine was EXACTLY the same size as the lift so there was no room to spare—luckily, the only damage to paintwork was to the lift and not the FR 80!

Next came the film processor. This was obviously too large for the lift and the only way up was via three short flights of stairs, with a corner to negotiate at the end of each flight. However, several strong men made short work of this task and surprisingly quickly everything was in its place.

One minor hitch since installation has been that due to late delivery of a calorifier, one wing of the building is denied supplies of hot water whenever film processing is going on!

Some careful manoeuvring as the FR 80's film processor, weighing about 400 lbs, is taken up to the first floor

Acceptance tests

Hardware acceptance tests began as soon as the machine was installed while at the same time programmers were rapidly putting the finishing touches to some eight months' work rewriting the graphical software for both the 1906A and 360/195 computers so that it would work with the FR 80.

Early in May, the full range of acceptance tests was completed—not without some celebration—and a user service introduced at the beginning of June.

Bob Hopgood is the Head of the Basic Software Group at Atlas.

Filamentary niobium-tin – a new high field superconducting magnet conductor

D C LARBALESTIER and C A SCOTT

The Rutherford Laboratory has been closely involved in the development of superconductors and the construction of superconducting magnets for some ten years.

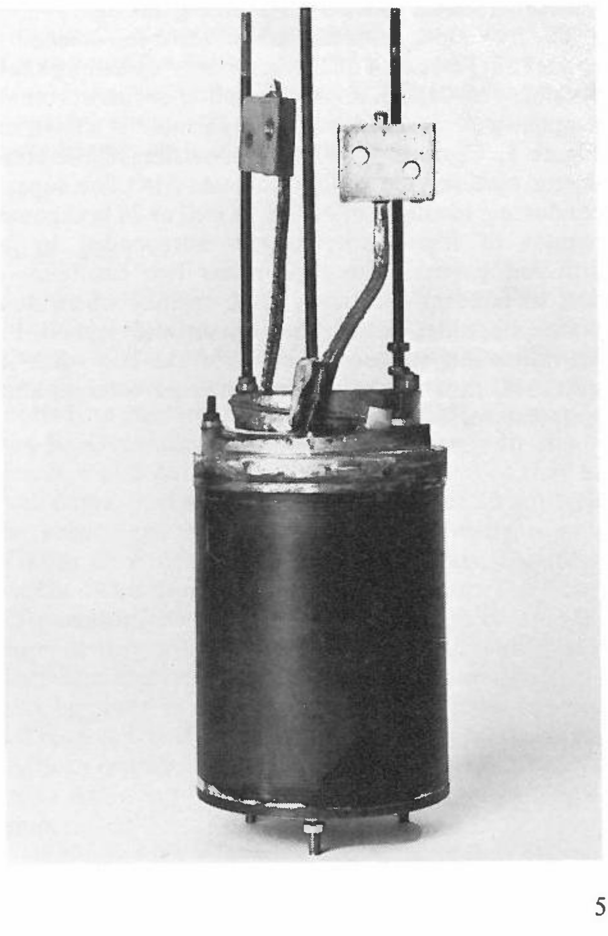
Over this period superconducting magnets have grown from small laboratory solenoids with bores of a few centimetres to beam transport magnets with lengths typically of one metre and, largest of all, to bubble chamber magnets with diameters exceeding 4 metres.

A crucial step in this progress was the development by the Laboratory, in collaboration with Imperial Metal Industries, of filamentary superconductors in which an array of fine filaments of superconducting Nb-Ti (niobium-titanium) alloy are embedded in a normal conducting matrix of copper or copper-nickel alloy. This fine subdivision of the super-conductor removes or greatly reduces the instabilities known as flux jumps which can initial premature transition ("Quench") from the super-conducting to the normal state and were responsible for the frequent observation in the early days of super-conducting magnet technology that the quench currents of coils were very much less than those of well cooled short samples of wire.

Although superconductivity is a property only found close to absolute zero (23°K maximum), the attractions of superconductors for magnet builders are very powerful. For example, to produce a field of 10 Tesla in a 5 mm bore solenoid using copper conductor would consume $\sim$ 2MW—a superconducting version might consume 500W in refrigeration to keep the magnet cold. The Rutherford Laboratory in common with other experimental high energy physics establishments uses large numbers of magnets to bend and focus beams of charged particles. Magnets are also required in bubble chambers and in polarised targets. The higher field strength and negligible power consumption of superconducting magnets thus offer the possibility of lower capital and running costs for these applications compared to conventional magnets with copper windings.

The Nb-Ti alloy developed for filamentary superconductors during the nineteen sixties remains superconducting in fields up to about 10 Tesla at its normal temperature of operation 4·2°K. The superconducting current density which can be carried falls off rapidly with increasing field however, so that practical solenoid magnets of NbTi are limited to about 8·5 Tesla and beam transport magnets such as dipoles to about 6 Tesla at 4·2°K. A much better superconducting material which remains superconducting in fields greater than 20 Tesla is the compound Nb_3Sn (niobium-tin) which has been available as a magnet conductor since the early sixties. Its use has however been severely limited due to problems connected with its great brittleness. Since it breaks at strains of much

Figure 1. A photograph of our most recent magnet, a 10 Tesla 55 mm bore solenoid



less than 1% it was quite impossible to draw Nb_3Sn down in filamentary form as is done for the ductile Nb-Ti alloy and the material was only available as a very thin layer some 2–5 μm thick deposited on a strong backing layer. To carry reasonable currents the tape has thus to be 15–30 mm wide and this wide tape configuration is the direct cause of unreliable magnet performance due to flux jumps which occur when currents flow across the width of the tape.

Recently AERE Harwell have been working closely with Rutherford Laboratory on a novel metallurgical technique which enables Nb_3Sn to be produced in filamentary form. The trick is to leave the formation of Nb_3Sn to the last stage in the process. The composite is made with Nb rods in a Cu-Sn (copper-tin) alloy matrix, both materials being ductile and thus capable of being reduced to fine wire by conventional processes. At its final size the conductor is insulated with a glass fibre braid and wound on a stainless steel former and is then reacted in a vacuum furnace at temperatures between 600–750°C. During this reaction process, tin diffuses from the bronze to the niobium, forming a layer of Nb_3Sn at the interface. After formation, the conductor is rather susceptible to damage but the fact that the last 4 coils have performed to their expected short sample characteristics, shows that the "wind-and-react" procedure is a perfectly feasible method for avoiding damage.

The maximum fields attained in these test solenoids exceed 12 Tesla at 4·2K, comfortably exceeding that possible with Nb-Ti. A photograph of our most recent magnet, a 10 Tesla 55 mm bore solenoid is shown in Figure 1. Figure 2 shows a cross-section of the conductor used for the coil. It contains 5143 fine superconducting filaments of Nb_3Sn as well as 24 hexagonal regions of high purity copper surrounded by a diffusion barrier. The copper has two functions—first to conduct heat away from regions where flux jumps or other instabilities occur and second to provide a low resistance shunt for the coil when it quenches, thus minimising the internal voltages and temperature.

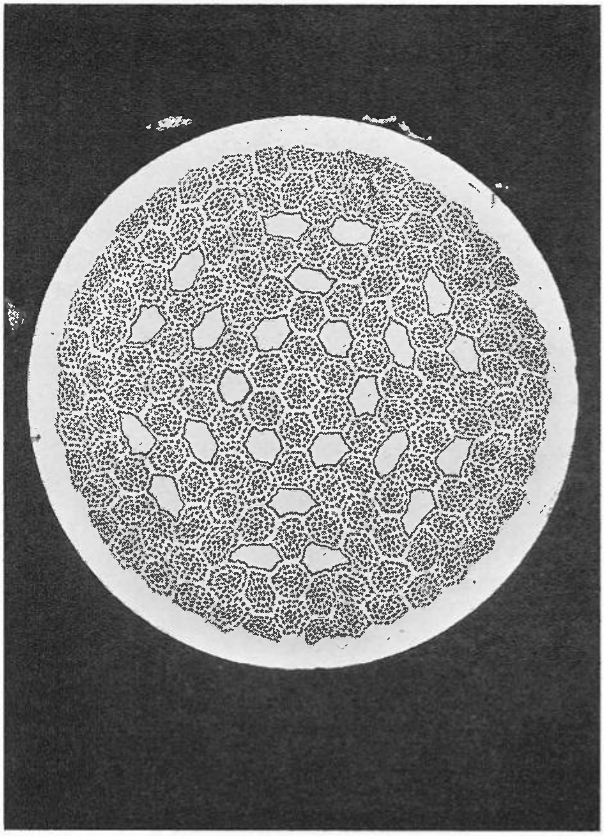


Figure 2 shows a cross-section of the conductor used for the coil

The successful application of filamentary Nb_3Sn to small solenoids now permits its application to larger magnets for beam handling, as well as to higher field solenoids. The new material should approximately double the fields already quoted for NbTi, thus allowing saddle shaped magnets of fields up to 10–12 Tesla and solenoids up to 15 Tesla at 4·2K.

Dr D C Larbalestier is a Research Associate and Dr C A Scott is a Senior Scientific Officer. Both are members of the Applied Physics Division of the Superconducting Magnet Research Group at Rutherford.

Observing can be fun

A POWELL

Friday 23 January—funds available and permission given for my observing run on the SAAO (South African Astronomical Observatory) 20 inch telescope. Yipee!—after waiting since January 1972 I am now in a position to successfully conclude (I hope) my observing programme on Strömgren photometry of F stars with known distances. Problem—next week I am going on my skiing holiday to Avoriaz in France and I have not prepared my observing programme. So I quickly ask "Admin" to arrange my flights. On return from my holiday I was refreshed and ready to make preparations. By the evening of 11 February I am all set to go. It's too late now to worry about any omissions. I managed to get my smallpox vaccination, work permit, international driving licence. travellers cheques, rands, plane tickets and passport all in order.

Back to School

At 10.30 am the next day the car comes to take my children Christopher and Sandy (See Quest vol 5 No. 3) and myself to Eastbourne station. No, the SRC are not letting my children come with me! Their mother is working hard at her teacher's training practice, so the children are going to find their way back to their boarding houses which are attached to the Thomas Peacocke School at Rye. They have £3.50 which should see them through lunch at Debenhams in Hastings followed by a film (The Man with the Golden Gun), then tea at the Golden Egg. [These companies are not sponsoring this article. In spite of all rumours Quest does not pay its authors—(Perhaps I will get Quest's Most Promising Writer of the Year Award).] Anyway back to the theme of this article. I see the children off on the 11.25. They both seem happy and this makes me contented. Parting on their return to boarding school is never a very happy moment. (The understatement of the year).

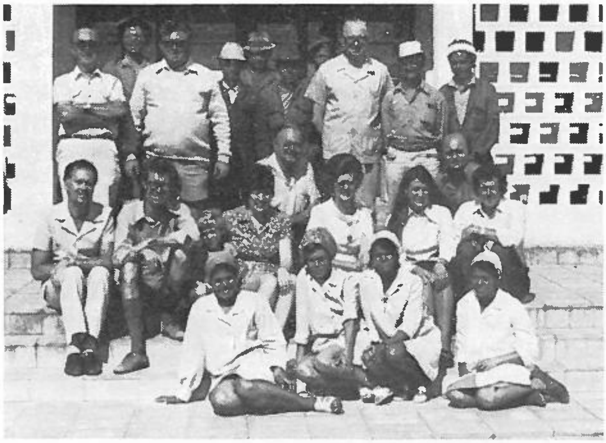
First stop: Ilha do Sai

The 13.03 train speeds me towards London. A sensual frisk by the Securicor security guard and I am boarding the 747 bound for Johannesburg. Fifteen minutes behind schedule, the plane takes off. At last I can relax —anything I have forgotten is now beyond recall—I will have to exist without it. I discover I am sitting next to a young married South African couple returning to their country after a three-month holiday on the Continent. This just happens to include two weeks skiing. At last my shade of green lessened when I heard they were on a tight budget. Only £12 a day to spend on food and extras! I told them how good the film being shown aboard was. (Actually I had never heard of it). This induced them to move to some empty seats in the cinema section. The plan had worked—I got two blankets from the steward and two Mandrax's later I was well away. So well away, they could not wake me at Ilha do Soi our first and only stop. The next eight hours were the worst especially when the crew decided that at 04.30 the tourist class passengers were ready for their breakfast. What had we done to deserve this? Kept them up all night with requests for tea or coffee! Mine arrived cold so I sent it back.Cold "bangers", scrambled egg and tomatoes were transformed into hot bacon, scrambled egg and fillet steak. Could the pilot be off his food? Airsick? Not worth worrying about such possibilities—enjoy the food now —tomorrow we might be in the sea.

Wally and I

Finally I arrive at Cape Town, only half an hour late. Surprise – surprise, they still had my case, it was in one piece (just) and most of the things were still in it. Beautiful sunshine – I could not care if there was nobody to meet me. Anyhow I phone Wally Grimwood (ex-RGO transferred to CSIR – who says "you cannot teach old dogs new tricks") and he replies that he will come "just now" (South African for 10 minutes) to collect me. My relationship with Wally is now taking on a new level. He is my opposite number in the Solar Department in Cape Town. The Solar Department relies heavily on the Cape Observatory to provide any missing Solar photoheliographic plates so that a continuous daily record of the sun's activity can be made at the RGO. Remarkably, the Sun can be recorded at Herstmonceux on plus minus (a South African expression meaning approximately) 280 days. Also Wally and I belong to the same Christian fellowship.

Wally and his wife Jenny live in one of the Observa-



The Observatory's staff

tory's houses. They have offered to let me stay with them rather than leaving me to the tender mercies of the South African hotels (actually they are very good). They show me to my room, soon I feel like one of the family – a lost son returned. In fact they have three sons who all work in Southern Africa. While Jenny prepared one of the superb meals which I was to enjoy during my stay (incidentally I have had to resign from "Weight Watchers" – I cannot afford the fines for losing ground in the "weigh-in stakes"), I went to see Mike Feast the deputy director at the SAAO. Panic – the original observing schedule has been brought forward a night which meant the non-arrival of my observing programme could be a disaster. For economy reasons this had been sent by airmail in an unsealed light-weight envelope just secured by a tie-tag. This had still not arrived by Friday morning and there were only two more postal deliveries before I left on Sunday. Fortunately it arrived by the next post. However, two items were missing from the envelope, one of them vital (some economy!) I telexed RGO to send out a copy of the vital documents, one has to be recovered from the ATLAS file store.

Setting out for Sutherland

Sunday: Wally and I set out for Sutherland some 270 miles NE of Cape Town. There is a fifty mile an hour blanket speed limit on the roads, so we will not arrive until 8 pm. We were accompanied by two of the administrative staff. One was new and was to be shown the observatory site at Sutherland. They were both very keen to discover how astronomers "do their thing", so that they could help the astronomers in their attempts to solve the mysteries of the universe. SRC has a lot to learn in this regard. They had given up their Sunday so that they could fit in with my plans to get to Sutherland a night early.

Cape Town was suffering from a heat wave and crawling along at fifty miles an hour on the fantastic South African roads, was just too much for me. Especially when one of the adminstrators told me that he used to swim in the river ahead. I demanded that we should stop – due mainly to my large size I have a very persuasive nature. Within minutes all four of us were stripped off to our underpants and were swimming in the beautiful clear water. After about an hour of pure ecstasy we dried off on the nearby rocks (when we arrived later at Sutherland Wally discovered that he had lost his underpants – I hope he can explain this to Jenny when he gets back).

Travelling on Sunday in South Africa is now limited because petrol stations are closed for the weekend. This combined with my progressive driving, (I was trained to Police standards for advanced driving) made it touch and go whether we could make it on a full tank. We arrived at Sutherland at 21.35. Mrs Roux the resident hostel manager was there to welcome us with soup, tea or coffee, rolled ham, meat on the stick, orange juice and sandwiches. Just a little something to make sure that we did not go to bed hungry! South African, Peter Warren and his English wife, Lesley, were the incumbents on the 20 inch telescope and they soon gave us a friendly welcome, typical of this country. We were then taken up to the telescope to be shown its intricacies. Every telescope seems to have its own peculiarities – this one is a delight to use. Before "women's lib" I would have called it a ladies' telescope. Incidentally Lesley had taken a week's leave so that she could act as an unpaid night assistant. Such devotion is not rare among long suffering wives of astronomers. Being more mercenary than Peter, I had pulled the Radcliffe Observatory apart three years ago in order that my wife could be paid while she assisted me to push back the frontiers of sceince.

And so to bed. I can now rest happy that my turn will come tomorrow to use the excellent facilities on this well chosen site. All that remains to be done is to recover the information lost in the post. I will rely on my astronomical colleagues at Herstmonceux and that well used and trusty friend the telex.

"Holding thumbs"

Now everything is set to go, only the weather can ruin the trip. However, they are "holding thumbs for me" (an Afrikaans equivalent of crossing ones fingers) for fine weather.

Dr Alan Powell is Head of the Solar Department at RGO.

Impressions of Russia

ANGELA KILLICK

Angela Killick, who works in the International Relations Section of the Council Secretariat, is a Westminster City Councillor in her spare time. Last summer she visited Russia with a group of Young Conservatives and in this article she gives her own personal impressions of Russia.

"Visit Russia," said the man on the corner, selling copies of Soviet Weekly, "you don't know what you're missing." Too true!

Last summer we visited four towns: Kiev and Kharkov in the Ukraine, Leningrad and Moscow in Russia. On the whole, Intourist took a lot of trouble over our visit. There was no harrassment. None of us was ever aware of being followed outside the hotels, though we were conscious of being watched in a hotel and we also found several bugging devices in hotel bedrooms but these were not necessarily active. To our knowledge, our suitcases were never opened and there was only the most cursory glance at some of our books. We were free to go where we liked, when we liked and how we liked within the towns we visited. (This freedom to explore accidentally resulted in two of us being carried into the engine shed in a blacked-out train in Kiev, to the subsequent consternation of the driver!) We were repeatedly told we could photograph anything, subject only to two caveats: that we should not photograph anything military (this was broadly interpreted and included road and railway bridges) and, more subtly, that we should not photograph individuals without their permission. This meant that when I wished to photograph a young women working like mad with a pneumatic drill, the Intourist guide watched her forbid me to do so. The USSR is, after all, a land where people are wary of foreigners, spies and photography.

Our passports were taken from us on arrival at each hotel and returned just before departure. We were told we need not take any identification papers with us in the streets as we would never be asked for them—and we never were.

An isolated group

We were, however, cocooned from human contact. Whenever a stranger came to the edge of our Intourist group he or she was rudely told to go away and if I were to single out one aspect of our visit which was unpleasant it was the feeling that one carried the plague: apart from isolated instances, people in the streets did not want to be seen talking to us. When I asked a young couple the way to the underground, they turned on their heels without answering. This nervousness was less marked in Leningrad and Moscow—towns which are more accustomed to Western tourists.

The building programme

The most impressive accomplishment of the Soviet system is its house-building programme. The USSR claims to have constructed 22 million flats between 1960–70 and to be building at an even faster rate now. The blocks are uniform and mostly ugly. It is still common in older blocks for five people to share two rooms and then to share a kitchen and bathroom with the occupants of another apartment. High rise flat phobias are either unknown or else the Russians do not admit to them. It may well be that they do not yet exist and may never develop because of the Russian character and the Soviet system. If your Government tells you that "you have never had it so good" and you have no access to the free press; if you and your wife both go out to work and the children go to a nursery or school, you join your floor committee, go to some of the many semi-political meetings which you are expected to attend, work on a couple of subbotniks (voluntary labour days) a year, and what little time is left you spend watching one of the four State Television Channels, why should you develop high rise phobias?

Some of the 22,000,000 flats built since 1960

Possibly as many as two-thirds of Soviet families own a home similar to this

Russian standard of living

This brings me to the standard of living. Leningrad, a prestigious city and justifiably known as Venice-of-the-North, enjoys standards which, in my opinion, are approximately the same as London in 1954. The choice of fruit and vegetables is limited to those grown locally (therefore, no oranges, grapefruits, bananas, coconuts, etc) but most other articles could be purchased even though there might not be very much choice. Deliveries are somewhat erratic, leading to massive queues, and (possibly to artificial shortages) the moment a new consignment comes in. Queues of 30–50 people are common and I saw one of over 100, though they did not appear to be sure what they were queueing for, apart from knowing there were some new shoes in . . . and there were many other nearby shoeshops with plenty of choice (though possibly not in all sizes).

Clothes are no longer labelled "Eastern Bloc" by their design or material but the prices are still quite high: £50 for the average woman's coat, £25 for the cheapest; fur coats around £300 (someone must buy them); 30p for the cheapest 'peasant type' stockings, £1 50 for nylons and £4 for tights. Functional shoes could be obtained for £3—most women's shoes ranged from £10 to £20 with some costing even more. Soap was poor but compared with ours in price. Colour television costs £340. Black and white half the price. Butter is £1 for 1 lb, and cheese and meat are little less than in Britain but the quality of the latter looks poor. An adequate meal can be obtained in a cafe for one rouble—50p on the rule of thumb exchange rate I have been using.

The minimum wage is £35 a month, the average wage £67 a month and it is rare to earn £100 but perks are another matter. Direct taxation starts at 6% and rises to 13%, on top of which there is a 6% tax applied to bachelors and childless couples. Utilities (rent, electricity, gas, water, central heating) come to an average of 5% of a man's wage, which means the less well off pay relatively more than those higher up the wage scale. Over 90% of Soviet taxation is indirect and—like profit—not acknowledged. Prices have remained fairly constant. The annual GNP growth rate is said to be 7–8%, and all workers have been promised an annual increase of 4%. No-one is unemployed, though sometimes fatuous jobs have to be found for people and sickness benefit is not universal. Communists we met were startled when I observed that if these figures were correct and sustained, their standard of living could improve dramatically and that in 22–30 years time they might catch us up materially. Road traffic, including the number of private cars, is increasing rapidly. There was a 12-lane road near our hotel in Moscow and the traffic never stopped day or night.

Before my visit I thought it was glib to say that Communism had become a religion. I was wrong. There is undoubtedly a Marxist-Leninist catechism, which is learned by rote and this is not necessarily thought out or criticised. I lost count of the number of statues and representations of Lenin, but on the morning we visited the Kharkov tractor factory, we saw between 50 and 80 pictures, medals, photographs, and statues of this man. We "christened" him ITMA. One of our party acquired four dozen different postcard representations of ITMA within two days. You couldn't do this in London if you combined the Royal Family and Winston Churchill! I don't know whether it could be done in Rome with "holy" postcards. At the same time I tried in vain to buy either an exterior or interior view of the glorious cathedrals of St Sofia in Kiev, or St Bazil in Moscow.

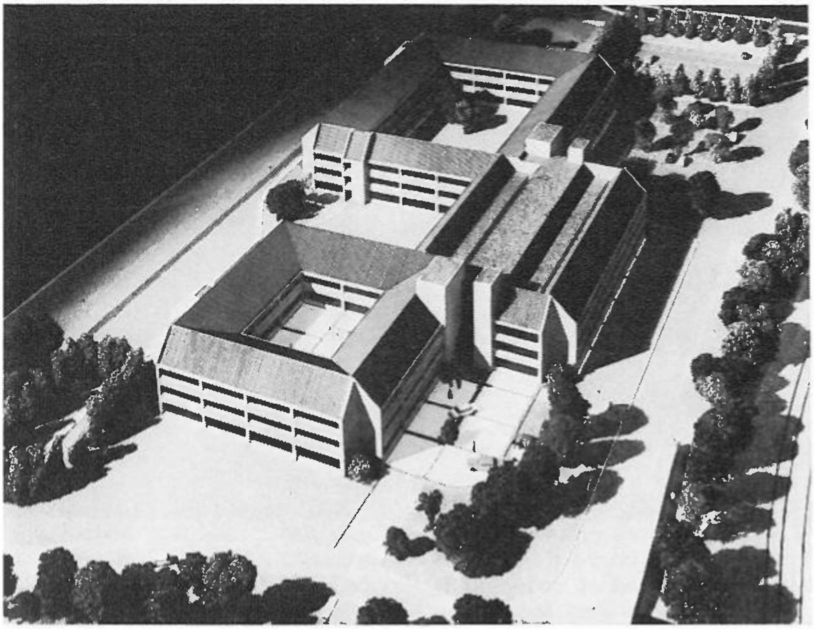
I would have liked to visit a Russian home. The Intourist guide said I should make friends with someone. It so happened that the next Young Communist I met, said that as far as he and his wife were concerned, they would very much like to invite me round "But, as you know, we have rules about these things". It is not illegal for a foreigner to go to a Russian home and this episode calls to mind the question asked by an Oxford don, when assessing the Soviet system: does the rule of law prevail?

Newsfront

Swindon

Our picture shows the architect's model of the proposed new headquarters which we shall share with the Natural Environment Research Council in Swindon. It now seems likely that the model shown will be the basis for the construction of the new building, to be erected on the railway site adjacent to the railway station and opened, if present plans materialize, in late 1977/78.

In September this year a further forty to fifty staff at the Council's London office are transferring to the Stage II Advance Office in the British Rail complex. After that there may be a further movement of staff in 1976 to occupy vacant space in the Stage II accommodation, provided a viable block of work can be isolated and adequately staffed.



Swindon Advance Office Stage II
The units of work being transferred in September and the senior staff involved are as follows:

Directorate B Engineering and Nuclear Physics
Under Secretary: Mr A J Egginton

E & O General
Principal: Mr B E Broughton

Finance II
Principal: Mr A Dobbins

Contracts (that part which remained in the Oxford Street Annexe at Stage I dispersal)
Principal: Mr R S Reed

Engineering (Aeronautical and Mechanical Engineering and Manufacturing Technology Secretariats)
Principal Scientific Officer: Dr N J Lawrence

Secretary's Department
Senior Principal Scientific Officer: Dr D L Johns

Regrouping of establishments

At its April meeting Council, after extensive consultation with all interested parties, including staff side, took a number of decisions about the regrouping of activities in establishments.

High energy physics
Support for high energy physics will be concentrated at the Rutherford Laboratory. Work at Daresbury Laboratory in preparation for CERN experiments which are already approved (such as the $e^{-}\gamma$ and muon programmes) will continue there, but work in support of all new proposals will be the responsibility of Rutherford.

A substantial part of the computing now carried out at the Atlas Computer Laboratory will be transferred to Daresbury where it will support a growing variety of work outside the field of high energy physics. The transfer will begin in 1976 and take several years to complete.

Interactive computer facility
The interactive computing facility recommended by the Engineering Board is to be set up, using as its base that part of the Atlas Computer Laboratory remaining at Chilton.

National computing campus
Discussions are under way between the SRC and the Department of Industry to consider the possibility of establishing a national computing campus to which the interactive facility would be the initial SRC contribution.

Transfer of staff
Specific plans for transferring staff will be worked out progressively with the staff and trade union sides and every effort will be made to ensure that movement of staff will be on a voluntary basis and full account will be taken of personal circumstances.

Ariel 5 results

The exciting results from the experiments carried out by Ariel 5, Britain's first x-ray astronomy satellite (see Quest vol 7 No 3 1974 for details) were widely reported in the national press and discussed at a well attended press conference at State House on April 15. Our picture shows from left to right five of the principal experimenters involved (Dr P W Sanford, University College, London; Professor A P Willmore, University of Birmingham; Dr Joycelyn Bell Burnell, University College, London; Professor K Pounds, Leicester University; and Professor R L F Boyd, University College. Among the new scientific data on the x-ray sources that have been viewed so far, the Leicester University, University College, London and Imperial College groups have reported on a new x-ray source in the constellation of Centaurus which is found to flash on and off with a period of nearly 6–8 minutes. This kind of behaviour is common, in x-ray stars but usually the period is that of the rotation of the star about its polar axis, when it is only a few seconds, or it is that of its orbital rotation about a companion star, when it is a few hours. A period of a few minutes implies either very slow rotation or fast orbiting: compare the orbit of the Earth about the Sun, with a period of a year. If orbiting, a period of the order of five minutes implies a very small orbit, smaller than the size of a normal star, so that a system consisting of, perhaps, a neutron star and a dwarf star must be involved.

A second new source reported by Ariel 5 investigators was found in February. It rapidly became the second brightest x-ray source in the sky for a time, after which it faded gradually. The source is in the direction of the centre of the galaxy and is probably actually in the galactic nucleus. It is possible that it coincides with a remarkable radio and infra-red source at the galactic centre, though other measurements at different wavelengths will be required to confirm this. The scientists believe this could be a new kind of object.

Finally, it is believed that x-ray emission lines have been detected from the Cassiopeia and Tycho supernova remnants. These are clouds of debris which result from the explosion which shatters many or all stars when their nuclear fuel is exhausted. If the observations are confirmed it will be possible to determine the amount of iron and silicon in the stellar debris. This will be important because it is believed that all the heavy elements in stars on planets such as Earth have been manufactured in nuclear reactions in supernova.

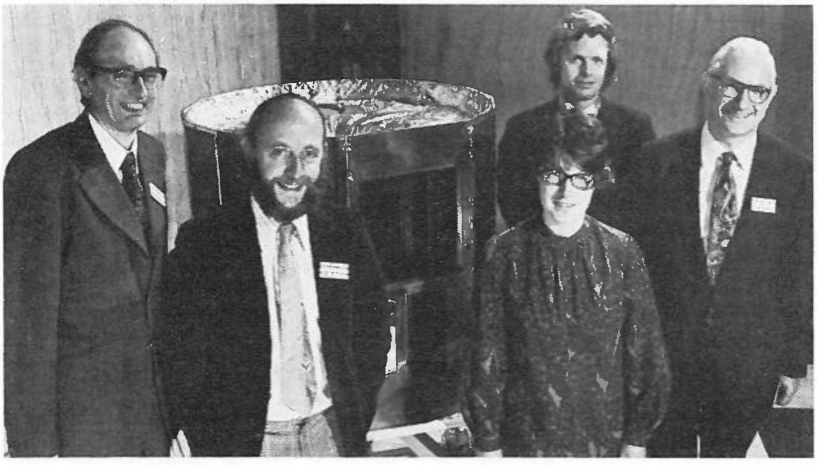


Photo: Keystone Press

European Space Agency
The setting up of the European Space Agency (ESA) was approved by the European Space Conference held in Brussels in April and ESA came into operation on May 31. ESA was formed from a merger of the European Space Research Organisation (ESRO) and the European Organisation for the Development of Space Vehicle Launchers (ELDO). The member states of ESA are: Belgium, Denmark, France, Federal Republic of Germany, Italy, Netherlands, Spain, Sweden, Switzerland and the United Kingdom. The Director General of ESA is Mr Roy Gibson, who was formerly Director General of ESRO. Mr Gibson joined ESRO in 1967 and prior to this spent eight years as an administrator with the UK Atomic Energy Authority.

CERN appointments
Dr John B Adams and Professor Leon van Hove have been appointed Directors-General of CERN for a period of five years from 1 January 1976.

Dr Adams will be responsible for administration, for the operation of equipment and services as well as the construction of buildings and major equipment. Professor van Hove will be responsible for the research programme.

Dr Adams first joined CERN in its earliest days and after being head of the division which built the 25 GeV proton synchrotron became Director-General in 1960 before returning to England. He rejoined CERN as Director of the 300 GeV accelerator project at the beginning of 1969 and became Director-General of Laboratory II in 1971.

Professor van Hove first joined CERN in 1961, as Head of the Theoretical Physics Division. Since then he has taken a leading role in the scientific life of the organization, twice serving as Director of the Theoretical Physics Department in 1966–68 and 1972–74. He was President of the Scientific Directorate of the Max-Planck Institute of Physics and Astrophysics in Munich from 1971–74.

‘The work of the Research Councils’

The ‘Work of the Research Councils’ is to be the subject of a major one day symposium (Friday, August 29) to be held at this year’s meeting of the British Association for the Advancement of Science at the University of Surrey, Guildford. Professor Edwards will present the opening address. He will review the work of the Councils, including support for ‘big science’. Other topics of discussion will include ‘Nutrition and food’; ‘Oil from beneath Britain’s seas and its consequences’; ‘Changes in the natural and social environment’ and ‘Some benefits of fundamental science’. The symposium—the first of its kind—will be accompanied by an exhibition on the work of the Councils. Those wishing to attend the symposium or British Association meeting are invited to contact Mr Peter Smith, the British Association’s Secretary at the University of Surrey, Guildford (Tel: Guildford 71281).

An aerial view showing the university campus and Guildford Cathedral in the centre of the picture. *Photo: Southern England Air-Photos*

Synchrotron Radiation Source

Approval has now been received from government for a Synchrotron Radiation Source to be built at the Daresbury Laboratory at an estimated capital cost of £3 million at mid 1974 prices. This includes the equipment for the first three beam lines. The Daresbury Source will be the first of its kind anywhere in the world to be purpose-built in order to provide synchrotron radiation which is applicable in the study of atoms, molecules and condensed matter covering a wide range of physics and extending to chemistry, metallurgy and materials science and molecular biology.

It is expected that this major scientific facility will be ready for the first experiments on completion of its construction in about four years’ time, and the construction programme has been arranged so that work involving the Laboratory’s 5 GeV accelerator known as NINA is not seriously affected.

The decision of SRC late in 1972 to terminate the high energy physics programme on the NINA accelerator within about five years had given extra urgency to the project. A panel set up at that time recommended the construction of an electron storage ring to replace NINA as a source of synchrotron radiation.

The project has arisen from the realisation of the scientific potentialities of such a source among users of the existing Synchrotron Radiation Facility on the NINA accelerator. Use of the Synchrotron Radiation Facility is near saturation, with nine sets of apparatus on two beam lines and over forty scientists using the Facility, including the Physics Departments of the Universities of Manchester, Reading, Cambridge, Oxford, Warwick, Leicester, Ulster and Bristol as well as the Metallurgy Department of the University of Strathclyde, the Chemistry Department of the University of Leicester, the National Physical Laboratory and the MRC Laboratory of Molecular Biology in Cambridge.

The availability of the new source of synchrotron radiation should result in a considerable increase in scientific interest in more universities and institutes as well as benefits of physics being brought into other subjects.

The RGO Tercentenary

Photo: Keystone Press

Highlight of this year's celebrations of the tercentenary of the foundation of the RGO, will be the Royal Garden Party on July 18 for delegates to the Symposia as well as RGO staff, past and present. The guest of honour will be HRH Princess Anne who will unveil a bust of John Flamsteed.

Two days later at the invitation of the Dean and Chapter of Westminster Abbey, a service of commemoration for the tercentenary will be held in the Abbey on Sunday, July 20 at 3 pm. An address will be given by Professor Sir Bernard Lovell, Director of the Nuffield Radio Astronomy Laboratories, Jodrell Bank, and the emphasis of the service will be on the themes of Time, Navigation and Astronomy. Before the service, at approximately 2.30, Sir Richard Woolley will lay a wreath on the tomb of Charles II, who founded the Observatory.

From Saturday, August 2 until August 17 it will be Open Fortnight at the RGO, Herstmonceux Castle. This is a unique opportunity for members of the public to see certain domes and departments that are not normally open to them and there will be recorded commentaries on the work carried out on some of the telescopes.

August 10 is the anniversary of the laying of the foundation stone of the Observatory by John Flamsteed, the first Astronomer Royal, in 1675. (A commemorative service for Flamsteed, who was Rector of Burstow, Surrey will be conducted in Burstow Church by the Bishop of Kingston-on-Thames on July 13.)

Photo: Keystone Press

Tercentenary transparencies

The Tercentenary Committee selected twelve subjects for transparencies to be on sale during the open fortnight in August and these are now available (from Miss C V Hewerdine) price 30 pence per set of three as follows:

1. Castle, an equatorial dome, a view of the Folly and lake.
2. Cooke Transit Circle, Photographic Zenith Tube, Time Department Control.
3. Isaac Newton Telescope, 36-inch Yapp telescope, 30-inch telescope.
4. Orion Nebula, M3 globular cluster, M51 spiral galaxy, the last two being taken on the Isaac Newton telescope.

"Greenwich Observatory"

The publication of the three volume history "Greenwich Observatory" by Taylor and Francis was marked by a reception in the rooms of the Royal Society on 18 April, attended by Dr A Hunter, the Director of the Royal Greenwich Observatory and Mr P S Laurie, the Observatory's archivist. All three authors pay tribute in their books to the amount of help they received from Mr Laurie.

Tercentenary medals

The Royal Mint has struck three $2\frac{1}{4}$ inch commemorative medals in gold, silver and gilt-bronze. The medals were designed by William Andrewes, who teaches horology at Eton and maintains some of the Old Royal Observatory clocks.

The reverse designs depict three themes: astronomy, time and navigation. The obverse design on each medal is of Flamsteed House at Greenwich.

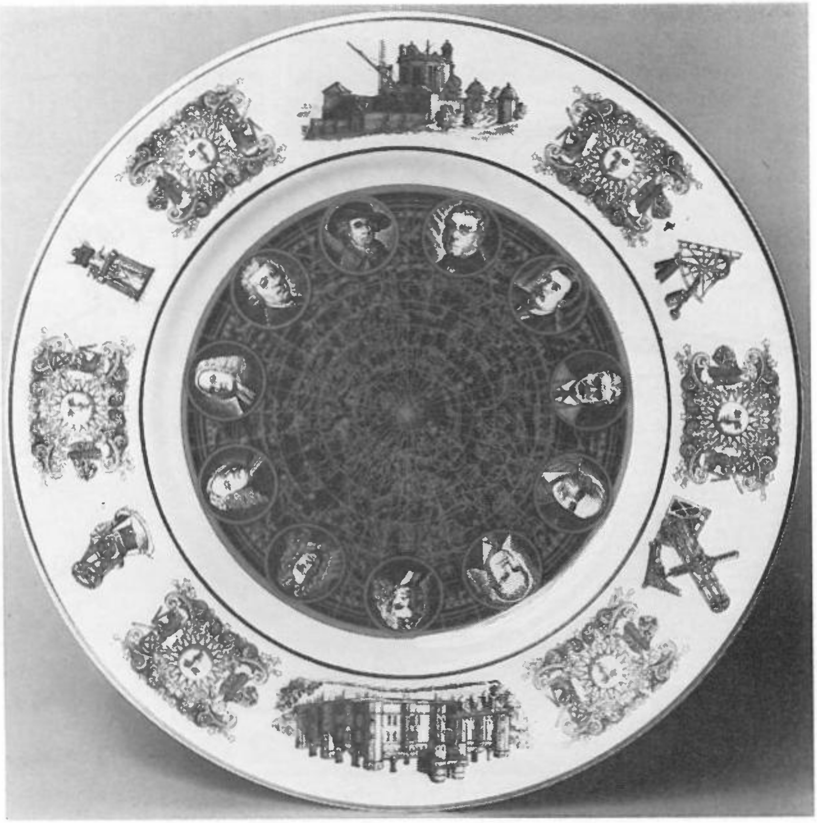
The price of the gold medals is £750 each, the silver £25 each and the bronze £7 each and they are available from the Royal Mint, Numismatic Bureau, P O Box 1000, Edinburgh EH1 1AG.

Tercentenary visits

A press visit to RGO was held on 19 June when science correspondents, technical journalists and local press were invited to tour the domes, exhibitions and displays prior to the visits by special parties the following week. These parties included the Royal Society, Royal Astronomical Society, National Physical Laboratory, Royal Institute of Navigation, British Horological Institute, Clockmakers' Company, British Astronomical Association, Institute of Physics (Optics Section) and Science Research Council staff.

Commemorative issues

Royal Observatory Plate
Josiah Wedgwood and Sons Ltd have produced a Royal Observatory Plate in fine bone china, to a commission by Harrods, who have exclusive selling rights. The design is in black and gold and the plate has a diameter of 10¾ inches. In the centre of the plate is a 17th century star map of the Northern Hemisphere, superimposed on which are portraits of the first eleven (the Greenwich) Astronomers Royal. The border illustrates the Old Royal Observatory at Greenwich, Herstmonceux Castle, and four important astronomical instruments—separated by a repeating 17th century star motif. On the reverse of the plate is a commemorative backstamp which incorporates the names, lifespans and periods in office of the past Astronomers Royal. The edition is limited to 1,000 and each plate is accompanied by a numbered certificate and illustrated folder which relates the history of the Observatory. The price is £25.



Commemorative Covers
The commemorative stamp of Flamsteed House, one in a series issued by the Post Office for European Architectural Heritage Year, appeared on the commemorative covers issued on Sunday, 22 June to mark the 300th anniversary of the foundation of the Royal Observatory. A facsimile of the Foundation Warrant was enclosed and the Post Office placed a special post box at RGO for collection and handstamping with a specially designed die stamp.

Flamsteed House, Greenwich was put up by Sir Christopher Wren on the orders of Charles II in 1675–76. Designed as a house for the first Astronomer Royal, the Rev John Flamsteed, it was not so much an observatory but more—as Wren put it—"for the Observer's habitation and a little for Pompe." Flamsteed presumably enjoyed the "Pompe" but in fact made most of his original observations from a hut nearby.

Flamsteed House (bottom left) stands on the site of an earlier fort. The building is in red brick, with stone dressings at its corner. With its tall first-floor casements and twin turrets (one surmounted by a red ball which falls as a time check for ships on the nearby river) it was certainly designed as an architectural set-piece crowning the view from Inigo Jones' Queen's House.

"ROYAL VILLAGE CONSERVATORY"

Our cartoonist is Geoff Berry, Publications Officer at Daresbury Laboratory

Now where was I . . . ?

The following is a list of the permutations and combinations of addresses received over the last couple of years in the Electronics Department at the RGO.

It makes you wonder whether people actually listen to what you are saying when you give the address over the phone.

Although it is supposed to be an advantage to have a 'good address' it's no use if nobody knows how to spell it. Three cheers for the GPO on delivering the goods.

Seabrook Telecommunications
Royal Village Conservatory
Herstmonceux Castle
Halesham Sussex

For the Attention of Mr P D Reid
Royal Greenwich Observatory
Herstaonagox Castle
Hailsham Sussex

Mr T J Bell
Electronic Department
Royal Greenwich Observatory
Herstmonseaus Castle
Near Hailsham Sussex

Mr A Seabrook
Royal Gremwich Observatory
Herstmonceux Castle
Hailsham Sussex

Royal Greenwich Observatory
Herstmoncleux Castle
Hailsham
Sussex

Mr A R Seabrook
Royal Greenwich Observatory
Hurst mon seux Castle
Hailsham Sussex

Mr A R Seabrook
Royal Greenwich Observatory
Herstmonoeux Castle
Hailsham Sussex

J P Bell
Electronics Department
Royal Greenwich Observatory
Huntmonceux Castle
Hailsham Sussex

Mr A R Seabrook
Royal Greenwich Observatory
Herstmoncevy Castle
Hailsham Sussex

Royal Greenwich Obseavatory
Merstmonceux Castle
Hailsham Sussex

Mr Norman
Royal Greenwich Observatory
Herstmoncex Castle
Hailsham
Sussex.

Mr P D Reid
Electronics Department
Royal Observatory
Herstomonclux Castle
Hailsham Sussex

Royal Greenwich Observatory
Herstmongeux Castle
Hailsham
Sussex

H G Gill
Head of Electronics
Royal Greenwich Observatory
Herstmoncuec Castle
Hailsham Sussex

For the Attention of Mr A R Seabrook
Electronic Department
Royal Greenwich Observatory
Hersthonceux Castle
Hailsham Sussex

Ultraviolet Skylark

Conceived by Man that you may probe God's sky
for light much fainter than the earth may know,
a wingless bird that's born so soon to die
and in your death celestial secrets show.

For Man would know what forms the canopy
which clothes the night with constellations,
since long before the noble Ptolemy
the stars commanded meditations.

With steps retarded by a need to see
that bridges built on proven substance stood,
Man's expertise proceeds to rocketry
from things of leather, brass and varnished
wood.

At last prepared, compared and primed for
flight
stripped of all earthbinding trivials,
you wait while men in bunkers filled with light
suffer a flood of falling numerals.

A spark is parent to a lightning flash
a click progenitates a thunder clap,
two tons of metal make a skyward dash
and soon see earth become a coloured map.

Earth bonds prescribe your trajectory in space
dictate your impact on the desert floor,
for you a dusty, empty resting place
God's message gracing some computer store.

H J B Paxton
(*Appleton Laboratory*
(*ARD*) *Culham*)

Presentations and farewells

Our picture shows the Lord Lieutenant of East Sussex, the Marquess of Abergavenny, presenting Mrs Marples with the BEM at Herstmonceux Castle on 7 May 1975. Mrs Marples is well known to almost all senior UK astronomers, and to a large number of foreign ones, as housekeeper at the castle. Her official grading as Canteen Manageress does not properly reflect the range of her activities which go far beyond her successful running of a canteen serving the staff and visitors at the Royal Greenwich Observatory. She has for nearly twenty-five years given cheerful service at all hours and well beyond the call of duty.

Freedom of the Worshipful Company of Clockmakers
Dr A Hunter the Director of the Royal Greenwich Observatory was admitted to the freedom of the Worshipful Company of Clockmakers at a ceremony in Goldsmiths' Hall on 7 April. One of the stewards who escorted him before the court was Mr John Spencer Jones, son of the tenth Astronomer Royal.

Farewell to . . .
Mr A J "Jack" Johnson, formerly a craftsman in the Engineering Department of the Royal Greenwich Observatory, who retired on 31 March after forty-six years' service. Mr Johnson joined the Royal Observatory at Greenwich as a boy mechanic in 1928 and had been employed on the maintenance and erection of telescopes and ancillary equipment ever since, apart from war service between 1943 and 1946.

Mr J H Whale who retired from the Royal Greenwich Observatory on 31 May, after forty-two years in the public service. He joined the Royal Observatory when it was still at Greenwich in 1947 and he became Secretary and Cashier in 1962. He has thus been responsible for advising three successive directors, each of whom has at different times expressed gratitude for the wisdom that has informed that advice.

"Energy Saver" pays off
Two hundred pounds, even in these days of rising inflation is still a healthy sum of money to take home. Mr C R "Chris" Brown, a craftsman in the Nimrod Electrical Engineering and Auxiliary Plant Group at the Rutherford Lab has been presented with a cheque for this sum by the Director, Dr G H Stafford.

Chris Brown, following the publication early in 1974 of a Laboratory Notice on energy conservation, noted the lighting requirements in different areas of the experimental halls, then operating under half normal lighting for reasons of economy. On bright days the level was adequate but on dull days supplementary lighting became necessary. The basic idea put forward by Chris was to leave a percentage of the lighting switched on and control the rest by photo-cell with overriding control from the main control room. The suggestion was investigated by a Nimrod Operations Group working party and by the Electrical Services Group who recommended certain refinements. The estimated annual savings amounts to many hundreds of pounds.

At the presentation Dr Stafford spoke of the simplicity of this very effective suggestion and, mentioning that Chris had already received an award of £10 for a previous suggestion, speculated on the future if he continued to produce increasingly successful suggestions. Chris, in reply said that he would now be able to pay his large electricity bill!

Professor Roderick Redman FRS

British optical astronomy has lost a gentle giant with the death of R O Redman on 6 March 1975 in Cambridge. He had been ill for only a few weeks, and though he had almost completed his allotted span, the energy and youthfulness he had displayed right to the end of his life prompted those who did not know his real age to think his death untimely.

Redman was attracted into astronomy by the teaching of Eddington at Cambridge between the wars. He gained his practical insight into astronomical spectroscopy at the Dominion Astrophysical Observatory at Victoria, British Columbia. Returning to Cambridge for six years' teaching, he accepted in 1937 the post of Chief Assistant at the newly-established Radcliffe Observatory in Pretoria. He was clearly motivated by the prospect of observing with the 74-inch reflector then under construction in Newcastle, but the outbreak of war prevented the completion of the telescope. For the next nine years he sublimated his frustration by taking part, with R H Stoy of the Royal Observatory at the Cape, in a major programme of stellar photometry that culminated in linking the two hemispheres through observations of intermediate zones from both South Africa and the United Kingdom.

He returned to Cambridge in 1947 as Professor of Astrophysics and proceeded to re-equip the two observatories there, now combined administratively, with modern instruments with which he developed the technique of narrow-band photometry that will always be associated with his name.

He participated fully in the work of SRC from its foundation, serving on the ASR Board and the RGO Committee, and as Chairman of the ROE Committee, from 1965 to 1970. He acted as consultant on the Anglo Australian Telescope from its inception: that it has turned out to be arguably the best telescope in the world is no more than one would expect from his influence. He has been equally concerned in the early stages of the Northern Hemisphere Observatory. He never spared himself in furthering these projects: in particular, he commuted between Australia and the United Kingdom in the last year of his life in a way that would have tested a much younger man.

Redman was completely without the stuffiness shown by some others of his generation. He affected a surface pessimism that was totally belied by the warmth and generosity of his real nature. His characteristic explosive laugh will be greatly missed in SRC committees and over tea at the Royal Astronomical Society; optical astronomy will be the poorer for his absence. **A.H.**

GEOS—Europe's first geostationary scientific satellite

The European Space Agency (ESA) is at present developing Europe's first geostationary scientific satellite GEOS. Scheduled for launch in autumn 1976, GEOS will probe the regions of the Earth's atmospheric environment in space from a synchronous orbit at an altitude of 22,300 miles (36,000 Km).

It will carry experiments devised by nine European scientific groups to study the electric, magnetic and particle fields in the Earth's magnetosphere.

Only one UK experiment is to be included in the GEOS payload. This experiment—the Suprathermal Plasmal Analyser experiment—is to be provided by the Mullard Space Science Laboratory (MSSL), and will observe low energy particles associated with geophysical phenomena such as magnetic substorms, solar flares and various wave particle interactions.

In addition, groups at the Universities of Sussex and Sheffield will participate in the data handling for the GEOS Electrostatic Wave Experiment (S300). This experiment is being built by a consortium of prime experimenters from France, Denmark and Holland.

This section of a radial boom on the GEOS satellite shows (left) a magnetometer that will measure the magnetic field in three axes so enabling its precise direction to be determined at any time. An electron gun (right)—one of four on-board GEOS—will emit an electron beam which after deflection by the magnetic field is sensed by another part of the experiment—so allowing electric field components to be measured.

Birthday Honours

Her Majesty the Queen has been pleased to award Honours to the following: Professor S F Edwards FRS, Professor P B Hirsch FRS, D L Nicolson and Professor A B Pippard FRS were made Knights Bachelor; Professor T W Goodwin FRS and Dr A Hunter were awarded the CBE; and Mr P S Laurie and Mr J Wilby received the MBE.

Professor P B Hirsch FRS is a former member of the Engineering Board and former Chairman of the Metallurgy and Materials Committee. Mr D L Nicolson is a former member of Council.

Professor A B Pippard FRS is a former member of the joint SRC/SSRC Committee.

Professor T W Goodwin FRS is a member of the Biological Sciences Committee.

Mr P S Laurie is a Senior Scientific Officer at RGO.

Mr J Wilby is a Stores Manager at Daresbury Laboratory.

Fellows of the Royal Society

All members of the Council's staff will wish to congratulate the following who have been elected Fellows of the Royal Society: Professor R Mason, Sussex University (Member of Council and Chairman of Science Board); Dr K Dalziel, Oxford University (Member of Enzyme Chemistry and Technology Committee); Professor R Wilson, University College London (Member of ASR Board and formerly Head of SRC Astrophysics Unit, Culham); Professor E C Zeeman, Warwick University (Member of Mathematics Committee); Mr R J Beverton, Secretary NERC; and Dr D A Haydon, Cambridge University (Member of the Colloid Panel of the Chemistry Committee).

Royal Society Soirée

Appleton and Rutherford Laboratories were honoured by our oldest scientific institution, the Royal Society, in being chosen to exhibit at their May soirée. Only about twenty-five exhibits are selected each year for demonstration to the Fellows and their guests.

Appleton's exhibit was 'The influence of solar phenomena and geomagnetism on the weather and climate'. It dealt with the recent discovery that the weather in certain parts of the world, including Britain, is apparently influenced by a wide variety of solar phenomena ranging from short-lived events such as solar flares to the eleven year and twenty-two year sunspot cycles.

Sunspot cycles are accompanied, for instance, by pronounced variations of the annual rainfall (up to fifty per cent in certain parts of the world) and of the winter temperature (up to 6° F). Droughts in some of the world's major food growing regions appear to be associated with the twenty-two year sunspot cycle. This cycle is also associated with a six week oscillation of the date in each year by which various percentages of the annual rainfall occur in Australia.

The number of days each year on which 'blocking anti-cyclones' occur over Europe (and hence the quality of the British weather) varies during the sunspot cycle, as does the temperature of the sea in the English Channel. These sun/weather relationships are obviously of great practical and economic importance and they are under further investigation at the laboratory.

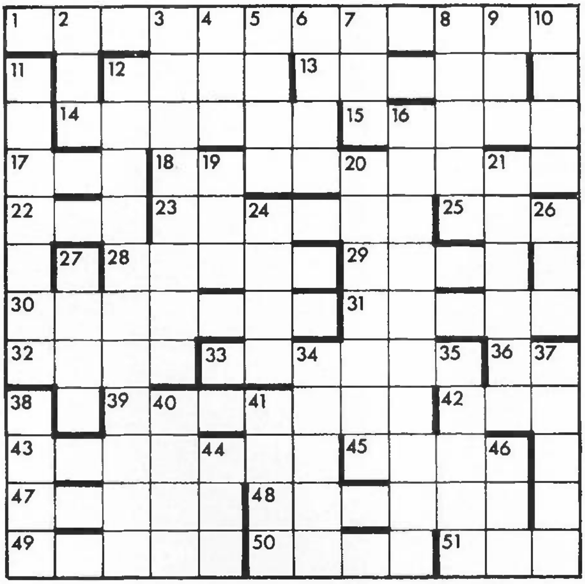
Short lived solar phenomena such as solar flares, and also magnetic sector boundaries that extend into space from the sun and sweep across the earth as the sun rotates, are accompanied by significant variations of the average wind speed over the northern hemisphere. Detailed analyses of sudden changes in the lower atmosphere are being made at the laboratory in order to identify the short lived solar phenomena with which meteorological changes are mostly closely associated.

Evidence suggests that certain sun/weather relationships are associated with charged particles from the sun. The approach of these particles to the earth is controlled by the earth's magnetic field and associations between the lower atmosphere and the geomagnetic field are therefore being investigated. It appears that variations of the magnetic field may play a major role in determining the earth's climate.

The Rutherford exhibit was 'The medical applications of high energy physics techniques' consisting of a Xenon fitted multiwire proportional chamber (M W P C) and associate equipment.

The M W P C detects x-rays and measures the position at which their paths intersect the chamber. The measurements are stored in a computer and used to build up a picture of the x-ray distribution. When an object is being x-rayed it appears as a shadow cast on the detector. If the source position is moved the x-ray distribution at the detector moves as indicated in the diagram. The distance moved depends on the height of the object above the detector and this relationship can be used to examine the structure of the object at specific heights. The object is viewed from eight positions and the information describing each view is stored in the computer. The views are moved a calculated distance so that, when superimposed, shadows cast from one particular height are clear while those from any other height appear smeared out. The effect is similar to focussing a light image of a three-dimensional object onto a screen with a large lens, only part of the object is clear at one setting.

This exhibit was the work of several groups: the Radiological Research Group who had been engaged on the medical applications; the High Energy Physics Electronics Group who provided the computer and electronics; the Nuclear Physics Apparatus Group who dealt with the engineering aspect and the Scientific Administration Group who liaised with the graphics and stand design.



MAXIM 9

Maxim 9

Answers to the clues asterisked will not fit into the diagram until they have been encoded. The nature of the code is indicated by the answer to 1 across. Solvers will also need to know that what some people call 'zero' or 'nought', Maxim calls 'nil' and that the golden rule of entering only one character in each square in the diagram is adhered to. Non-asterisked clues are normal.

Clues

ACROSS

1. 1 Ac, for example. Otherwise N—ah, a prim clue! (12).
12. Male, or put another way, dashing fellow (4).
13. What turns, yet stays constant? (5).
*14. How astronauts feel: light, disturbed, in a small craft (10).
15. A soak drunk in Japan (5).
17. Constellation visible from Seattle Observatory (3).
18. Delights in request for mad ruses (9).
22. He's a little man in himself (3).
23. M40 is highly resistant (6).
25. Stance alternately adopted by bag (3).
28. Note gang-leader in . . . Dickens (5).
29. One mile per second from small cars (4).
30. Hydrogen-consuming means of keeping warm (7).
*31. Wife's behaviour? Mine's upset, inside—result of careless parking (8).
*32. Get nervy in the troubled teens (5).
*33. Draw lots somehow for success in the argument (4, 4).
*36. State House on Tyneside? I'm not joining in (4).
*39. Unpaid, our selected side achieves a draw (7, 4).
42. Part of Scotland in Alloway region, and vice versa (3).
43. LP hints obliquely at method of supporting busts (7).
45. Device for firing in unlikely retreat (4).
46. Nearly unusual, our smell (5).
48. If I'm out, it's something to do with chaps, usually (6).
49. Weed clobbers Yorkshire opener (5).
50. Tight-fitting about the arms (4).
51. What 'aye-aye, sir' implies (3).

DOWN

2. 7 down, not up (3).
3. The ample contents of first-aider's position (8).
4. Used to measure area mostly (3).
5. Mr Heath's best-known organ, played on by his depictors (4).
6. In one great power, take symbol of another (4).
7. Nothing after a short wait—typical of the cow (3).
8. What you hear in the 40's—'take paddles' (5).
9. Trouble of the fair kind (3).
10. Trouble with cash for the little prince (4).
*11. Device that gives buzzing noise when most of trunk-caller's inside (9).
*12. Take hose off a thigh in roughly attaining the in thing (6, 2, 7).
*16. ' . . . on a -- --, in his tent, That day he overcame the Nervii' (Shakespeare, *JC*) (7, 7).
19. It's just not on, in cricket, to run very fast (3).
*20. Move labour to get continual manning (5, 4).
21. With bags of room in Eastern Islay perhaps (6).
24. Trap one? She used to in the cinema (4).
*26. What makes N a nice doggy (6).
*27. Direction from here and a river you'd come to late in life (6).
34. American in sick-bay, a girl with black eyes (5).
35. Flirt with lady, her first flirt (5).
*37. Roneo breaks down; it's burdensome when me and you are there (7).
38. Opts out? The very place! (4).
40. There's nothing at sunrise like hard work (4).
41. Units that need no stamps (4).
44. Essay that's sometimes converted (3).
46. Bevan—a US city on the coast that it's on (3).

The prize will be awarded to the first correct entry drawn. Please state whether you would prefer a book or record token. The solution will appear in the next issue.

Rutherford gets the bird

An EPIC occasion (or our colleagues at the Rutherford Laboratory, if not for the ornithological world in general, has been the construction of their family home, by a couple of friendly blackbirds, in the east entrance to building R1. Our pictures show not just father feeding the young but mother hatching them.

The nest has been occupied twice by the same pair who have produced two sets of eggs. This is extraordinary in view of the site which is within hand-touching distance of a doorway used by dozens of people every day. The brilliant wildlife photography is by Reg Jones of the laboratory's photographic services staff.

European science writers visit SRC

The Association of British Science Writers organised a three day programme in March for members of the European Union of Associations of Science Journalists. Journalists from Austria, Belgium, France, Germany, Italy, Netherlands, Spain and Switzerland took part in the programme which included visits to Cambridge University, the Huntingdon Research Centre and Winfrith Atomic Energy Establishment. The Science Research Council gave a buffet lunch at State House on Wednesday, 19 March at which senior representatives of all five research councils were present.

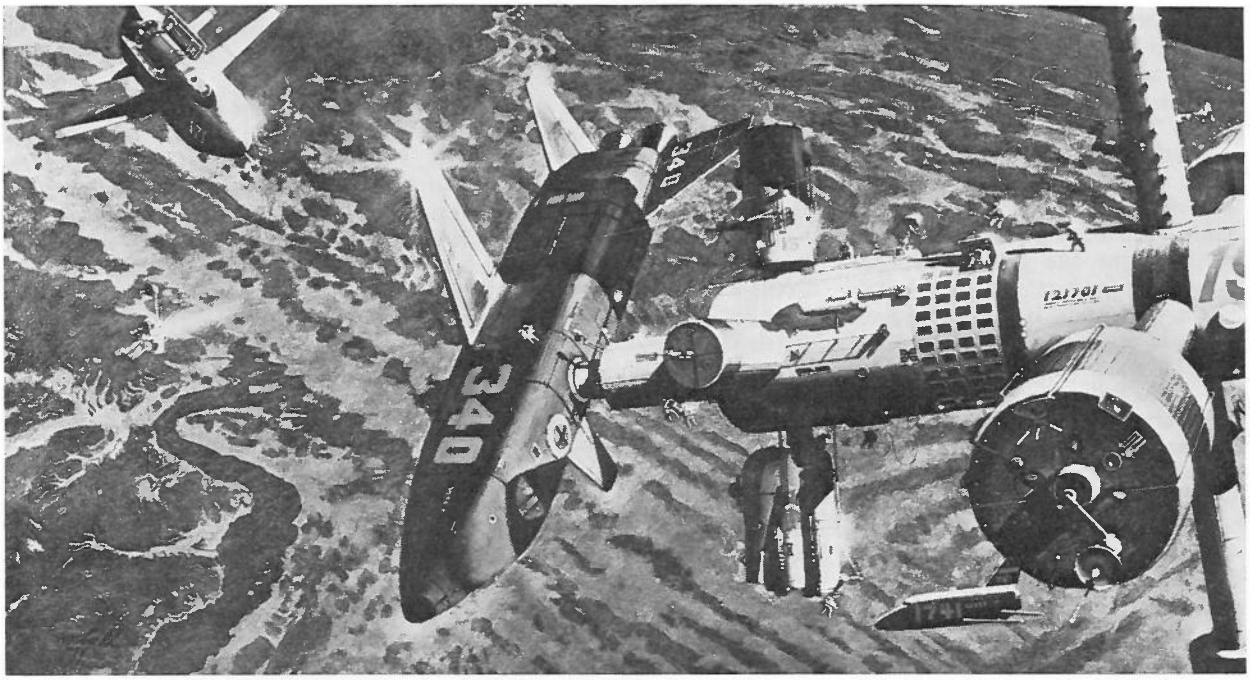
Computational Physics of Liquids and Solids

Atlas held its fifth symposium on the subject of "Computational Physics of Liquids and Solids" at Queen's College, Oxford in April. While the majority of the hundred participants were from the UK there were speakers from the USA, France, Italy, Holland and other European countries, showing the high level of interest in this field.

By the end of the symposium it was clear that high speed electronic computers have made a tremendous impact on the theory of liquids and solids. As one speaker remarked "Computer simulation methods have not so much replaced theory, but have made a theory of liquids possible".

Daresbury's swimming club

In January a swimming club was formed at Daresbury Laboratory. In the few months since then several of the non-swimmers have made great progress and joined in with the swimmers. Tuition is given to new non-swimming members. All the swimmers have been encouraged to improve their standard and learn different strokes and it is hoped to enter a team in local competitions in the future. In the meantime everybody enjoys their weekly night out supervised by Gordon Foster.



Shuttlecraft docking with space station. A scene looking forward to the time when shuttles, like aircraft today, will be specially designed according to their functions. *(Illustration reproduced from "Our World in Space" by Isaac Asimov, by permission of the publishers Patrick Stephens Limited.)*

SPACE TIME DIARY No. 2. In this second article, Gerry Webb reports on the visit last year of popular science writer Isaac Asimov to the Globe Tavern, Hatton Garden, former haunt of the London Circle and reviews Asimov's "Our world in space".

Being crushed to near suffocation amongst a hundred 'sercon' fans (sercon = *ser*ious and *con*structive to non-fans) at the large, shabby bar of the 'One Tun', my thoughts wistfully drift back to June. I had been prophetic indeed! Hearing that the apocalyptic visit of Asimov to the British Isles was at last to take place and that we were going to arrange one last meeting at the 'Globe Tavern' in Hatton Garden in his honour before it was pulled down for redevelopment, I had quipped "so, its after Asimov–the deluge".

The 'London Circle'

Perhaps I had better explain the history of the regular Thursday night meetings of the 'London Circle', now so sadly gone awry. Before the war, a group of the ridiculed minority comprising science fiction readers and those interested in practical space travel (the two being indistinguishable at the time); those interested in the general future possibilities for mankind; and anybody with what the old-timers now nostalgically call 'a sense of wonder', met frequently in London at several locations one of which was the flat shared by A C Clarke and W F Temple, which at times got so crowded that people had to sit on the windowsills.

Post-war, these meetings were put on a regular basis, and weekly gatherings of a small group of people that had kept in touch took place at the 'White Horse Tavern' in Fetter Lane, just off Fleet Street. These early meetings have since been made famous by A C Clarke in his collection of tall stories allegedly told at this pub: 'Tales from the White Hart'. The meetings moved to the 'Globe Tavern' in Hatton Garden, following the now legendary landlord Lew Mordecai.

Meanwhile, back in the bar of the One Tun.... Fate is acting in a mysterious way. Instead of being swept away in some gigantic and sudden biblical-style cataclysm, the remnant of the 'London Circle' (what us old hands like to call ourselves) looks fair to being squeezed out of life by a welter of humanity. The reason for the milling crowd around us is that 'Science Fiction Monthly', a rather novel, showy and popular but at times adolescent and garish publication from New English Library, has for several months been mentioning where and when the meetings take place. Gone for ever is the intimate and stimulating gathering of writers, publishers, professional scientists, and just plain fans, meeting for reassurance that it is indeed the rest of the world, and not themselves, that need changing. After Asimov, it is indeed a deluge.

The 'Good Doctor'

This is not to say of course that the 'Good Doctor' as he is known is in any way responsible for the changes that have taken place at the Thursday night meetings. Indeed, my comment was actually occasioned by his renowned reluctance to depart his adopted country. In fact, his visit in June was his first foreign trip since, at the age of three, his parents took him to America from his birth place in Russia.

Although now a popular science writer of world renown and one of the doyens of Science Fiction, Asimov remained a full time academic until the late 1950's when he found that writing was more profitable. He still, however, retains associate professor status with Boston University Medical School. On his visit to Britain he was installed as Honorary Vice President of International Mensa. Not noted by his fellow writers for his reticence about his abilities, he is reputed to have begun a speech to a Mensa meeting with the words "It is a pleasure to at last have an audience with an I.Q. equivalent to mine! Sum total, that is!" A remark such as this can be readily forgiven in a man whose output of books has now reached the phenomenal level of averaging one per month and yet still manages to maintain a consistent and high standard.

'Our World in Space'

One example of this prodigious output that I can particularly recommend to readers of 'Quest' is "Our World in Space"*, a book that charts the possible pattern of our World's progress outwards into space, in the next few decades and beyond. In this book, Asimov collaborates with Robert McCall, the Art Director of '2001, a Space Odyssey' and official artist to NASA. The production is in an elaborate and handsome 'coffee table' style, which in the main succeeds very well. But there is a noticeable divergence between text and pictures for the last two chapters, where Asimov discusses man's eventual exploration and settlement of the outer solar system and his ultimate journey to the stars. This criticism is only of minor importance. Both text and paintings provoke many hours of entertaining speculation. To give just one example, Asimov proposes that it will be 'men' from the low gravity environment of the outer solar system that will be colonizing the universe by 2200 AD, rather than the physiologically and psychologically unprepared 'stay at homes' on the high gravity mother planet, Earth.

Asimov has countered those who chide him on his lack of willingness to travel with the comment "I am perfectly content to sit at home and let my mind wander. And wander it does...... very effectively. In the course of the books I have written, it has wandered from the dawn of the Universe to its end and from here to the farthest star. It has wandered almost over every field of human knowledge without ever growing foot sore". As I crouch in the bar of the 'One Tun' attempting to extract ash from my beer, I deeply regret not having adopted the Good Doctor's policy.

*"Our World in Space" by Robert McCall and Isaac Asimov. (Foreword by Edwin E Alderin Jr) Published by Patrick Stevens Limited, Cambridge, June 1974 pp 176, 72 colour pages, £6.95 pence.

Gerry Webb is a Higher Scientific Officer in the Space Research Group at the Appleton Laboratory.

Solution to Nutcracker 17

4	9	8	8		4	2	4	2
1		4	6	8	4	8		9
7	4	6		0		2	8	2
6	7		1	4	1		5	8
	3	2	8		1	1	6	
6	4		3	3	2		5	1
2	5	8		3		2	6	1
0		3	8	5	1	2		3
4	2	3	3		6	5	3	2

Clue 6 Down should, of course, have read "Twenty-nine Down multiplied by 14 Down".

The winner was K Stone (Rutherford Laboratory) who wins a £2 book token.

Solution to Maxim 8

T	H	I	R	T	Y	S	I	X	C	O	D	A
W	A	N	E	D	O	F	L	E	A	P	I	T
E	R	A	V	I	G	I	L	R	R	I	C	E
N	I	N	E	S	I	X	T	E	E	N	T	D
T	H	E	R	M	O	N	U	C	L	E	A	R
Y	O	R	E	A	V	O	N	T	E	M	P	I
F	O	U	R	L	E	N	T	O	S	P	I	V
I	T	E	M	S	R	E	I	N	S	O	L	E
V	A	C	U	U	M	C	L	E	A	N	E	R
E	L	I	N	H	E	R	E	S	B	U	R	L
H	I	N	G	E	P	A	P	A	L	D	O	E
A	C	T	O	R	S	G	I	B	E	E	L	S
P	E	O	N	D	I	S	C	U	S	S	E	S

John Barrow (Royal Observatory Edinburgh) wins a £2 book token.

NUTCRACKER 18

In "The Gold at the Starbow's End" Frederick Pohl gives the following example of a Gödelised message:

$$1973^{354} + 331^{852} + 17^{2008} + 5^{47} + 3^{9606} + 2^{88} - 78$$

Such a message is encoded by representing the characters of the message by the prime numbers, taken in order, raised to the power represented by the relevant characters (where A = 1, B = 2, etc, a space is zero (φ), and a full stop 27). These numbers are then multiplied together. Thus: "I am". would be represented by $2^{I} . 3^{\varphi} . 5^{A} . 7^{M} . 11^{\cdot} = 2^{9} . 3^{0} . 5^{1} . 7^{13} . 11^{27}$. This is a very large number. (It has 43 digits) but it can be compressed, as Pohl has done, by representing it as the sum of a number of integers raised to suitable powers. To decode, one simply has to work out the sum and factorise it.

Pohl writes "You could not get even the first letter until you had the whole number, and IBM had refused even to bid on constructing a bank of computers to write that number out unless the development time was stretched to 25 years".

Pohl is wrong. What are the first three characters of his message?

Thanks to John Feather of the Department of Industry for drawing my attention to this problem.

Book or record token prize for the first entry drawn.

QUEST

Vol 9 No 1

QUEST

House Journal of the Science Research Council

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1976

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Cover

Cover picture shows an unusual view, taken at a press preview last November, of the Research Councils' Exhibition, at the Royal Scottish Museum, Edinburgh. The exhibition, which has now transferred to the National Museum of Wales, is on view in Cardiff until 28 March.

Photo by courtesy of 'The Scotsman'

Contents

The car of the future?

One of two test vehicles used to study energy requirements and fuel utilisation in conventional automobile drive systems

Work at the University of Warwick, where Dr Mike Hughes and his team have a six-year, £39,000 Council grant, for the study of the feasibility of a hybrid car, has reached an interesting stage. The method of approach is to fit specially designed instruments to a standard car such as a Ford Cortina or a Chrysler 'Hunter' series, to measure and record continuously the vehicle speed, and the torque transmitted via the propeller shaft, whilst the vehicle is being driven 'normally' over selected representative routes. On return to the University after the test, the recorded data is processed, using an XDS Sigma 5 computer provided by the Council, to yield hitherto unknown details of the second-to-second demands on energy from the engine, made by the driver in the course of extracting 'normal' performance from the vehicle.

Further analysis of the data can show how this energy could be supplied, as demanded above to a *hybrid* power train, from *two* or more energy sources, such as a reasonably conventional engine, a bank of batteries, or even a rotating fly-wheel. A popular concept of a hybrid car consists of a vehicle fitted with a smaller than normal conventional engine, petrol or diesel, operating over a carefully chosen, restricted range of power and speed, thus permitting finger tuning for efficiency, and lower levels of exhaust pollutants and noise. This engine would supply the *average* power during a journey, but, to provide for acceleration demands, would be supplemented by energy drawn from electric batteries carried on the vehicle. The *hybrid* characteristic of the scheme is the combination of the mechanical and electrical systems, for which a

SRC supported staff, working on the project. From left to right, back row: Mr D Hurtley (Research Fellow) and Dr M T G Hughes (Principal Investigator). Front row: Mr T M Winter (Assistant Research Officer), Mr J N Devlnpia (Research Officer) and Mr G S Gill (Research Student)

carefully devised control strategy will be required.

It will be an important part of the research project to ascertain whether energy losses due to the additional energy transfer processes required by the hybrid configuration will be more than offset by the extra efficient use of the engine.

Signal conditioning equipment and instrumentation power supplies are carried in the luggage compartment of the test vehicle

Warwick have not re-invented the hybrid car, which has already received attention, notably in the USA. Their 'invention' is their original approach, whereby the analysis of requirements is matched to standard family cars of mass consumer appeal, with the object of examining *real* journeys, complete with full range of known and unknown variables, as opposed to the use of rather arbitrary 'standard' duty cycles, in which particular aspects of vehicle performance have been lumped together in the interests of ease of application. The latter approach is not seen by Warwick as a fair test of a hybrid vehicle, since it fails to examine the effects of actual transient demands on engine and batteries, and it is on the satisfactory handling of these transient demands that the success of the hybrid vehicle will depend.

The Teaching Company

A scheme to provide manufacturing engineers with the industrial equipment of a teaching hospital has been proposed by the Council and the Department of Industry in a recent consultative document called "The Teaching Company". Through the scheme, selected well-managed and successful manufacturing firms would, in partnership with university and polytechnic departments, become "teaching companies" in which young engineers under the supervision of industrial and academic staff would receive training at postgraduate level in the advancement of manufacturing. At the same time, they would help to introduce advances in production and management methods in the collaborating firm. Their practical work would be complemented by instruction at their university or polytechnic.

The scheme, which is intended to improve postgraduate training in manufacturing industry would be financed through the Council, the DOI and the cooperating firms and educational institutions.

The document suggests that programmes at the individual firms and educational institutions would be co-ordinated and cross fertilised by a central administrative group which would provide a sense of unity to all the trainees and staff taking part in the programmes at the "teaching companies". The group would ensure that the results of the research carried out were made known and help to convince schoolchildren and others that manufacturing engineering is an exciting and rewarding profession.

The Council and the DOI intend to decide this year whether to adopt the proposed scheme and are inviting comments on the proposals. In the meantime, limited programmes have started at four prospective companies. In consultation with the Social Science Research Council, SRC and the DOI have appointed a working party under the chairmanship of Professor L Maunder of Newcastle-upon-Tyne University to consider the comments made on the proposals, ensure that the first programmes proceed satisfactorily and recommend how the scheme should be developed.

Council Commentary

October to December 1975

Membership
In October, the Council welcomed Professor Jinks (Birmingham University) the new Chairman of the Science Board, and Professor Polkinghorne (Cambridge University) as new members.

The Council formally agreed a resolution seeking Privy Council approval to an amendment of the Council's Charter. The proposal is that the maximum size of the Council be increased from a Chairman and fifteen members to a Chairman and eighteen members, of whom not more than four should be Departmental members. The proposed increase will allow the balance of academic members to be improved while maintaining membership from industry and government.

(Note: Formal approval of the proposed amendments to the Council's Charter has now been obtained.)

Finance
(*i*) *Estimates 1976/77*
As part of the government's counter-inflation policy, the basis of updating Estimates allocations for inflation has been altered by the new "cash-limits" procedure. Although the Government has still to announce its Public Expenditure plans, the Council expects to receive a 1976/77 Estimates allocation about £6M lower than would have been expected under the previous system. In November, the Council, following a meeting of Board Chairmen, agreed a 1976/77 Estimates submission of £113M.

(*ii*) *Guidelines for the Forward Look 1977/78–1981/82*
In November, the Council approved the financial guidelines to be used by Boards in preparing the 1977/78–1981/82 Forward Look. The Council's Forward Look will be submitted to the Advisory Board for the Research Councils in April 1976. Provisional DES guidance suggests that the Council's resources after 1976/77 will be reduced by about 2% per year in real terms until 1980/81. This provisional planning assumption will be reviewed in the 1976 Forward Look exercise.

December Review Meeting
In December, the Council held a special review meeting with Board representatives at Reading University. The main issues discussed were the SRC methods of supporting research in universities and polytechnics and the related SRC policy on extramural research manpower. Proposals arising out of the meeting will be considered at later Council meetings.

Postgraduate Training
(*i*) *Postgraduate Awards*
The take-up of studentship awards in 1975 is expected to be about 3550 compared to the 3620 awards available, of which Co-operative Awards in Science and Engineering (CASE) are expected to number over 300 compared to the target of 240. There were nearly 200 unsuccessful appellants in Science (including NP and ASR). However, the Council was particularly pleased with the increased take-up of CASE awards.

For 1976 Council has decided to make 3300 awards available. The reduction in awards compared to 1975 reflects the reduced numbers expected to graduate in science and engineering in 1976 (3% and 8% respectively) and also the pressure on the Council's funds. Council agreed that the allowance for CASE studentships in 1976 should be 310 although extra awards will be made available as necessary.

(*ii*) *SRC Postgraduate Training Reports*
SRC has recently published two reports* on postgraduate training, namely the Report of the Working Group on Postgraduate Training under the Chairman and the Second Report of the Joint SRC/SSRC Committee Report. The reports have been widely circulated for comment to all interested parties and Council in October agreed that it should hold a series of regional meetings to allow the academic community to discuss the Council's future policy on postgraduate training in the light of the two postgraduate reports. The meetings will also discuss the Council's new methods of supporting research following the Reading Review Meeting (see above). Universities and polytechnics will be invited to nominate academic representatives to attend the meetings. It is hoped that some postgraduate student representatives and industrial members of the Confederation of British Industries, the Council of Engineering Institutions and the Council of Scientific and Technical Institutions will also attend.

* For details see Council Commentary in Quest Vol 8 No 3.

Data Compilation

SRC took over responsibility for the compilation of critical data in April 1974 and the Council subsequently set up a Data Compilation Committee to advise it on the organisation and extent of SRC support required in this field. Council in accepting the recommendations of the first interim report from the Committee, at its November meeting, endorsed the Committee's highly selective approach to the establishment of new data bases and agreed that Boards and Committees should be invited to consider whether there are any areas within their remit on which the compilation of data should be encouraged by SRC. Council also agreed that the remit of the Committee should be broadened to advise generally on scientific and technical information matters.

Astronomy Space and Radio

(*i*) *Termination of the Skylark Programme*

Council in November endorsed the decision of the ASR Board to terminate the standing Skylark Rocket programme. There will be a controlled run-down of the programme and by 1978 a saving of £4M per annum will result. The Board took this decision in order to ensure that some new projects can be started before the end of the decade. Council expressed its appreciation of the willing co-operation provided for this successful programme by RAE Farnborough, BAC Ltd and the Australian authorities over some 20 years.

(*ii*) *EISCAT*

In May 1975, Council gave conditional approval to UK participation in the proposed collaborative European Incoherent Scatter Facility (EISCAT)* by provision of a VHF transmitter. It had since become clear that a combined VHF/UHF transmitter would provide significant savings. The Council reaffirmed its approval of UK participation in the proposed VHF/UHF EISCAT project and agreed to contribute £2·4M towards its capital cost subject to DES approval. [N.B. This scheme has now been approved and the six-country EISCAT Association has come into being.]

(*iii*) *IRAS*

In November, Council agreed in principle, subject to DES approval, that SRC should participate in the Dutch/NASA Infra-red Astronomy Satellite (IRAS), the spacecraft for which will cost about £22M. This project will carry out the first infra-red satellite sky survey and its results are expected to have a major impact on the future of the fast developing subject of infra-red astronomy. Council has agreed that the UK should provide a fixed price contribution of £2M to the project, together with an offer of observing time on SRC facilities for Dutch astronomers. In return UK scientists would have immediate access to the survey results and the bulk of the UK contribution will be spent on contracts with British industry.

(*iv*) *Northern Hemisphere Observatory* (*NHO*)

The Council in November received a progress report for 1974/75 on the NHO project and proposals for its next phase. The main development was that La Palma was now the preferred site for the proposed Observatory. It was hoped that, under an international convention, an institute for astrophysical research would be established, which would allow a number of European countries (including the UK) to use this observing site. The Council reaffirmed its full support for the project and approved the proposed scheme which included the modification and transfer of the Isaac Newton Telescope (INT) to La Palma from RGO. Formal DES approval will be sought for the various phases of the scheme at appropriate times.

(*v*) *Revised Costs of UK-6 Satellite Project*

The Council approved increases in cost of the UK-6 project of nearly £1·4M arising from increased NASA launch costs and slippage of the project. The approved cost estimate for the project up to launch, now planned for January 1978, is £7·557M.

(*vi*) *Replacement of the Appleton Laboratory's Argus Computer at Chilbolton*

The Council in October approved the proposed replacement of the Chilbolton Argus computer by a 2 processor system at a cost of up to £110K.

(*vii*) *Research Grants and Contracts*

The Council approved:

(a) additional costs of £304K for the Multi-Telescope Radio-Linked Interferometer project of Professor J G Davies (University of Manchester);
(b) an SRC contribution of £164K towards the costs of the Mullard Radio Astronomy Observatory (University College, London) for the calender year 1976;
(c) the placing of a contract with Imperial College London for the continued operation of the 1·5m flux collector at Tenerife until 31 December 1977 at a cost of £111K.

Nuclear Physics

(*i*) *EPIC*

Council learnt at its November meeting of the decision of the German government to proceed with the PETRA project. They welcomed this far-sighted decision but noted that it meant the end of the imaginative EPIC project.

(*ii*) *NP Board Committee Structure*

Council approved the revision of the NP Board Committee structure. The four main committees,

* See Quest Vol 8 No 2.

SRC Whitley Council

Inaugurated in December 1965, its constitution provides the machinery for consultation between the SRC's administration, in its capacity as employer, and its non-industrial staff, as represented by members appointed by staff Associations having members employed by SRC, with a view to securing the greater measure of co-operation to increase efficiency in the SRC combined with the well being of those employed. While the full Whitley Council meets only once a year, consultations and negotiations between the Official Side and the Staff Side are conducted both by informal contacts and through discussions in sub-committees of the General Purposes Committee which is the main negotiating body of the Whitley Council. Apart from the Staff Side Chairman and Secretary, who are given secondment full time from their official duties, all time devoted to Staff Side activities by other members is purely of a voluntary nature.

Picture shows backrow (from left to right): Dr E Dunford, Miss J Donohue, Mr P Seager, Mr P Casey, Mr W M Bray, Mr J T Reader, Mr R St J Walker, Professor V C Reddish, Mr M W Message, Dr J M Valentine, Mr A H Spurway, Professor A Ashmore, Mr R Edmonds, Mr A J Egginton; front row (from left): Mr R F Childs, Mr G Scott, Miss C J E Penny, Mr J D Clenaghan, Miss A C Hilton, Mr F Farrimond, Mr R W H Morgan, Mr V Foley, Mr J H Aram (Vice Chairman), Professor Sir Sam Edwards (Chairman), Mr B E Broughton, Mr J B Visser, Mr M O Robins, Dr J A Saxton, and Dr A Hunter

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Council Commentary *(continued)*

Film Analysis Grants, Nuclear Structure Grants, General Grants and the Laboratories Committee, will be wound up and replaced by two main committees, Particle Physics and Nuclear Structure, with a Nuclear Physics Theory Sub-Committee to advise each Committee on theoretical studies. The Film Analysis Grants Committee will become a sub-committee of the Particle Physics Committee. The NP Board will also establish a Standing Committee on all matters relating to CERN.

(iii) Nuclear Structure Facility

Council approved an increase in the capital cost of the NSF project of about £1·9M bringing the approved revised cost £9·856M (at June 1975 prices). The increase was due to inflation rather than design changes but, in view of the financial climate, some re-phasing of the project might be required.

(iv) Enhancement of the Rutherford 370/195

Council approved enhancement of the Rutherford IBM 370/195 computer at a total cost of £240K. This would allow upgrading of the magnetic tape system and purchase of a second block multiplexor and eight Menorex disk drives.

(v) Research Grants

Council has approved consolidated grants for the five major Film Analysis Centres (namely Birmingham, Glasgow, Liverpool and Oxford Universities and Imperial College London) totalling £981K for the year ending 31/1/77 subject to some reductions by the NP Board.

Approval has also been given to two grants to allow nuclear structure research groups at Birmingham and Oxford Universities to utilise Harwell accelerators. The grants total £240K for the year ending March 1977. The Council has also approved an annual consolidated grant of £109K to Birmingham University for nuclear structure research for the year ending January 1977.

Science

(i) Purchase of a Nuclear Magnetic Resonance Spectrometer

The Council approved the purchase of a WH 180 WB nuclear magnetic resonance spectrometer at a cost not exceeding £150K to provide a general service. The location of the spectrometer is still to be decided. This instrument uses a super-conducting magnet with a very large bore, enabling high-resolution NMR spectra to be obtained from samples as large as 25 ml.

(ii) Research Grants

The Council approved a grant of £109K over three years to Professor M M W Thompson et al Sussex University for the study of particle-solid interactions.

SRC and noise control

More than half a million people, in the manufacturing industry alone, work in an environment which may cause permanent deafness unless precautions are taken. These facts came from a survey carried out by the Factory Inspectorate for the Industrial Health Advisory Committee. In 1972 a code of practice was issued, which recommended maximum acceptable noise levels for the protection of industrial personnel and it is likely that legislation will follow.

The present state of noise control is such that reduction of noise levels to acceptable limits (at present 90 decibels—roughly equivalent to the noise of a motor-bike revving up), is sometimes extremely difficult. Many industrial users are already pressing manufacturers to provide machinery with noise levels substantially lower, to meet any possible further lowering of acceptable limits, or to improve the working environment in their factories and the cumulative noise levels of machinery within a localised area.

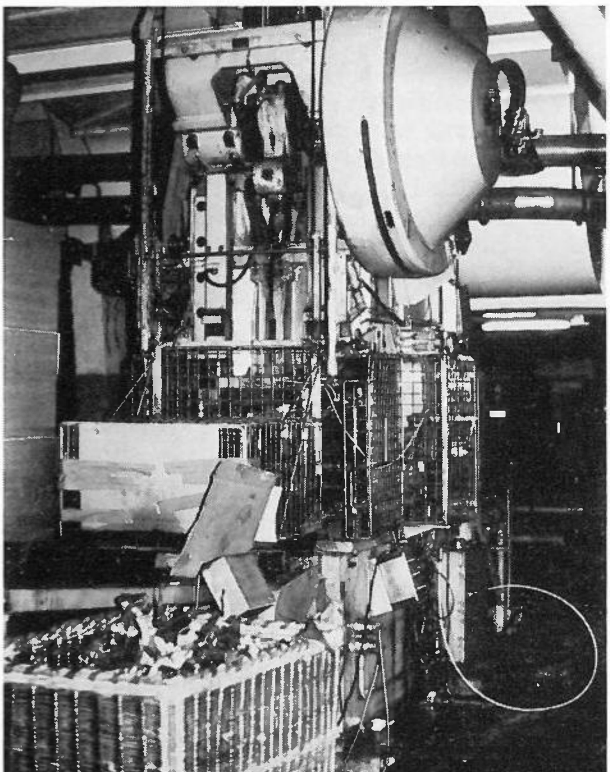
An appropriate grant in this field of study, is one which the Council made last summer, when the Institute of Sound and Vibration Research at Southampton University was awarded a three year £121,000 grant to study industrial machinery noise and to find ways of reducing it.

The grant will establish an Industrial Noise Research Unit under the direction of Professor E J Richards. He founded the Institute, which has a world reputation in matters of acoustics, some eleven years ago and has given up the Vice-Chancellorship of Loughborough University to lead the Unit.

The Unit's work will be related to deafness in places of work such as factories, lorry cabs and construction sites. Its first objective is to collect information on the fundamental nature of the most serious noise problems in factories or offices. This survey of industry will be carried out with the help of both the Health and Safety Executive and, of course, relevant industrial firms. Then research will be undertaken to develop quieter but still practical techniques of production for industry.

Fundamental work on reduction of noise from individual sources within machines will be complemented by studies of the combined effects of the many different sources in entire installations: for instance noise from manipulative machines and mechanical noise in hand-held tools and woodworking machinery.

The Unit will establish close links with industry, and research into modifications of entire machines will take place both at industrial sites and at the Institute using machinery loaned by industrial companies. The Unit ultimately aims to help industrial users and manufacturers of machinery to reduce levels of noise by the production of design guides, the dissemination of advice through the advisory service of the existing Wolfson Unit for Noise and Vibration Control at the University, and by offering short courses on noise control.



Picture shows a typical press used in an industrial process. It is used to press out small containers (such as freezer containers) from aluminium foil sheet

Preserving our resources

Recent speakers at the Rutherford Laboratory's monthly general lectures have highlighted the problems of the world's limited energy resources. Gordon Fraser, the lab's new resident technical editor took time off from editing to report for Quest on these topical issues. In the first lecture Dr John Davoll, Director of the Conservation Society, took a pessimistic view, saying that the whole motivation of industrialised society is 'mad'.

"The whole drive of industrialised society, judged on anything but a short-term basis, is mad," alleges Director of the Conservation Society Dr John Davoll, comparing the situation to the philosophy of Captain Ahab, who said "All my means are sane: my motives and object mad".

"The outcome of an exponential growth of technological skill inspires fear rather than admiration," Dr Davoll says. "A minimum of eight billion people living in a highly industrialised world would be supported by a huge technological equivalent of the biosphere, with wastes being recycled by energy from thousands of breeder reactors, fusion reactors and orbiting arrays of solar cells."

"With a population and level of economic activity far beyond the capacity of the battered remnants of the biosphere to support, it will be necessary for our only partially sane species to manage the mechanism for ever, phasing in new resources exactly as needed."

"Consider the life this would offer," Dr Davoll continues, "Human behaviour would need to be wholly predictable and controlled in a highly optimised physical and organisational structure which itself could be highly unstable—a prospect which makes the effects of today's malaises seem like momentary unease."

Dr Davoll basically questions the need of industrialised society to continually increase its flow of goods. Only a minor fraction of the world's energy output goes into providing warmth, food and shelter while the remainder goes into increasing the flow of consumer goods demanded by the developed nations.

Turning to possible solutions to resolve the world's energy problems, Dr Davoll proposes that it is quite possible that a more labour-intensive system, using maximum recycling of wastes, could supply an adequate, if largely vegetarian, diet indefinitely for the whole population of the world.

He declares that in future our economy will need to be based on stock in which durability, ease of maintenance and design for reuse and recovery are especially important. Overall a change of emphasis is required away from progress as an increase in material possessions by the individual towards progress which strives for a more broadly satisfactory society and for pride in common achievement.

"The acceptance of the idea of an economically steady-state society is essential if an adequate environmental policy can be set up before the present one begins to break down," he asserts, warning that the present growth patterns in both population and consumption have considerable inertia and cannot therefore be modified within the space of a few years. Once the rot sets in and shortages of essentials become severely felt, there might be little chance of peaceful change.

Another problem he declared is that the majority of people have no wish to exchange the high standard of living which they enjoy today for nebulous promises of a better environment and they are therefore reluctant to advocate any changes which might make their position perilous.

"I do not believe that my assessment of the situation should lead to despair, or to any abandonment of action," concludes Dr Davoll. "Continuous growth can only be a limited phase, insignificant in terms of length to the span of human history, and eventually we will be forced back to a lower level of population and economic activity. This will involve crossing unknown but perilous social terrain, and the further we continue to grow economically, the longer this journey will be. But understanding that growth could never have solved our problems anyway, may make this journey a little easier."

A few weeks later, Ian Glendenning of the Energy Studies Group at the Central Electricity Generating Board's Marchwood Engineering Laboratories proposed that natural sources of energy, particularly wave power, could provide important new sources of energy to satisfy the needs of an energy-hungry society.

With the increasing awareness of the limited resources of fossil fuels and even nuclear fuel available to mankind, some people have begun to look to the possibilities of apparently limitless power available from the sun, the earth, the atmosphere and the oceans. Scientists from the CEGB's Research Department have been looking at the prospects which these natural power resources offer.

"Despite the fact that Britain is one of the windiest places on earth, a barrier of windmills around the entire coastline of the British Isles would provide only a small fraction of the country's power requirements—less than ten per cent of the present installed capacity in the UK" says Ian Glendenning, head of the long-term studies group at Marchwood.

Apparently the economic generation of electricity by wind power only becomes feasible when the average wind speed exceeds about nine metres per second, and a survey conducted some years ago by the Electrical Research Association found only thirty nine sites in the UK which were suitable.

"Wind power," says Mr Glendenning, "is therefore not likely to make a major contribution to the country's overall power requirement, but individual small stations, say of about 1MW capacity, might be useful. Moreover the Dutch, with a deep-rooted tradition of windmills, are apparently considering a national windmill research programme."

Another potential source of energy with which Britain is particularly well-endowed is ocean tides. The waters around Britain have a wide range of tidal patterns, and a French pilot scheme has been in operation for many years, in the Rance Estuary, off the coast of Brittany, but has encountered problems with silting, Mr Glendenning points out.

Electricity is produced from tidal energy by trapping a high tide behind a barrage and making it drive water turbines as it returns to the sea at low tide, explains Mr Glendenning. Because the available energy is proportional to the square of the tidal amplitude, about two-thirds of the available tidal energy around Britain is concentrated in the Severn Estuary, he continues. This source alone could provide up to 10 per cent of the country's present power consumption.

But the energy available from just two high tides a day means that a single barrier is not sufficient if a constant supply of energy is to be made available. One way to do this, Mr Glendenning suggests, is to construct multiple barriers so that water can flow from one to another at various times of the day, so ensuring a more or less constant output of energy from a limited number of high tides.

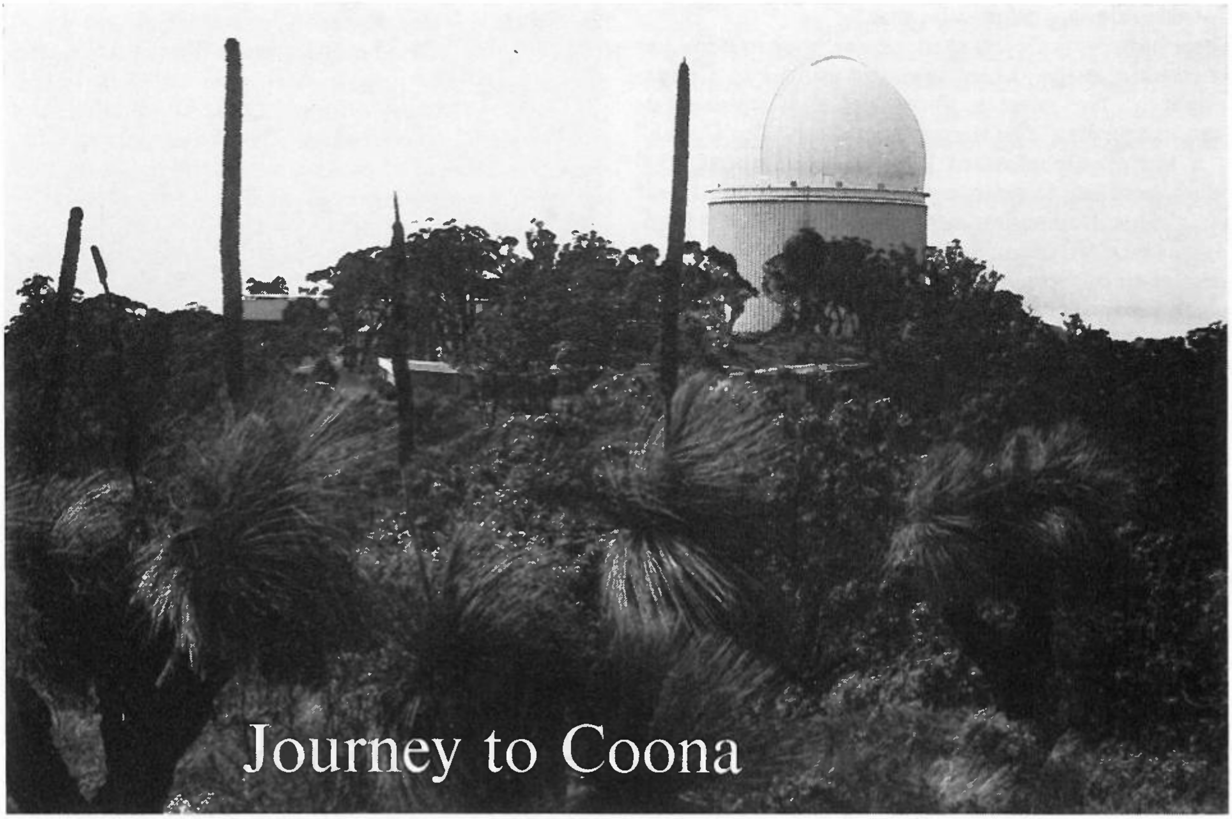
Another problem is that tidal energy cannot be exploited piecemeal. Unlike a windmill solution where more and more windmills can be constructed as time and available resources allow, generation of electricity from tidal energy demands the construction of some vast installation, with all the difficulties and uncertainties which such a large project entails.

As well as the tides, the water waves themselves can be considered as new sources of electrical energy. Again Britain has an ample supply of wave power, and, as Mr Glendenning points out, it has a seasonal peak in the winter which closely matches the demand for electrical power. On the debit side, the available power is not predictable and adequate storage or standby units would be required to provide the necessary output during calm weather.

Mr Glendenning tells of a floating 'duck' which has been developed to extract power from waves and is thought to achieve conversion efficiencies of up to 90 per cent, many times that of other mechanisms which have been proposed.

Before wave power can be exploited on a large scale, there are technical difficulties to be overcome, for instance the provision of adequate cables to bring the current to dry land where it is needed. Alternatively large power-consuming units could be based on floating platforms.

Initial work in the laboratory had produced schemes for converting wave power to electricity which are highly efficient and look promising, and that only a relatively small investment would be required to produce a working prototype wave power plant, concludes Mr Glendenning. If this were successful, a concerted wave power programme could make a significant contribution to the country's energy resources within a relatively short time and within the existing technological framework.



Picture shows the AAT dome seen from grass trees standing just below the summit of Siding Spring Mountain

D ALLEN

The seasoned astronomer must be congenitally nomadic: globetrotting is his way of life. If not at a conference in an Austrian ski resort he may find himself lazing on Waikiki Beach as a prolegomenon to tackling the rigours of cold nights on the bare mountain of Mauna Kea. In his stride he takes day-long flights to South Africa or the States. So when the roulette wheel of research fellowships stopped with "Anglo-Australian Telescope" displayed, shoulders were shrugged, visas acquired and suitcases packed.

Flight delays

All travellers have tales to tell, spicy morsels to toss in at the dinner table. If the Sydney radio announcements of international flight delays are acceptable evidence, Qantas passengers get more than their fair share. We were no exceptions: scarcely had we left behind the bustle of Amsterdam airport than two explosions jolted the starboard wing. A voice from the flight deck calmly announced that we were returning to London on three engines. We eventually limped into Sydney on Good Friday morning, twenty six hours late, to find a Marie Celeste city basking in what to us was an oppressive heat wave. (The radio stations continually insisted it was mild).

Observatory headquarters

The headquarters of the Anglo-Australian Observatory is in Epping and presently occupies three cramped portable huts in the grounds of the CSIRO Division of Radiophysics, the abode of most of Australia's radio astronomers. More spacious accommodation is under construction. It seems a far cry from the castle at Herstmonceux, but the mocking calls of mallards on the moat have been freely translated into the comic cackling of Kookaburras in the gum trees (memo: only toffee-nosed Poms call these trees eucalyptus). Epping is a pleasant enough suburb sporting much of the forests that must once have reminded settlers of the Motherland. It lies about ten miles from the cosmopolis, in the nor'west quadrant, and is spread thinly across an undulating counterpane of rounded hills and shady streams. Our first impressions of Sydney were of its similarity to California. The spacious streets, wooden bungalows, rows of used car lots and garages and the hint of photochemical smog in the air all stirred dormant memories of the Los Angeles basin. But on closer acquaintance we found Sydney to have a character of its own—unique Australiana glazed with only a thin Anglo-American veneer. Sydney is, in fact, quite a nice city.

Coonabarabran—"inquisitive man"

Three hundred miles by road, or one hour in a Fokker Friendship, takes the enthusiastic nomad to Coonabarabran. The name is aboriginal and translates as "inquisitive man": a fitting site for the AAT. "Coona" is a thoroughly pleasant little town of about 3000 people set close to a range of volcanic peaks that bear the almost Dickensian name Warrumbungle Mountains. The AAT sits on Siding Spring Mountain, one of the highest of these, at an altitude close to 1200 metres, which for the benefit of non-metric readers is about as high as the Cairngorms. It is remarkable how many major observatories are sited on volcanoes; in case persons of nervous disposition read this I should hasten to add that the last eruption of Siding Spring Mountain occurred about 13 million years BC. From the catwalk around the dome there is an extensive view over the bluffs and pinnacles of the Warrumbungles to the inland plateau which stretches from their feet towards the sunset and the edge of the world. The same view is shared by the bedroom windows of the observers' lodge and is the most beautiful from any observatory I have visited.

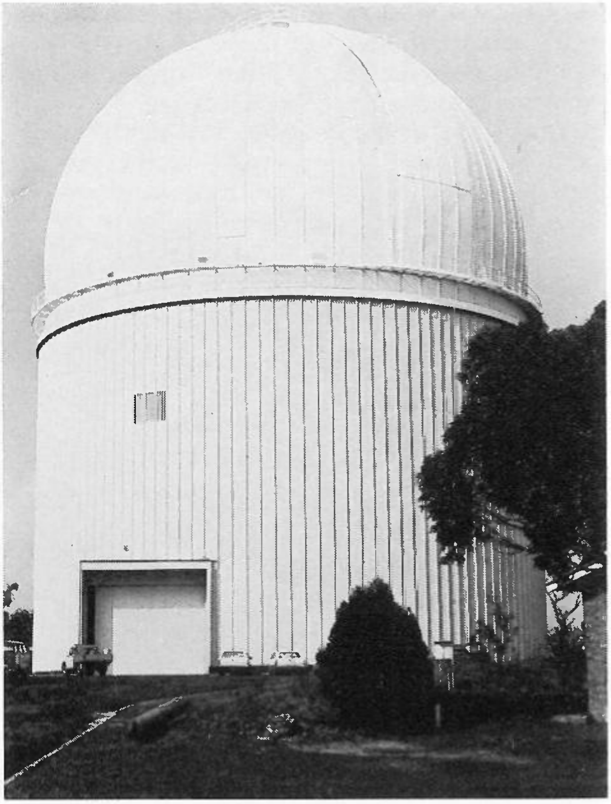
I used to believe that the 200-inch Palomar reflector was the finest telescope in the world. I have had to revise my judgement. The new generation of 4 metre telescopes marks a pronounced step forward in astronomical technology. Three giant eyes have been completed in the past few years: one at Kitt Peak, the sacred mountain of the Papago Indians of southern Arizona; one on the foothills of the Andes just inland from the southernmost tip of the Atacama Desert; one on Siding Spring Mountain. From the meagre comparisons I can make, the AAT is the best of these: it surely deserves to be, it cost the most.

The tourist's view

To the average tourist who stops off on his way through Coona and makes the pilgrimage to the visitors' gallery it is no more than a gigantic piece of machinery that, like the ark, has run aground on a mountain top. This average tourist may be impressed by its sheer size, by the soaring grace of its horseshoe mounting, or the confident way it sweeps across the dome at the controller's merest fiat. More likely he will be impressed by its sleek pastel paintwork or by the rich wooden floor of the dome.

The computer's role

The observer, however, sees a whole new dimension to the telescope when he enters the control room. The buzzing of line printers, the hiss of tape decks and the random flashing of lights tell him that he has entered the den of a pack of computers, and indeed almost all the functions of the telescope are controlled by these beasts. The setting to any desired star, the tracking of that star across the sky, the rotation of the dome: all



The massive dome of the AAT stands over 50 metres high, its top is the highest point for over 50 miles

are computer controlled. For many purposes the taking of data is also automated. Gone are the long nights of discomfort when numbed fingers manipulate ice-cold knobs and levers, when red-rimmed eyes strain to focus a star barely bright enough to stir the rhodopsin into action. Much of the observing is performed in the fleshpots of the computers' den, a television screen replacing the eyepiece, a teletype instead of a spectrograph at the fingertips.

When the observing gets to be a little boring, a video disc can bring back one of the prettier objects observed last night or last month. I shouldn't be surprised if they soon start to intersperse the starfields with adverts. Nor is this all mere showmanship. Under computer control the telescope sets, guides and manipulates far better than in the hands of all but the most experienced observers. This giant hulk can be aimed at any chosen star with an accuracy of 2″ arc, which means that it is theoretically capable of selecting the left or right eye of a man three miles away across the Warrumbungles. Alas we are precluded from attempting this experiment: the telescope cannot be pointed close enough to the horizon.

The AAT is a humbling instrument, and not just because of its size. A great deal of money and effort has been put into making this telescope the best available to the astronomical community; the observations that come off it should repay this confidence, which in turn means that the astronomers who use it are under some pressure to select the most rewarding observing programmes. In addition to the director, therefore, six staff positions have been created to provide a nucleus of observers who will be familiar with the telescope and will be able to use it to the full. Two UK fellowships tenable at the AAT were also created by SRC to further swell this nucleus. Aside from the directorship, all staff positions and fellowships are for terms of 1–5 years, so there will be a continuous infusion of new blood and hence new ideas.

Siding Spring Mountain

The massive dome of the AAT does not stand alone on Siding Spring Mountain. There are three smaller telescopes operated by the Mount Stromlo Observatory, Australia's long established astronomical centre in Canberra. Here too is the UK 48-inch Schmidt telescope, busily engaged in mapping the southern sky. The proximity of the Schmidt and the AAT is valuable, for interesting discoveries made on the former can be quickly followed up with the larger instrument. With just a smidgeon of luck we might make some of our better discoveries this way.

The astronomers do not rule Siding Spring Mountain, however. In the dead of night most people opt out of driving round the summit area. This is not in deference to the observers' distaste of headlamps. Rather it is to avoid antagonising the true owners of the mountain top. From sunset to dawn, when astronomers are safely tucked up in their domes, Siding Spring resumes its time-honoured role: playground of the grey kangaroo. What right have we to displace them?

David Allen holds an SRC Fellowship tenable at the AAT. Prior to going to Australia in March 1975, he worked in the Astrophysics Division at the Royal Greenwich Observatory.

Select Committee Reports on Scientific Research

Scientific research in British universities, including the activities of the Science Research Council, is the subject of a new report from the Science Sub-Committee of the House of Commons Select Committee on Science and Technology which was widely reported in the national press.

While noting the 'high regard' in which many British scientific institutions are held by their counterparts overseas, the Sub-Committee does not think that all is well with the British system of research funding, saying 'we are deeply disturbed about the effectiveness of the universities' present contribution to the national scientific effort and believe that considerable changes in attitudes and practice may be required. This question will be the subject of further study, but the principle of enabling the universities to provide their staff with independent facilities for research is one we support."

The Select Committee employed a consultant to study SRC grant-giving who reported on the statistics he had gleaned from SRC's published data. He concluded that "there is room for further study of the extent to which the existence of a handful of highly favoured university scientists may influence the formulation of SRC policy." However, as an editorial in 'Nature' has noted, and as will be obvious to any member of SRC staff who follows the way grant-giving goes on, the consultant has completely misread the statistics and made elementary blunders in interpretation (SRC was not asked to verify any of the work).

Although the Sub-Committee acknowledged that there were difficulties in dealing with large numbers of grant applications and that dissatisfaction among disappointed applicants is inevitable, it nevertheless recommended that "the element of uncertainty, particularly when applications are made for the renewal of grants" could be reduced to a minimum, citing the example of an overseas research council which provides additional grants to cover the period after the termination of research grants to help staff readjust to a new situation.

The Sub-Committee agrees with the SRC's view that improved methods of support for 'engineering research' are needed and that the requirements in this direction of the natural sciences and the engineering sciences are different, but rejects the idea of the creation of a separate 'Engineering Research and Development Council', saying that this would represent unnecessary bureaucracy."

Instead, the Sub-Committee says that there would be 'merit' in renaming the Council as the 'Science and Engineering Research Council', as this would emphasise the SRC's national role for funding research in both science and engineering.

The Sub-Committee also endorses the SRC's own recommendations that "a substantial improvement is needed in the training of future research workers and particularly for those many scientists and technologists whose careers should be outside the confines of research." It agrees with the views of the Council's own specially-appointed working party which recommends that broader, less specialised postgraduate education is called for, and that a number of research studentships should be awarded competitively to students who would then be free to choose the subject of research at any university with any supervisor. Some students could be selected by the SRC to work on particular topics of national importance.

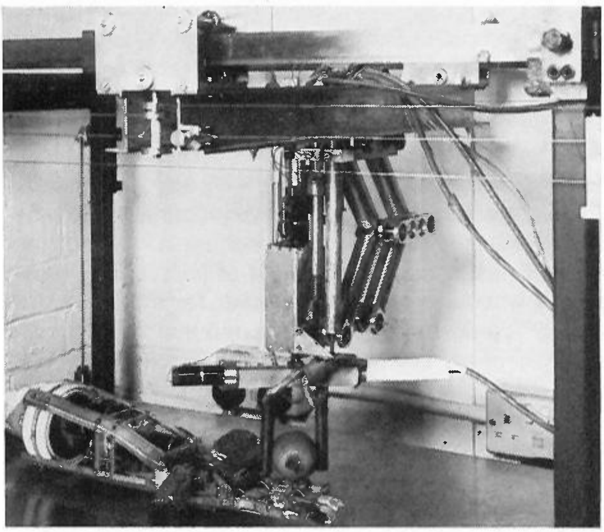
First Report from the Select Committee on Science and Technology—Second Report on Scientific Research in British Universities. HMSO, 75p.

The mechanical manipulator

Professor J M Nightingale of the Department of Electrical Engineering, University of Southampton has a £14,000 grant from the Council to investigate the automatic control of prehension and manipulation and here he explains the purpose of the investigation.

"Over the years the design of manipulating machines incorporating and extending the skills of the human beings has been of great interest. While outlets for this effort have existed in diverse fields of application there has also been a basic fascination for hand-like devices.

This project is concerned with the tactile properties of a mechanical manipulator and in particular with control systems which may be employed to achieve flexibility and reliability of operation. The work is being undertaken with a view to application in automatic assembly, inspection, testing etc. However the principles underlying the systems being developed have been conceived and tried in a different field, namely, powered artificial hands for amputees. While the overall aims are quite different here, many of the control concepts are equally applicable and we are drawing heavily on an earlier work on an adaptive multi-degree-of-freedom prosthetic hand. This earlier work, which has been sponsored by MRC and DHSS as well as SRC, has reached the advanced stage of clinical assessment.



Picture shows the mechanical manipulator in action

Our approach to control of prehension has involved a multi-level control system. The key to this is a sensory system which measures contact points, operating forces, joint angles etc. These sensors are incorporated in fast reflex loops which achieve particular actions. Intermediate levels in the control hierarchy adapt the shape of the manipulator to the object contours and also vary the forces to correspond to a number of basic commands such as hold, squeeze, manoeuvre, release etc. These systems receive many feedback signals from the lower system but they are activated by a few inputs from a high level logic system which interprets simple decision signals as appropriate commands. In this way the manipulator is able to operate on a very low level of "conscious command" from the input, just as does the neural system which controls our own limbs. This greatly simplifies the task of controlling such devices in terms of the communication rate required."

Royal Observatory Dinner

In their heyday dinners given for the Board of Visitors of the Royal Greenwich Observatory were gargantuan and it is impossible to resist the temptation to give the menu submitted by the manager of the nearby Ship hotel in 1889.

Royal Observatory Dinner

Sherry	Thick or clear soup
Hockheimer	Flounders Souchée
Bordeaux	Lobster Rissoles, Fried Slips
	Whiting Pudding à la Crémiere
	Stewed Eels à la Bordelaise
	Grilled Trout. Tartare Sauce
	Crab Omelettes
	Salmon Cutlets à l'Orientale
	Whitebait, Plain, Black and Red devil'd
Champagnes	Timbales Foie Gras Périgord
Irroys	Fore quarter Lamb. French Beans and Potatoes
Delbeck	Ducklings and Green Peas
	Asparagus
	Devilled Ham and Tomato Salad
Liqueurs	Jellies, Creams, Pastrys
	Ice Puddings
Port	Dessert
Margaux	Claret Coffee

20 Courses and Dessert Wine, inclusive attendance, 25s. per head

(*P S Laurie The Board of Visitors of the Royal Observatory. Q J Royal Astronom. Soc., 8, No 4 1967*)

Newsfront

Professor H A Brück CBE

Hermann Alexander Brück retired on 30 September 1975 from the Directorship of the ROE and the combined posts of Regius Professor of Astronomy in the University of Edinburgh and Astronomer Royal for Scotland.

He was born in 1905 and his early education in Berlin imparted a life-long love of the classics as well as a strong interest in physical science. Although born into a military family, he became determined to follow a scientific career. Studying at the Universities of Bonn, Kiel, and Münich, he came under the influence of Sommerfeld, and it was in the new field of wave mechanics that he gained his first doctorate. On Sommerfeld's advice, and in the footsteps of his friend Unsöld, he decided at first to work on the application of the new atomic physics to astronomical problems. In Potsdam, however, joining the Einstein Institute in 1928 and the Astrophysical Observatory in 1930, Brück became interested in the newly developing field of the structure of our Galaxy. He pursued this work when in 1936, increasingly unhappy in the political atmosphere of Germany, he joined the new Vatican Observatory at Castel Gandolfo.

His long-cherished ambition to work with Eddington at Cambridge was fulfilled in 1937 when he was appointed to a post at the Solar Physics Observatory, later becoming chief assistant and John Couch Adams Astronomer. His work there included solar physics and the development of photoelectric equipment for accurate solar spectrum scanning; and many present astronomers are grateful to Brück for his encouragement during their undergraduate days at Cambridge.

Professor Brück at his farewell reception

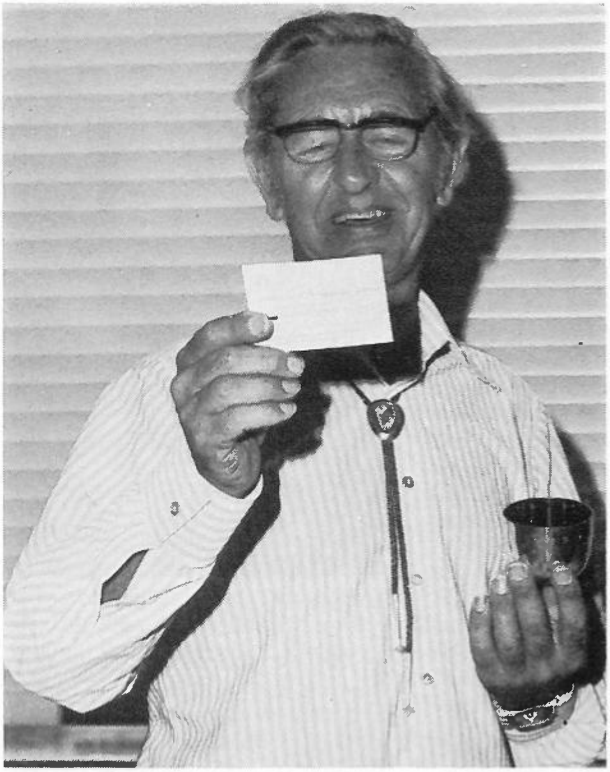
In 1947 he was invited by Eamon de Valéra, Prime Minister of the Irish Republic, who had a life-long personal interest in mathematics and astronomy, to re-open and modernise Dunsink Observatory. Formerly belonging to Trinity College Dublin, the Observatory had been closed since 1921, and on its re-opening was incorporated in the Dublin Institute for Advanced Studies. Telescopes for solar spectroscopy and stellar photometry were set up at Dunsink, and in co-operation with Armagh Observatory in Northern Ireland and Harvard College Observatory the A D H Schmidt telescope was established at the Boyden Observatory in South Africa for research in southern-hemisphere galactic astronomy. A notable event during Brück's directorship at Dunsink Observatory was the Dublin meeting of the International Astronomical Union in 1955.

While he and his staff gave many public lectures in Ireland, Brück missed the University teaching that he had enjoyed at Cambridge. He was therefore happy that the Edinburgh post, to which he was appointed in 1957 following the death of Professor W M H Greaves, combined the Regius Chair of Astronomy with the directorship of the Royal Observatory. To the traditional first-year lectures in astronomy, he added a new honours course in astrophysics run jointly with the Department of Physics. During the years from 1957 to 1975 he transformed the Royal Observatory from a modest observatory promoting national facilities to a major establishment. He encouraged the development of automatic plate-measuring equipment and the extension of optical observations into the ultra-violet and infra-red, established an observing out-station at Monte Porzio near Rome, and set up a project for world-wide testing of potential sites for a national northern hemisphere observatory. Brück valued the link with the Scottish Home and Health Department under which the observatory operated during his early days, and regretted the transfer to the London-based Science Research Council in 1965.

Brück is a Fellow of the Royal Society of Edinburgh and a Member of the Royal Irish Academy, and for twenty years a member of the Pontifical Academy of Sciences in Rome. He received honorary doctorates from the National University of Ireland and the University of St Andrews. In the 1966 New Year Honours he was made a CBE.

He has retired to a gracious house in the country near Edinburgh, but it seems unlikely that gardening will entirely supplant his interest in astronomy.

HEB, MJS



Dr Howlett admires his presentation gift—a silver tumbler cup (a copy of a traveller's wine cup)

Dr Jack Howlett CBE

When the octal number 70044772 ("idling in execution . . .") reappeared on the Atlas computer console at 15.00 hours on 15 August 1975, it signalled the end of a luncheon party and presentation to Jack Howlett, Director of the Atlas Computer Laboratory on the occasion of his retirement.

The Laboratory staff, together with a small group of friends and colleagues, gathered together to give him an informal luncheon party and afterwards Mr Christopher Jolliffe, one time Director of Science Division, presented him with a hallmarked sterling silver tumbler cup (a copy of a travellers' wine cup in use during the sixteenth and seventeenth centuries).

In addition he was given a presentation piece constructed from parts of the Atlas and 1906A computers, and the original Atlas Visitors Book containing evidence of the national and international groups with whom the Laboratory has been in contact.

In making the presentation, Christopher Jolliffe referred to the happy choice of Jack Howlett as Director of the Laboratory, after the very difficult negotiations in 1961 which led to the purchase of the Ferranti Atlas 1 and the decision to make this powerful computer available not only to AERE and the high energy physicists of RHEL, but to ensure that other disciplines in the UK universities would also have a substantial share of the new resource.

Supporting the good wishes, Bob Churchhouse, formerly head of Programming Group and now at Cardiff University, reminded everyone of the rapid growth of computing and computers and the great influence that the Laboratory had exercised under Jack Howlett's leadership.

In thanking everyone for the gifts and the flowers for his wife, Joan, Dr Howlett noted that he had now worked for his living for 40 years almost to the day, and described the exhilaration of a young numerical analyst working for the LMS railway when his hard won hand calculations proved correct as a 50 ton steam locomotive was run up to leave the rails at the predicted 105 mph! He referred to the debt he owed to Professor Douglas Hartree, the distinguished numerical analyst, his supervisor at Manchester University and to the early days at Harwell when he was invited to set up the computing section. He was still capable of wonderment at this remarkable device—the computer—and hoped that the initiatives and flexible approach to new problems which had marked the years of development of the Laboratory would continue to flourish under the new organisations to be established by SRC.

Later, in accord with local custom and at the request of the girls from Data Preparation, he was taken away to be dressed in an "emperor" costume complete with a laurel leaf crown, and given a scroll, which took the form of a diploma "for long and faithful service" and amongst other well applauded qualities for "being the best boss we've ever had!"

In switching the Atlas console to a display "70044772" (idling in execution . . .) Dr Howlett completed the final plans for Atlas; the console was to be on permanent display in the reception lounge. It is clear however that in his retirement Jack Howlett will be far from idle and he looks upon the years ahead as yet another phase of working for his living. Already he has a full calendar and will still play an active role in the computer world. With a truly international circle of friends and acquaintances, he will indulge his capacity to lead an interesting and varied life.

Dr Hunter was presented with a replica of the new sundial inaugurated by Princess Anne

Dr Alan Hunter

Dr Alan Hunter, Director of the RGO, retired on 31 December 1975. Dr Hunter joined the staff of the Observatory at Greenwich in 1937 after he had obtained his doctorate at Imperial College where he did research in spectroscopy. Much of his earlier astronomical work was concerned with the photographic determination of the colours of stars and with an investigation into the reddening of starlight by interstellar matter. Also whilst at Greenwich, Dr Hunter was involved with photographic astrometry, that is to say the measurement of the relative positions of stars on photographic plates. This field of work, and in particular the determination of the distances of stars by this method, was his main interest when the observatory moved to Herstmonceux. He was closely associated with the adjustment of telescopes, and the successful re-erection of the telescopes on their new site in Sussex owes much to his expertise.

Dr Hunter's career embraced a variety of astronomical subjects. He was, for example, interested in the study of the Sun. Whilst travelling to observe a total eclipse of the the Sun in 1947, he was in a plane which crashed killing the two other members of the expedition. Although Dr Hunter was badly injured, he showed great fortitude in recovering from the effects of the crash.

In a lighter vein, we mention one of his most talked about papers, that in which he examined the relationship between the occurrence of certain planetary configurations and that of matinée performances at the Folies Bergère. We understand that this was one instance when Dr Hunter relied on the observations of others; the purpose of the paper was to illustrate by the use of appropriate statistical models the unsoundness of a certain technique described elsewhere in the literature.

Dr Hunter was in charge of the Astrometry Department until 1961, when he became completely involved with the administration of the Observatory, first as Chief Assistant, then as Deputy Director, and finally as Director from December 1973 until his retirement. He was Secretary of the Royal Astronomical Society from 1949–56, Vice-President of the same body in 1956–7 and 1965–7, and President of the British Astronomical Association from 1956–8. He was awarded the CBE last year.

Undoubtedly, the most vividly remembered events of Dr Hunter's directorship will be those connected with the Tercentenary celebrations. The highlight of these was, of course, the visit of HRH Princess Anne to unveil the bust of John Flamsteed and to inaugurate the new sundial. However, it must not be forgotten that many important decisions affecting the future role of the RGO were also made during the past two years. During a time of great change, Dr Hunter has played a vital part both at the RGO and in British astronomy generally. His invaluable advice will be missed everywhere both by many committees and by numerous individuals.

We all wish Dr Hunter well in his retirement.

New Year Honours

Our congratulations to Dr A W Merrison FRS who was made Knight Bachelor; Professor H Elliot FRS, Mr J M Ferguson and Professor E W J Mitchell who received the CBE; Mr H F Lovesey who was awarded an MBE and Mr M Dermody who was awarded the BEM.

Dr A W Merrison FRS is a former Director of Daresbury Laboratory.

Professor H Elliot FRS is a Council member and Chairman of ASR Board.

Mr J M Ferguson is a member of Council and Chairman of Engineering Board.

Professor E W J Mitchell is a former member of Council and Science Board. He is a former Chairman of the Neutron Beam Research Committee.

Mr H F Lovesey is a workshop manager at the Appleton Laboratory.

Mr M Dermody is a workshop foreman at the Royal Greenwich Observatory.

Obituaries

Dr A W Lines

The death of "Freddy" Lines came as a shock to his many friends. The brief statement of his career and achievements in the Obituary columns of the press revealed nothing of the nature of the man himself. I wish, however inadequately, to add a little to what has been written to portray something of the character of a late colleague and friend.

After graduating at Birmingham, Dr Albert Walter Lines began his working life as a lecturer but was very soon swept into the war effort on radar, first of all on the R & D of airborne navigational systems and later as a member of the all-important group who introduced these new devices to the RAF and made them an operational success. There is little doubt that the imperious war-time need to take quick decisions and to settle for something that worked now in preference to waiting for something that might work better tomorrow were important formative processes in his career. This ability to size up a situation and take quick decisions made him the perfect man for the job when the formidable task was presented to him in the early '60s of helping to get the European Space Research Organization going.

Freddy has played a leading part in the early planning of the joint European space venture and the technical programme set out in the "Blue Book" was the work of a group of European experts chaired by him. This later became the blue print for the European Space Research Organization, of which he became the first Technical Director.

It was in this position that Freddy showed his immense skills not only as an engineer but as an administrator. His admiration for the "total technologists" ESRO recruited from some of the continental countries influenced his thinking when he later returned to the United Kingdom. At that time, however, it was fortunate for the United Kingdom that, if more by luck than design, we had produced a man who could match up to the "polytechniciens". The burden carried by the Technical Director of ESRO at that time was enormous. Laboratories and control centres had to be built up in Europe and tracking and telemetry centres established over the surface of the globe; the first satellites were designed and contracts placed in a very difficult political climate; launching arrangements had to be negotiated with NASA; at the same time the immediate demands of the scientists were met by a hastily arranged sounding rocket programme; all of this with a staff recruited from all over western Europe most of whom had no previous experience in the space field. The complexity of such a programme involving not only many material, legal and administrative problems but, what was often more difficult, national pride and sensibilities, would take volumes to describe. The scope for misunderstanding was limitless and the amazing fact looking back on these hectic times from the tranquility of the United Kingdom, is that so much was achieved in so short a time. A large part of the credit must go to Freddy. A born manager, whom life seemed to have fashioned carefully for the task, he knew instinctively when to leave things alone and when to intervene. His prime concern was always how things could be kept moving forward. He drove himself hard and expected others to do the same. Belying appearances at times, however, he was not a hard man and if he occasionally let people feel the cutting edge of his tongue, one felt it was more in sorrow than in anger.

He was perhaps difficult to get to know but an apparently brusque manner, which mellowed in his later years, concealed a warm-hearted personality and many people benefitted from kindly advice conveyed diffidently in sentences punctuated by a hesitant "you know what I mean". He had a keen eye for the false argument and would lay it bare with impish glee. He had a firm belief in the essential simplicity of nature and disarmed many a scientist by reducing abstruse concepts to simple physical and preferably engineering explanations. It was this gift to understand what was what which enabled him to work in close harmony with the space scientists, to chide them when he felt they were making excessive demands and to back them when he believed their case was sound.

Freddy suffered from ill-health after his return to the United Kingdom but he put a great deal of expertise and energy into setting up and defining the functions of the Engineering Division of the SRC. As Director of Engineering and Nuclear Physics he later brought his matter of fact approach to an area which was new to him. It was perhaps the misfortune of NP that he could give so little time to its affairs.

JB

Dr J A V Willis

Dr John Arthur Valiant Willis, 63, Rutherford Laboratory's first Secretary, died on 28 November.

He was educated at Bristol University where he read Chemistry. This was followed by nine years with the Tube Alloys Directorate. In 1946 he joined the Department of Atomic Energy of the Ministry of Supply and in 1948 became a member of the Extra-Mural Research Division, AERE, Harwell. He stayed at Harwell until 1954 when he was appointed Atomic Energy Representative on the UK Scientific Mission at the British Embassy in Washington. On his return to England in 1957 he was

appointed Secretary to the National Institute in Nuclear Science (NIRNS) and Secretary of the Rutherford Laboratory. In 1965 he became Secretary to the Council's Nuclear Physics Board and later Head of the Council Secretariat. He became Secretary to the British Association for the Advancement of Science in 1970, a position he held until his retirement in 1972.

Perhaps the most fitting epitaph to this most gentle of men was spoken by an old colleague who on hearing the sad news referred to John Willis as 'a scholar and a gentleman'.

The Dancing English

The "Nonsuch" dancers made a gracious and impressive entrance to the Ballroom (Long Gallery) of Herstmonceux Castle on the evening of 30 August on the occasion of a Country Dance to celebrate the Tercentenary of the Royal Greenwich Observatory. Dressed in Elizabethan costume, they portrayed the style of social behaviour of the period as well as the styles of dress and dance. A reader set the scene and added tremendous atmosphere by giving some historical background to the dancing and reading short excerpts from contemporary sources, from which we learned that our forbears in Elizabethan times had earned the epithet 'the dancing English'. Musica Antiqua completed the scene by accompanying the dancers on replicas of instruments then in current use. During the displays of court and country dances the newly decorated Ballroom seemed to recapture its more illustrious past, providing a perfect setting for this backward glance to a more elegant age.

Two of the "Nonsuch" dancers in the Long Gallery Herstmonceux Castle

Queen Elizabeth I was an enthusiastic dancer and evidently took great delight in the more lively dances such as the Galliard and La Volta. She confounded the many critics of La Volta by dancing it at her court after they had denounced it as bold and indecent. La Volta had originated as a folk-dance from Provence, and as a court dance it was unique in that the couple were constantly in close embrace, the man putting his arm round the woman's waist as they both leapt into the air together. A picture at Penshurst Place is reputed to show Queen Elizabeth dancing La Volta with Robert Dudley, Earl of Leicester. Nonsuch performed the Galliard and La Volta to a spellbound assembly.

Charles II, founder of the Royal Observatory, was also a keen dancer, in an age when dancing was still an essential accomplishment of a gentleman on the same footing as riding. It was therefore of particular interest to watch Nonsuch perform the country dance 'Cuckolds All Awry' (nowadays usually called 'Hey, Boys, Up Go We'), which Samuel Pepys tells us the King called for at a New Year's Eve Ball at White Hall in 1662 and referred to as 'the old dance of England'.

The striking feature of Nonsuch's dancing is the graceful fluidity of movement, each figure progressing smoothly into the next and giving a feeling of continuity rather than an impression of a series of figures put together. No doubt it was this feature which marked the difference between the style of dancing at court and in the villages. The general dancing later in the evening, to the accompaniment of the local 'Magham Ranters', included some of the displayed country dances in the versions currently performed by the 'folk', revealing differences in some of the figures which probably stem from this difference in style.

Naturally, 'Greenwich Park' had a place in the programme and was preceded by a folk song to the same tune called 'Come Sweet Lass', sung by Fred Watson of H.M. Nautical Almanac Office to his own guitar accompaniment. It was a very memorable evening, greatly enjoyed by all who took part.

Celia V Hewerdine

Rare bones for BM

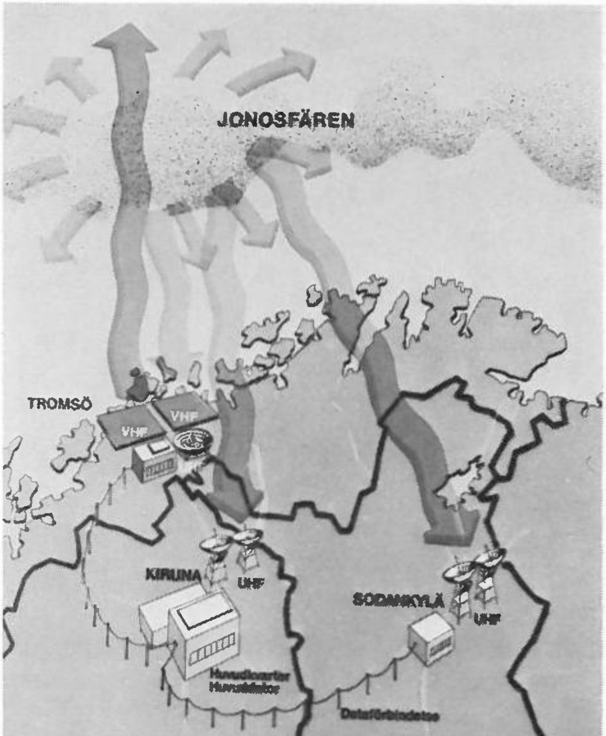
The fossilised bones discovered last spring under the British Rail Works' foundry, Swindon are being transferred to the British Museum. The bones, which are between 130 million and 150 million years old, are the remains of a 30ft Pliosauraus Brachyspondylus, a rare amphibious reptile. They are said to provide the most complete specimen ever found in this country.

A winning suggestion

Norman Goddard of the Nimrod Division, Rutherford Lab, has been presented with a cheque for £500 by the Director, Dr G H Stafford, for his money-saving suggestion. The suggestion concerned a method of modifying the bases used for quadrupole magnets so that the Type 2 base could be used in place of Type 1 and also that future orders should be of the dual purpose type. As usual, the most significant advances and breakthroughs are those which hindsight shows to be the most simple and relevant suggestions—but it always takes a clear mind to see where these developments are possible. When Dr Stafford made the presentation he pointed out that this was the ninth Suggestions Award made to Norman Goddard in the past four years and he stressed the importance to the Lab of such money-saving suggestions.

Dr G H Stafford (left) presents Norman Goddard with a cheque for £500

EISCAT



The picture is from the Swedish research magazine Forskning och Framsteg 4/75

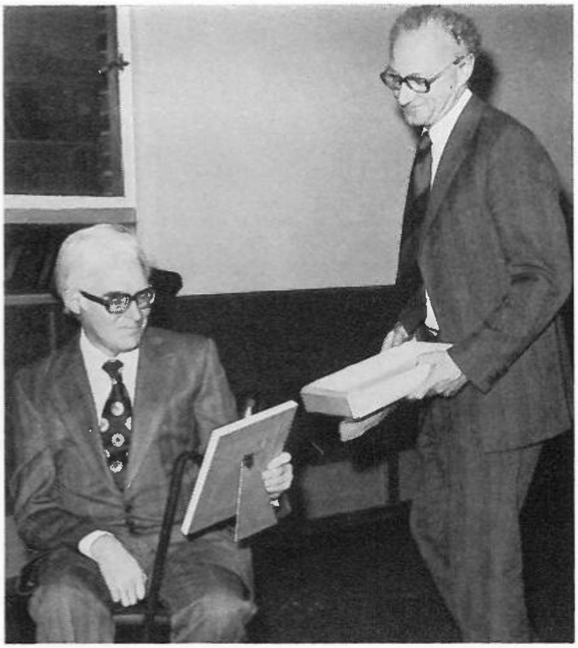
The planned EISCAT facility in the North of Scandinavia.

The transmitters will be at Tromsö (Norway), one for ultra high frequency, UHF (933 MHz), and one for very high frequency, VHF (224 MHz). The VHF transmitting/receiving antenna will be at Tromsö, Kiruna (Sweden) and Sodankylä (Finland). Details of the antenna system are not yet settled, so the diagram should be taken to be only schematic. Computers at the three observatories will be connected by a permanent telephone line, the EISCAT HQ and main computer being at Kiruna. The EISCAT facility should be in operation by 1979.

NUTCRACKER 20

"This is our new career planning scheme", said the Establishment Officer. "On these slips of paper I have listed five vacant posts, which I am sure you will find are unequal in every way. I now put them into this hat and invite you to draw them one at a time. When you draw a post, you must either accept it or reject it. If you accept, we stop there. If you reject, it goes back into the hat and you draw again. You can draw up to five times in all; if you have not accepted anything by your fifth go, you must accept whatever post you draw then." Assuming I know nothing whatsoever about the posts beforehand, except that no two are equally desirable, and assuming I can evaluate them instantly when I draw them, what should I do to give myself the maximum chance of accepting the best post? And what is that chance?

The prize will be awarded to the first correct entry drawn. Please state whether you would prefer a book or record token. The solution will appear in the next issue.



Far left: Lord Bridges admires the portrait of his father, the late Lord Bridges

Near left: Dr Stafford presents Dr Pickavance with a colour print of the portrait

A 'gift' occasion

A final touch was made to the decor of Rutherford's coffee lounge in November when Lord Bridges unveiled a portrait of his father, the late Lord Bridges and first and only chairman of the National Institute for Research in Nuclear Science (NIRNS).

Before the unveiling, Dr G H Stafford, Director, spoke of the opening of Rutherford's new library in 1974 by Dr Gerry Pickavance (the lab's first Director) and of the generous monetary gift he had made on that occasion. The use to which the gift was put had been left to the Lab and the result was the portrait which effectively linked together Dr Pickavance's gift, the Lab and the first chairman of NIRNS.

Picture (above right) shows members of the Daresbury Lab Party who visited Warrington Town Hall in December. They were welcomed by the Mayor and Mayoress and then given a guided tour of the building. The original Georgian building has an interesting history. It was designed by James Gibb in 1750 for the Wilson Patten family, and constructed on a foundation of copper slag from the family's smelting foundry. Copper also played a major part in the construction of the ornamental light fittings and the window frames, and the main gates are made from copper clad wrought iron. The gates were presented to Queen Victoria on the occasion of her sixtieth birthday but she declined the offer. The gates were then entered for the Crystal Palace exhibition where they won first prize for design and engineering ability. Afterwards they were sold to a local scrap merchant and councillor who presented them to Warrington Council.

* * *

Our cartoonist is Geoff Berry, Publications Officer at Daresbury Laboratory

Picture shows from left to right, computer staff: Lynn Nash; Sheila Coleman, Pauline Field; and Tony Rooker

Data Processing at State House

The ICL 1906A computer at Atlas Computer Division is now being used to assist in the administration of research grants awarded to Universities, Polytechnics etc. Proposals for the system were presented in March 1972. After testing, instruction manuals were prepared and formal training sessions were instituted. Clerical records were then converted to the computer system and the two systems ran satisfactorily in parallel for four months until the new system of administration became fully operational in April this year.

Silence Research Council

Staff may be interested to see this item about the work of the Council, which appeared in the Newcastle Evening Chronicle on 22 November:

"A young Newcastle scientist whose work helped to gain a unique mobile laboratory for Newcastle Polytechnic, received a degree of Master of Philosophy.

Mr Andy Tomlinson, aged 24, of Cramlington, wrote a thesis on traffic noise at traffic junctions on Tyneside.

The work so impressed the Silence Research Council that it provided a £30,000 grant for Mr Tomlinson and his colleagues to continue the project.

The money has been used to buy and equip a mobile acoustic laboratory which is now used by the acoustics group in the Polytechnic's Department of Physics and Physical Electronics to carry out research.

The group leader, Mr Brian Oakes, a senior lecturer, said: 'This is a most useful unit. It will allow us to make prolonged and extensive studies of noise problems that plague towns and cities'."

* * * * *

Transaction forms and claims are received in the Data Processing and Control Unit at State House from the registries, committee secretariats and institutions. They are sorted into batches and the information punched on to computer input cards. This information is verified. The cards are then run through the card reader of a CTL Satellite 1 terminal which transmits the information to Atlas over a Post Office data link.

Once the transactions have been processed by the computer, a variety of "update reports" are produced by the terminal listing various details held on the computer records. Data can be extracted to produce lists and analyses for committee and management purposes. Payable orders are also produced from the system to be posted to Institutions in settlement of claims.

The use of the Atlas computer will be further extended in the new year when it will be used to assist in the administration of SRC studentship awards. **A Lewis**

Swindon Office celebrates

From left to right: Paul Samath, Secretary of the Swindon Sports and Social Club and Mr & Mrs St J Walker, guests of honour. Mrs Walker kindly presented the trophies to the winners of the Winter Indoor Tournament

Winners of the Darts Trebles
From left to right: Jock Caldwell, Bill Pitman and Dennis Rose

Swindon Sports and Social Club held its annual dinner and dance on Friday 12 December 1975. Guests of honour were Mr R St J Walker, Secretary of the Council and Mrs Walker. One hundred and ninety six guests danced to the music of the Swinging Shepherds and highlight of the evening was the presentation of trophies to the winners of the Winter Indoor Tournament.

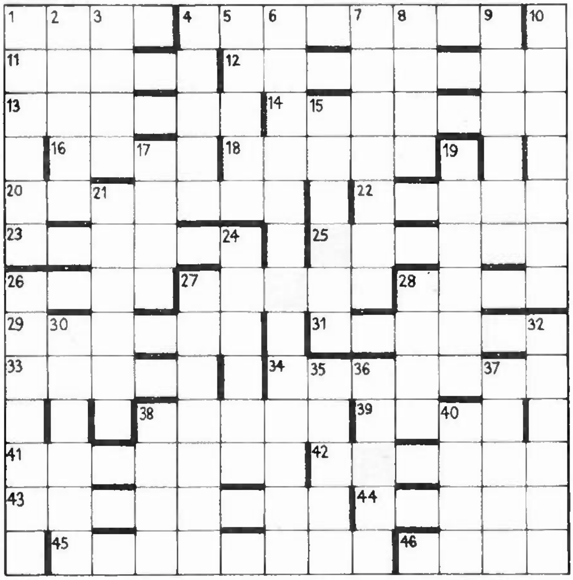
"There are those who take the view that only the use of chisels, gouges, rifflers and other hand tools represents true wood carving and who disapprove of the employment of power tools.

The carving above represents a mixture of techniques but for anyone wishing to embark on the fascinating hobby of wood carving the possibilities are endless. For amusement, or wonderment, look out for misericords in, say, St George's Chapel Windsor, or at cathedral stalls or screens, or many of the sculpture exhibitions.

Almost any piece of wood, is likely to be suitable for making something pleasing, the final configuration not necessarily being dependent on either the graining or the texture of the wood—all that is required is imagination, some patience, initially a few sharp tools and a piece of wood—you may be a Hepworth or Moore in the making.

Whether you whittle wood or do figure, portrait, relief or abstract work, is entirely up to you; as is the wood you use, your inclinations and the effort you are prepared to make."

A Dobbins, Swindon Office



MAXIM 11

MAXIM 11

Answers to the clues asterisked need shortening to fit the diagram. In keeping with the nature of the required surgery, this operation could be called "utation".

Clues

ACROSS

*1. Used to kick fish—how trivial! (8)
4. Do pleats, when knitted, show shape of jumpers to come? (8)
11. I judge 5 (5)
12. What makes you feel lousy and upsets negro—it's fresh air, mostly (8)
*13. Quietly undo, undone in journey hither; putting together again (11)
14. Lean drunkenly with DT's, leaning one way (7)
16. He was well qualified in Roman erotica (4)
*18. Grovel cunningly, clutching cash—disgusting! (9)
20. Sonny, my new name's the same (7)
22. It's inherent to making a person open his mouth wide (5)
*23. Cite green as an example of having "go" (9)
25. Live next to town on the A10? Look out! (6)
26. Food-flavouring often found at mayoral tables (4)
27. Start permutation with zeros and get pounds in this competition (5)
28. Did some walking is doubly shorter than did some striding (4)
29. East German the French take for a stable-hand (6)
31. Way out, way out, co-exit (6)
33. Indian Tribe loses one Hot-Foot (5)
34. Notice in cemetery: tip rubbish in disorderly heap (7)
38. Southend's first source of water was the waves (5)
39. It's very large, London Office, in the capital (4)
41. I'm in it—I always am in it (7)
42. All hot and messy, following Blair in Scotland and Queensland (6)
43. Feminine teeny-bopper's age is just above that of the majority (8)
44. To be abhorrent to a f-friend (5)
45. Joints where airmen go (8)
46. A million million is a hell of a rate (4)

DOWN

*1. Like a fighter, signal for end of round one, gets cross with me losing every other one (9)
2. What is hard but ends happily? Gentle sarcasm (5)
3. Identify the variance of the mean (4)
4. No way of stopping upward cutting saw (5)
5. One grey, one missing, in a state that can induce whiteness (5)
6. No guts? Such dreadful weeds I'll demob! (13)
7. Gore's an epitome for one branch of this family (7)
8. Describes soldiers' opinion of spell on guard (4)
9. Member of vocal group—and *Quest* reader? (6)
10. Put up with the final rude muddle (7)
15. Half-lies in a position to make you vulnerable (6)
17. Tore madly into psittacine learning method (4)
19. In Greece a part's recognised as providing the simple life (6)
21. Did gods canter, running amock, after downing this? (6)
24. Part of ocular disc (or nearly!) (6)
*26. Cortina or MG might be seen doing this (6,6)
27. Birds that get cooked in pie and stew (7)
28. Computes the cost of having children (4)
30. Advice to disc jockey who has lost his thread? (4,2)
*32. Provider of fur; where you might take it, catching a cold with one (10)
35. Flat method of approach to runways (5)
36. Jots down one-nil, sat up afterwards (5)
37. Bear here? Yes. Bare here? It's not advisable (5)
38. Cuddles up in dance (4)
40. A long sort of walk—look, taking exercise! (4)

The prize will be awarded to the first correct entry drawn. Please state whether you would prefer a book or record token. The solution will appear in the next issue.

London area hockey tournament

What's this? Civil Service London Area Indoor Mixed six-a-side Hockey Tournament—well, there's Janet Simpson from LOA, Janet Manfield from ASR Division, John Parsons from E & O and myself from Finance all playing club hockey, I wondered if there was anyone else? Yes, we found two more players "resting": Mike Patterson from Engineering Division and Paul Gilbert from Public Relations Unit. That really does make a side to represent London Office! Unfortunately we could not find players from Science and NP Divisions to make the full team of eight—two substitutes were allowed.

Wednesday, 4 February found us joining the rush hour bus queues for Waterloo and beyond to get to Manor Place Baths for the preliminary rounds of the contest. Top two sides to reach the finals—well, when one of the team sat down in the bus on seats reserved "for the elderly, handicapped or pregnant ladies" I did not think much of our chances! Then the first game against Inland Revenue—we had not practised together before, some of us had not played indoor hockey before and this was the strongest side we were to play—so, we lost 5—1, although it was only 3—1 till the last 90 seconds. Then, across the road to the pub where we chatted with the tournament organiser and had a liquid supper before being extracted to play the second game against NPL. Gin and beer obviously are good for hockey, we only lost 2—1 and could have won or drawn. The third game against MOD was much harder and we were tired but we defended desperately to lose only 3—0. Janet Simpson scored both the goals and I let in 10. All right we came bottom but thoroughly enjoyed ourselves and we are entering next year—any more hockey players around?

Graham Tidmarsh

Daresbury Ladies' soccer team in action

Father Christmas presides over contented youngsters at Children's Christmas Party, Appleton Lab

Solution to Nutcracker 19

The solution was 143. The winner was C S Biddlecombe (RL) who wins a £2 record token.

Farewell

As a result of Rutherford and Atlas' merger, we regretfully say farewell to Doug House, local correspondent at Atlas. Our thanks go to him for his enthusiasm, ideas and the hard work he did for 'Quest'. (Harry Norris will now cover both Rutherford and Atlas and can be contacted on ext. 484 at RL).

Welcome

Adrian Dent will be Quest's new local correspondent for the Swindon office.

QUEST

Vol 9 No 2

Viking mission to Mars

Franco-British scientific agreement

Angus underwater explorer

QUEST

House Journal of the Science Research Council

Vol. 9 No. 2
1976

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Quest will be issued four times this year by the Science Research Council for members of staff only. The Council is not necessarily associated with any individual views expressed.

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Cover

Picture shows the launch of Angus from the Ministry of Agriculture, Fisheries and Food vessel '*RV Clione*' during trials off the coast of Norfolk in July 1975. For story see opposite.

Contents

Angus, underwater explorer

Angus, a small, unmanned, navigable vehicle for underwater surveying is the creation of the Department of Electronic Engineering at Heriot-Watt University. It was built in 1972 with a Council grant and further Council funds this year have meant that work on the design and construction of the more advanced Angus 002 can begin.

Unmanned vehicles

The advantages of un-manned cable-controlled underwater vehicles are numerous. The very fact that they are unmanned means that, in an emergency, they can be considered expendable. Their size means that they are more manoeuvrable in confined spaces. They can be operated 24 hours a day, seven days a week by a crew working shifts. Because they are small and light, surface support can be provided by any small 'ship of convenience' equipped with an adequate derrick. Finally, by removing the need for heavy pressure-proof spheres and banks of massive storage batteries, the cost of designing, constructing and operating can be reduced by ten per cent.

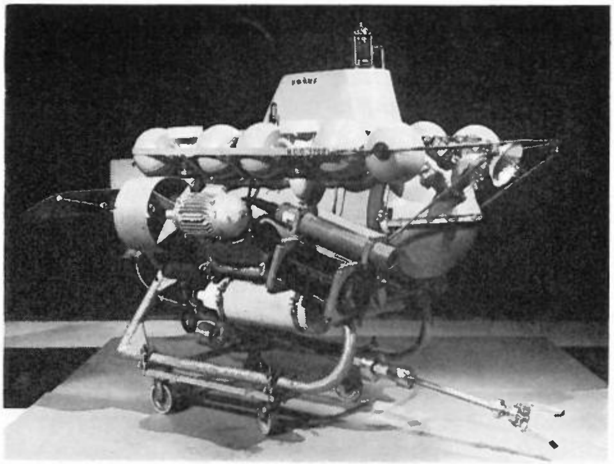
Potential uses

There are many potential applications for these vehicles. They could be employed by oil and telecommunications companies for inspecting oil and gas pipelines/submarine cables. They could be of use in seabed search missions by, for example, oil companies relocating equipment or by salvage companies looking for ship/aircraft wreckage, etc. They would be particularly advantageous in hazardous environments – searching for explosive devices, gas or oil leaks or where there were radioactive fallouts. They would also be of use to universities, government laboratories and private companies interested in marine-resources exploitation and in the effects of pollution on marine ecology.

Angus system

The vehicle itself is designed on the pressure-compensation principle, which allows a thin-shell hull to be used, with consequent advantages of weight and cost. The system consists of the following modules: vehicle; control console; navigation transponder buoys; earth-leakage protection unit; set of tools, spares, handling gear; compressor; and video recorder.

An important design feature of the Angus system is its modular construction which makes it much easier to handle. The vehicle itself can be handled by about six men and the other units by about four. The surface support required is minimal, and the vehicle is small and light enough to be operated from a 20 m fishing boat equipped with a small derrick.



Angus 001, in 1975 state. Manipulator is experimental, attached for photograph only

At the outset it was decided, where possible, to use readily available low-cost components modified for the unusual environment, rather than high-cost components designed for underwater applications but available only in small quantities from abroad. Apart from one or two specialised items, eg the television camera and the main umbilical-cable connectors, the idea has proved successful.

While Angus is capable of roaming over selected areas of the seabed at will, this is of little value unless its exact location is known. For this reason, considerable effort has been devoted to designing an effective, low-cost navigation system.

Sheltered-water trials
In the early stages of development, tests were carried out in pressure vessels, diving pools and the open sea to check the control of the propulsion units, methods of buoyancy control and pressure compensation. During the summer of 1973 the vehicle was operated in Loch Linnhe in water depths from 10 to 150 m and excellent closed-circuit television pictures were possible.

The Angus vehicle is designed to operate to a depth of 300 m, although the principle on which the hull construction is based does not in itself impose any depth limitations and during December 1973 the vehicle was submerged to a depth of 335 m in a flooded mineshaft at Rothes, Scotland. The deep dive was a total success, proving the soundness of the design philosophy. (It is also believed that this dive is a record for a vehicle of this type in the UK).

In 1974, the acoustic-navigation facility became operational and the whole system was successfully tested at Loch Linnhe. Then Angus was operated in the Moray Firth and off Aberdeen during joint trials on the Ministry of Agriculture Fisheries and Food Vessel *Clione* and later took part in joint submersible trials in Scottish and Norwegian waters on RV *Challenger* under the auspices of the Institute of Geological Sciences. During 1975 a total of thirty dives were carried out, including assignments for MAFF in the southern North Sea, filming near Oban for a 'Tomorrow's World' television feature and inspection work for Admiralty Research Laboratories, in Loch Long. The integral navigation system with a demonstrated position-fixing repeatability of 1.5 m proved to be a unique and invaluable asset on these trials.

The future
The difficulties of carrying out detailed remote-controlled inspection in depths of hundreds of metres of water in the open sea are immense, but the demand for such work is increasing daily and technology is barely keeping pace. The designers are now looking to the likely demands of 1980/85 and are embarking on studies which they believe will lead to the capability of submersible operations under computer control, with advanced viewing and manipulative facilities.

CompAir, the first Teaching Company

Work on the first practical project under the Teaching Company scheme, is already under way at CompAir, the UK's largest manufacturer of air compressors and associated equipment. The aim of the project, which is under the direction of Professor R H Thornley of Aston University, is to determine the most economical methods of producing the volume and variety of replacement parts for CompAir equipment in use throughout the world.

Three graduate engineers, two appointed from outside and one seconded by CompAir, are working to a three-year schedule to produce a scheme of reorganisation. Research at the plant is being complemented by instruction at Aston's Department of Production Engineering. Progress on the project will be regularly monitored both by the Department and the company to ensure that it is taking the most practical course.

Franco-British scientific agreement

An agreement for scientific cooperation between Britain and France represented by the Council and the Centre National de la Recherche Scientifique (CNRS) was signed in Paris on 14 June, by Sir Sam Edwards, Chairman and Mr R St J Walker, Secretary and M Bernard Gregory, and M Pierre Creyssel, Director General and Assistant Director General, CNRS.

During the last few years close ties have been established between the two organisations. A joint SRC-CNRS committee meets annually either in Paris or London to discuss problems of mutual interest and to organise a programme of seminars.

The agreement which has just been signed will enhance this bilateral cooperation in three fields: facilitating visits each way by scientists; joint seminars; and collaborative research projects.

Research Worker Visits
Each year the joint SRC-CNRS Committee will make arrangements to finance a scheme of visits by research workers. The aim of the visits will be to formulate or carry out collaborative research schemes.

Joint Seminars
The CNRS and the SRC will organise joint seminars for about twenty people to examine areas of cooperation and to measure progress. These seminars, which will meet by invitation only, may in certain cases be open for European participation.

Collaborative Research Projects
The joint SRC-CNRS Committee will examine suggestions for collaborative research projects, which may be made during research worker visits, at seminars or by any other means.

The CNRS and the SRC already participate in many multi-lateral activities; examples are: European Millimetre Wave Diode Laboratory at University College, Cork, S Ireland; Institut Max von Laue-Paul Langevin, high flux reactor institute at Grenoble; and EISCAT, a scientific project to construct a European incoherent scatter facility in the auroral zone.

Council Commentary

January to April 1976

Membership

In January the Council welcomed Professor Reddish, Astronomer Royal for Scotland and Director of the Royal Observatory Edinburgh, who succeeded Professor Ashmore, Director of the Daresbury Laboratory as the Establishment Director in attendance at Council meetings.

Finance

(i) Provisional Outturn 1975/76

The provisional outturn for the financial year 1975/76 was £106·39M compared with Supplementary Estimates of £106·37M. The Council noted that the maximum possible supplementaries had been claimed and subsequently spent.

(ii) Estimates 1976/77

The Council's Printed Estimates for 1976/77 totalled £117M, this was about £4M above the Estimates submission (see Quest Vol 8 No 1), due to supplementation for inflation and depreciation of sterling and did not provide any increase in Council's funds in real terms.

(iii) Forward Look 1978/82

At its March and April meetings, the Council discussed the Forward Look proposals of the four Boards. The Forward Look has now been submitted to the Advisory Board for the Research Councils whose advice to the Secretary of State on the allocation of the Science Budget should be known by the late summer.

Regrouping of Central Computing Facilities

In April the Council approved the proposed distribution of computing work between the Rutherford and Daresbury Laboratories. This involved the transfer to Daresbury of Science Board computing for X-ray crystallography and related subjects, together with applications group staff posts.

The Council agreed to take direct responsibility for central computing and to establish a single Facility Committee to supervise the management of central computing at both Laboratories. This Committee will, when it is set up late in 1976, take over the continuing functions of the Atlas Computing Committee and the Computer Regrouping Co-ordinating Committee. This completed the Council's planning of the SRC computing regrouping.

The Council also approved the purchase of a second IBM 360/195 processor and one Mbyte memory store at a cost of up to £1·6M (subject to DES approval) and the transfer of the existing 360/195 at Rutherford into the Atlas Building. This will allow the two processors to be run as a coupled system sharing the existing peripherals. The existing 1906A will continue in operation with only a small additional staff. An 80% increase in Chilton capacity is expected in the upgrading without any increase in the recurrent costs. Enhancements to the Daresbury IBM 370/165 were approved to allow purchase of an additional Mbyte memory and a third channel and enhancements of the tape and disk drives at a capital cost of £275K. Proposals for further upgrading of the Daresbury computer are awaited.

Select Committee on Science and Technology

The Council noted the second report from the Select Committee on Science and Technology, which on the basis of an unsound statistical analysis of SRC current grants had implied that a handful of highly favoured university scientists might have undue influence on the formulation of SRC policy. At the request of the Committee the SRC has recently submitted a memorandum on the statistical analysis contained in Annex II of the Report which explains why the implication was unwarranted.

Postgraduate Training

(i) SRC Regional Meetings

In April, the Chairman reported on the first two SRC regional meetings held at University College, Cardiff and Aston University to discuss future SRC policy for support for postgraduate training and new SRC methods for funding research. The meetings had been well attended and the discussions had been most helpful. Further meetings in the series have been arranged at Glasgow University, Leeds Polytechnic and London (CBI).

(ii) Senior Fellows hips

The Council was informed that six senior fellowships have been awarded in 1976. These new Fellowships allow outstanding academics or research workers in industry to devote themselves full-time to research and scholarship in any suitable laboratory, for a maximum of five years, free of their normal teaching and administrative duties.

Support for Science-Based Archaeology

The Council at the request of the Advisory Board for the Research Councils has agreed to establish a research grants committee for the support of the scientific and technological aspects of research and development in archaeology. The Committee will have the normal delegated powers of an SRC committee and will also advise the other funding agencies concerned, namely NERC, SSRC, the British Academy and the Royal Society. Financial provision has been made for SRC expenditure of £30K per annum.

Astronomy, Space and Radio

(i) Mirrors for X-ray Telescopes

The Council has improved contributions totalling £195K towards a National Physical Laboratory facility for the figuring of mirrors for use in X-ray telescopes. The NPL has already carried out the figuring of a 70 cm mirror for a joint NASA/MSSL experiment.

(ii) UK participation in the NASA Solar Maximum Mission

In March approval was given for UK participation by the Mullard Space Science Laboratory (University College, London) and the Appleton Laboratory in the provision of an X-ray polychromator for solar flare studies from the NASA Solar Maximum Mission satellite to be launched at the end of 1979. The UK experiment will be developed jointly by consortium of the two UK groups together with a group at the Lockheed Palo Alto Laboratories, USA. The Council approved expenditure totalling £166K on a detailed design study and purchase of long-lead items and in principle approved further expenditure of £450K for construction of the payload subject to the final US approval of the NASA satellite.

(iii) Millimetre Radio Astronomy

Problems areas identified in two independent feasibility studies on the proposed millimetre radio astronomy facility were the selection and method of fabrication of the panels, and the disc surface alignment. The Council approved further studies at a cost of a further £56K.

(iv) UK Use of the Kottamia Telescope

The Council agreed to seek an initial three year agreement with the Egyptian Academy of Scientific Research and Technology for the use of the 74 inch telescope at Kottamia by UK astronomers. The agreement would cover the period 1977/79 during which it was planned to move the Isaac Newton Telescope to the Northern Hemisphere Observatory site.

Research Grants

The Council approved the following grants:

Astronomy, Space and Radio

A consolidated grant of £415K for the year ending July 1977 to Professor Boyd, University College, London, for space research at the Mullard Space Science Laboratory.

Engineering

(i) £130K over three years to Professor Butters, Loughborough University, for work on new and improved measurement techniques for engineering;

(ii) £107K over three years to Professor Keller, Bristol University, for work on polymer crystallisation and micro-structure in relation to mechanical properties, molecular homogenity, flow and processing.

(iii) £109K over five years to Professor Maver, Strathclyde University, for research in computer-aided architectural design. Support in the final two years will be conditional on satisfactory progress during the first three years;

(iv) a supplement of £231K over three years to Professor Edels, Liverpool University, for research into arc phenomena in industrial devices.

Nuclear Physics

Annual consolidated grants totalling £424K to Glasgow and Oxford Universities for the maintenance of their nuclear structure accelerators.

Flare studies during the Solar Maximum

A H GABRIEL

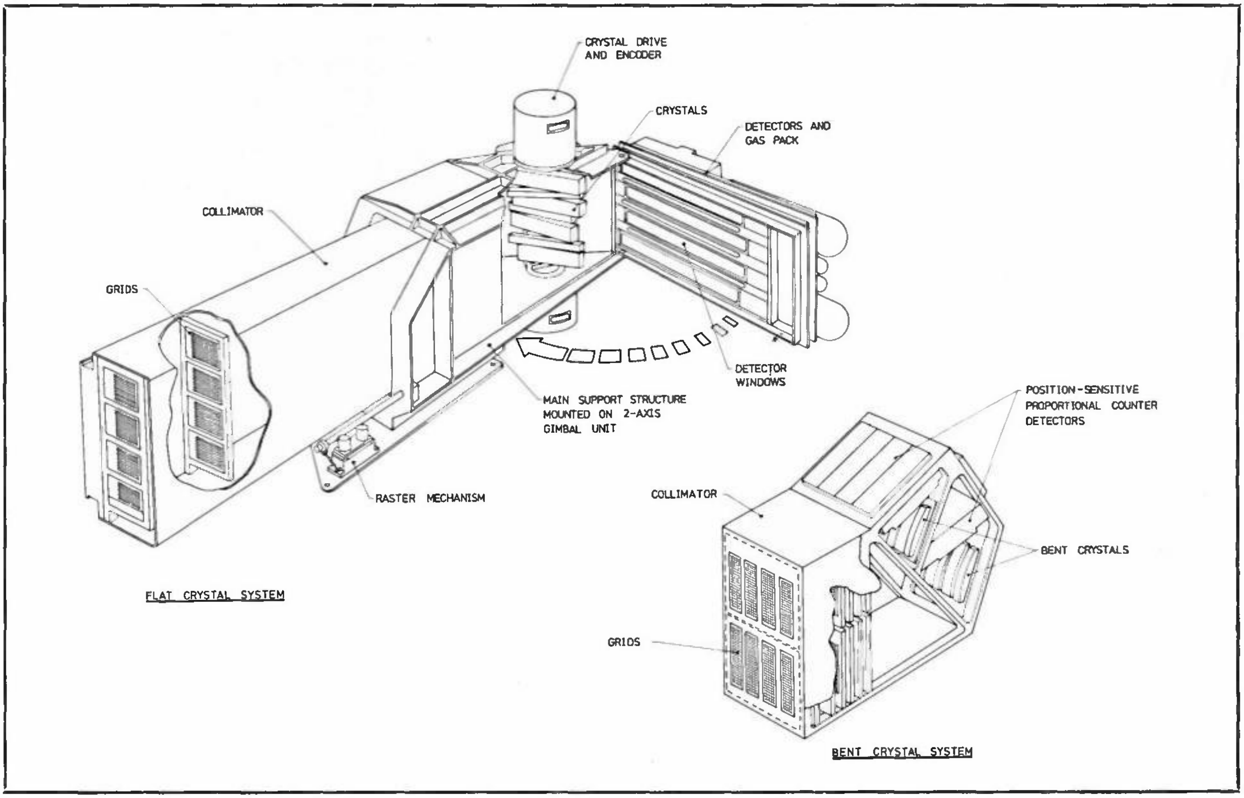
The Appleton Laboratory Astrophysics Research Division at Culham is collaborating with two other research groups to build a new and complex X-ray spectroscopy payload. This will be launched on a NASA satellite during the next period of maximum solar activity in 1979/80.

Solar flare

Perhaps the most puzzling phenomenon occurring on the sun is the solar flare. Flares occur as random explosive events, resulting in intense emissions over a wide range of photon and fast particle energies, arising from small regions on the sun. In visible light these appear through a telescope as tiny brightened filaments. However, in the X-ray region the emission from the flare often exceeds that from the entire remainder of the sun. The streams of particles, as well as the X-rays, can be detected at the earth where as well as being observed directly, disturbances are produced when they collide with the ionosphere and magnetosphere. Much of this has been known for years, yet the precise mechanism that leads to these flare is still not understood. It is broadly assumed that stored energy is built up in solar magnetic field configurations, and that this is released explosively by means of some plasma instability.

Solar Maximum Mission

The occurrence of flares is linked to the solar activity cycle and rises to a maximum every eleven years. With the next maximum due in 1979/80, NASA is planning a co-ordinated study, by launching a dedicated satellite; the Solar Maximum Mission (SMM). The most complex experiment on board will



Layout of the proposed solar flare X-ray polychromator

be a soft X-ray spectrometer system, and this is to be provided by a consortium of two UK and one US groups. The other two are the Mullard Space Science Laboratory of University College, London, and the Lockheed Palo Alto Research Laboratories.

XRP experiment

The experiment known as the X-ray Polychromator (XRP) consists of an array of seven flat-crystal and eight bent-crystal spectrometers, covering between them the wavelength range 1·3 Å to 23 Å. The array includes the capability of a wavelength resolution of 0·0001 Å, spatial resolution of 10 arc sec and time resolution of 0·1 sec, and is far in advance of X-ray instruments flown previously. Particular emphasis will be placed on the narrow waveband 1·8 Å to 1·95 Å, known to contain many lines of highly ionised iron which have a powerful diagnostic capability. Operation of the experiment, including data formatting and compression will be carried out by a microprocessor which forms part of the instrument.

The project is now entering a detailed design phase, prior to manufacture of flight equipment which is due to be delivered to NASA at the end of 1978. Participation by the UK groups was approved by Council in March, and now awaits endorsement by DES.

Dr A H Gabriel is a principal investigator in the NASA XRP experiment for the Solar Maximum Mission.

Viking mission to Mars

Using the 250-ft telescope at Jodrell Bank, under the direction of Professor Sir Bernard Lovell, British scientists will be playing an important part in the Viking spacecraft mission to Mars. The first of the two US Viking spacecraft, launched by NASA last year, is scheduled to land on Mars this month after an eleven month journey through 736 million kilometres (460 million miles) of space. Jodrell Bank's participation in the Viking project is funded mainly through a Council grant.

Viking I was placed in orbit around Mars in June and the second spacecraft should arrive in August. After surveying the surface of the planet for suitable landing sites each spacecraft will separate into two parts, an orbiter and a lander. Each lander, containing its own package of scientific instruments, will descend to the Martian surface to carry out a number of experiments and televise its surroundings. It will also take measurements of the atmosphere as it descends to the surface. The orbiters will observe and map Mars from above and relay to Earth some of the data transmitted from the landers.

An important feature of any space mission is its radio communications system for the transmission of data back to Earth. In the Viking mission this system will also be used as a scientific instrument which, together with a radar altimeter on the lander, will be used for measuring the gravitational field of Mars, determining the axis of rotation, measuring surface properties and performing certain relativity experiments. It will also be used to determine the location of the lander on the ground. A special radio link will provide a useful tool for studying charged particles in the Martian atmosphere, particularly studies of the ionosphere of Mars. It will also be used for studies of the solar corona when Mars and the Earth are lined up with the Sun.

Commissioning of the Super Proton Synchrotron at CERN

The 400 GeV Super Proton Synchrotron (SPS) at CERN in Geneva reached its design energy at 15h 35m on June 17 and progressive commissioning has begun. Construction of the machine began on 19 February 1971 and will officially end on 19 February 1979. The cost of the project when completed will have been some 1150 million Swiss francs at 1970 prices.

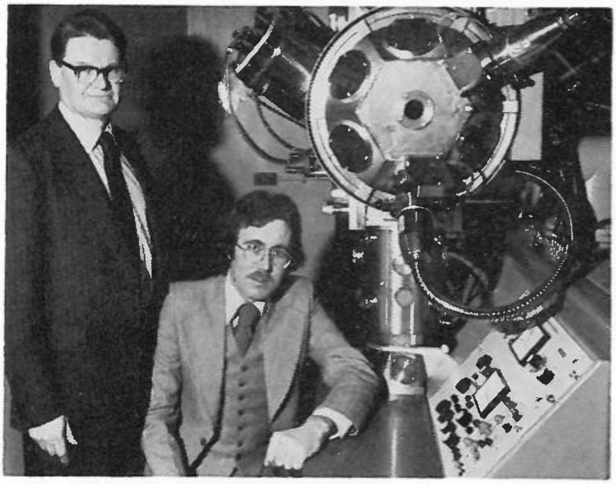
The machine, which will be the largest accelerator available in Europe, has been built in a doughnut shaped tunnel almost 7 kilometers in circumference about 40 metres underground beneath the French-Swiss border near Geneva.

In mid-March ejection tests were begun with protons of 10 GeV from the injector, the 28 GeV proton synchrotron (PS), which has been in operation at CERN since 1959. On the 5 April the first beam of protons was successfully brought from the PS to the end of the 1 km long transfer tunnel leading to the SPS and on 3 May protons were successfully brought to the SPS, injected into the machine and bent around the main ring within the confines of the vacuum chamber. The next stage in the commissioning will involve the radio frequency acceleration unit and it is expected that the SPS will be available for experiments at the end of 1976.

Preparations for experiments (involving Rutherford and Daresbury labs as well as a number of universities) are now well under way.

First metioscope at Leeds

Britain's first PEEM (photoemission electron microscope or metioscope) was switched on for the first time in Leeds University's Metallurgy Department in March. The PEEM was provided by the Council at a cost of £130,000 and Professor Jack Nutting who has a five-year Council grant to study polymers using electron microscopic techniques, is directing the research effort with Dr Alan Baker.



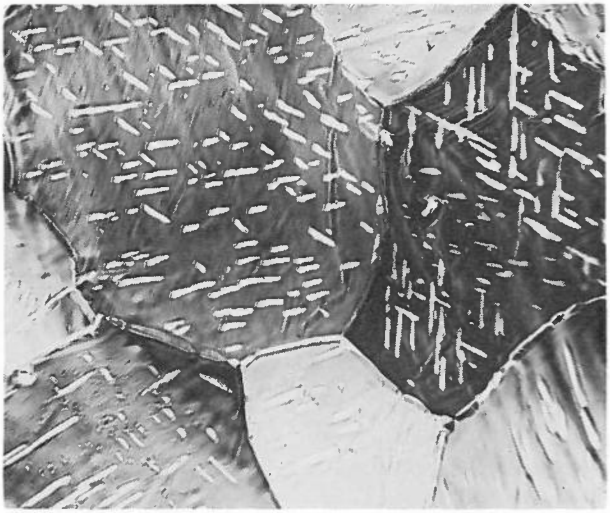
Pictured here with the PEEM, are left to right: Sir James Menter, Director of Research for Tube Investments, who officially inaugurated the metioscope and Dr Keith Parker, Research Fellow in Leeds University's Department of Metallurgy

First permanent facility

Now that the PEEM is operational British electron microscopists will have their first permanent facility for studying high temperature structural changes of metallic and ceramic materials and even plastic and bone.

Ultra-violet rays

The PEEM works by means of ultra-violet rays which are shone on to a target of the metal to be observed which then gives off electrons. These are collected and focused into a kind of television picture. The instrument can pick out features less than one millionth of a centimetre across.



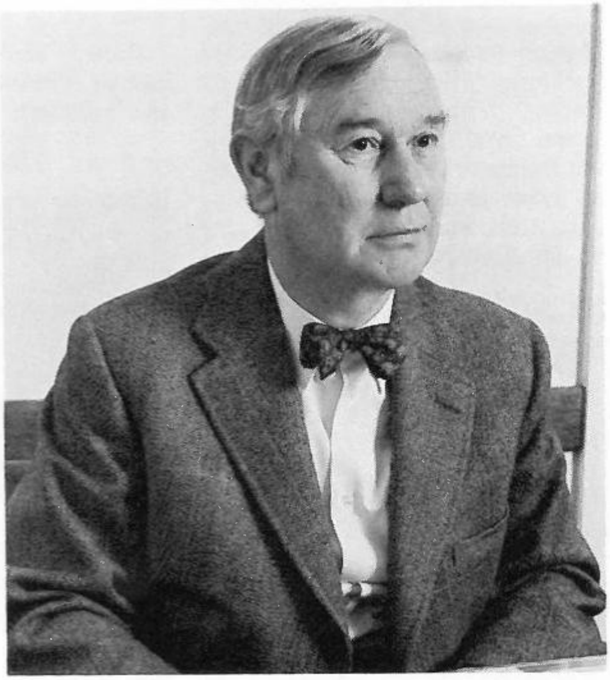
This picture shows the fine needle-like growth of tungsten carbide on a tungsten sample. The carbide was produced by the reaction of metal and acetylene gas in the microscope at 1200°C. Magnification is x 1000. Temperature 1650°C

Projects underway

Four projects are already using the facilities, these include one on grain growth in steels which is being carried out in close co-operation with the British Steel Corporation. Another concerns controlled rolling and heating where the direct observation facility is likely to remove much of the guesswork and give finished steels greater strength. This could be of particular benefit to Britain's natural gas distribution pipeline system. An examination of die steels has been started as part of a national programme aimed at the improvement of metal cutting and forming operations. An oxidation and reduction study of iron ore aimed at making iron smelting more efficient through fuel and other savings has also been started.

Newsfront

Birthday Honours
Her Majesty the Queen has been pleased to award Honours to the following: Professor W J G Benyon and Professor G Wilkinson were made Knights Bachelor; Dr G H Stafford and Professor J C Gunn were awarded the CBE; and Mr R M Jenkins received the OBE.
Professor W J G Benyon, Professor of Physics, University College of Wales, is a Member of the Astronomy, Space and Radio Board.
Professor G Wilkinson, Professor of Inorganic Chemistry, Imperial College of Science and Technology, is a former Member of the Chemistry Committee.
Professor J C Gunn, Cargill Professor of Natural Philosophy, Glasgow University is a former Member of Council and former Chairman of Nuclear Physics Board.
Mr R M Jenkins is former head of personnel at Rutherford Lab.



Mr R M Jenkins
'JENX'
(see below)

Fellows of the Royal Society
We offer our congratulations to the following who are among those who have been elected to the Royal Society:
Dr T G Pickavance CBE, ex-Director, Nuclear Physics Division, previously Director Rutherford Lab, distinguished for his contribution to the design and construction of accelerators for high energy particles and for his exceptionally effective direction of the Rutherford Lab.
Dr J H Horlock Vice-Chancellor, Salford University (Member of Council).
Sir William Henderson Secretary of the Agricultural Research Council.
Professor D J Bradley Imperial College London (Chairman of Laser Centre Steering Committee).
Professor G Allen Imperial College London (Member of Engineering Board).
Professor J I G Cadogan Edinburgh University (Former member of Science Board, former Chairman, Chemistry Committee).
Professor G Eglinton Bristol University (Member of ASR Board).

Salford honours
Congratulations to both Professor Sir Sam Edwards and Professor Sir Hugh Ford who have been awarded the honorary degree of Doctor of Science by the University of Salford. Professor Ford, who is Professor of Mechanical Engineering at the University of London, is Chairman of the Engineering Board's Total Technology Panel.

New Director for AAT
Professor Donald Morton has been appointed as the new Director of the Anglo-Australian Observatory. Professor Morton, a Canadian, is senior research astronomer and lecturer and also director of graduate studies in the Department of Astrophysical Science at Princeton University, New Jersey, USA. He is expected to take up his new position in September. He succeeds Professor E J Wampler who will return to the Lick Observatory in California.

Cymru am Byth
Mr R M Jenkins – JENX to all his friends – retired at the end of 1975 as Chief Personnel Officer at the Rutherford Laboratory. Mr Jenkins served in several Departments of the Civil Service before he joined AERE in 1950. Towards the end of 1960 he was invited to transfer to the Rutherford Laboratory and took up what was virtually the post from which he retired. He had therefore seen the Laboratory through the transition from AEA to NIRNS and then to SRC. On leaving Rutherford

he said that he could always be contacted at Ascot, Newbury, Twickenham or Cardiff Arms Park.

It will be seen therefore that Mr Jenkins had been actively involved over a long period with the Staff Side at both local and central levels and when the SRC Central Staff Side heard of Mr Jenkins retirement they felt that they should present him with a gift, notwithstanding all his involvement being "on the other side of the table".

The result was that a small Staff Side team consisting of Harry Aram, Vince Foley, Wally Bray, Ron Morgan and Roger Childs together with Jack Wyatt, the new Chief Personnel Officer at the Rutherford Laboratory, presented Mr and Mrs Jenkins with a miniature rugby ball signed by the Welsh Rugby Team and dated 17 January 1976, the day that Wales defeated England at Twickenham by a record score and then subsequently went on to the Triple Crown and Grand Slam.

Needless to say both Mr and Mrs Jenkins were delighted with the present and Mr Jenkins' reply to Mr Aram, Chairman of the Whitley Council Staff Side is reproduced below.

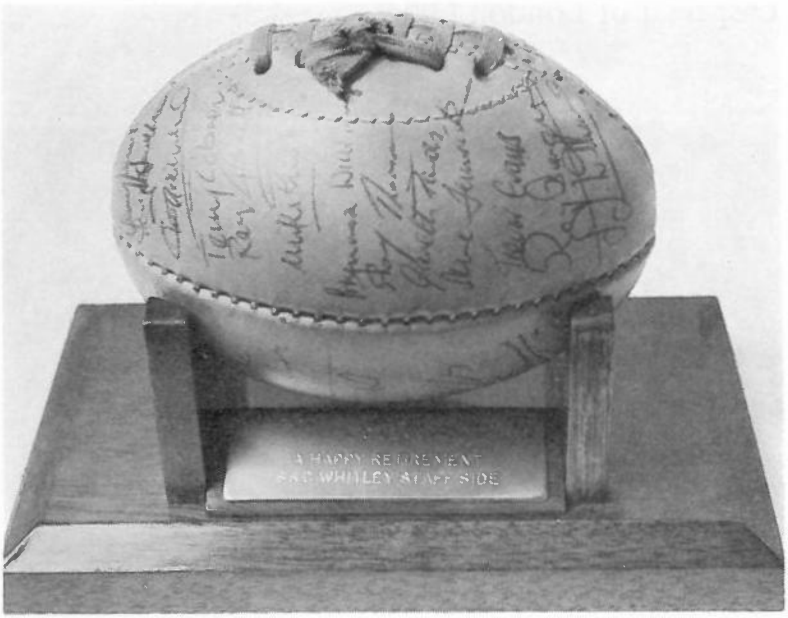
"Dear Harry,

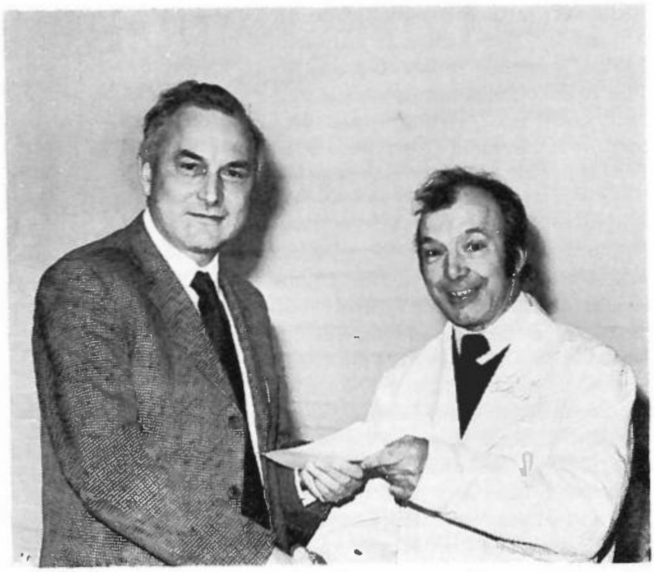
Richard Plantagenet led the first touring side to leave these shores: they played the Saracens in the Middle East and won a fine test match at Acre in 1191. It was there he was dubbed 'Coeur de Lion'; the sobriquet spread to cover the entire party, thereby giving us our earliest reference to British Lions. Their baggage-man and physio was a fellow called Blondel and he it was who remarked that if all the relics of the true cross then being hawked around the ballparks were laid end to end there would be enough material to erect the Eternal Goal-posts in the Sky.

This Levinesque opening was merely to provide the allusion to blessed relics – you presented me on Friday last with an object that commands immediate veneration and whose reverential value will increase through the generations.

The inventive resource in obtaining this magnificently autographed ball is much to be admired, both in idea and execution: certainly a double first.

Once again, thank you. It remains for me to thank Mr Clement, through you, for his kindness and the 1975/76 Squad for their cooperation."





Ron Russell (left) presents Peter Champ with the cheque

Suggestions Award

Peter Champ, a skilled craftsman in the Mechanical Engineering Group of the Nimrod Division (RL), has been awarded £125 under the Suggestions Award Scheme, for his suggestion for a transducer support platform.

When Ron Russell, Nimrod's deputy division Head presented the cheque, he spoke of the money which would be saved by using the platform. It would reduce technical and craft effort and cut down time spent working in very cramped and awkward conditions.

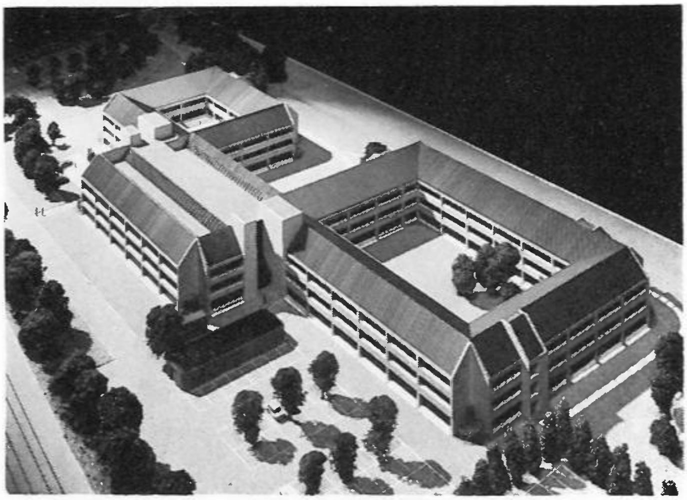
Dispersal of London Office

In recent months the London Office dispersal programme has made considerable strides forward.

Towards the end of 1975 negotiations for the purchase of the site for the new offices, alongside Swindon Railway Station, were successfully concluded with Thamesdown Borough Council. This was followed early in the New Year by the formal conveyance of the land into the ownership of the Science and Natural Environment Research Councils.

In mid-April the main contract for the erection of the new offices for the two Research Councils was awarded to W E Chivers and Sons Ltd of Devizes, Wilts; the site was formally handed over to the contractor on 3 May. Chivers will be placing major sub-contracts for the provision of specialist services with firms approved by the Research Councils' Joint Dispersal Policy Committee. The main contract stipulates a two-year construction programme and, therefore, planning is proceeding on the basis that the new premises will be ready for occupation by the Spring of 1978.

The Stage II interim dispersal of further units of work from State House and the Oxford Street Annexe, successfully accomplished last Autumn, left the London Office with a small amount of temporary rented accommodation at its disposal within the British Rail Engineering works complex at Swindon. Preliminary agreement has been reached with Division Heads that this accommodation might be utilised by the dispersal this summer of Science Division's Chemistry Secretariat, and part of E & O's O&M Unit followed at the turn of the year by the Research and Training Support Section from Secretary's Department. Thus at the end of Stage III transfers there will be in Swindon an advance party of every Division of the London Office with the exception of Nuclear Physics and Astronomy, Space and Radio Divisions. The staff located at Swindon will number about 155, approximately two-fifths of the London Office.



The architect's model of the new building looking approximately West. The Council's offices comprise the quadrangle in the right foreground
Photo by courtesy of Clifford Culpin & Partners Ltd

The site viewed from a point close to the Southern boundary with Swindon Railway Station looking towards the north-west (approximately) and Swindon Technical College and the domed Oasis Sports Centre in the background

Although final dispersal is still almost two years distant this is about the minimum period which is required to successfully plan and carry out the phased release and replacement of the many staff who require assistance to find other public service employment in the London area as an alternative to dispersing to Swindon. In the months to come these many staff changes will make for an extremely busy but undoubtedly rewarding period for the personnel section of the London Office.

SRC sponsors walk for NSPCC

Members of the Swindon Sports and Social Club organized a sponsored walk in aid of the National Society for the Prevention of Cruelty to Children on Saturday, 24 April.

The Mayor of Thamesdown, Councillor J R Stevens, Mrs Stevens and Mr Maurice Message of the Swindon Advance Office started off the walk which covered a 15-mile circular route through the beautiful Wiltshire countryside along the Ridgeway and over the Downs.

In addition to members of Swindon Office the walkers (thirty-five in all – the youngest only 5½) included staff from the Employment Services Agency, NERC, DHSS, the Department of Employment and the Post Office.

Geoff Strange (Swindon Office) completed the entire course in good time and would have done it in record time if he hadn't taken a wrong turning and ended up walking eighteen miles!

Refreshments, donated by local hotels, a supermarket, soft drinks manufacturer and brewery, were provided along the route.

'Swindon Viewpoint', the local television company covered the event and screened the programme the next day.

It is hoped that this walk for charity will become an annual event and one which will help newcomers to Swindon to get to know the countryside.

Pictured above from left to right are: Mr Mick Jefferies (Swindon Office); Mr Maurice Message (Swindon Office); the Mayor of Thamesdown, Councillor John Stevens, cutting the tape for the start of the walk, and the Mayoress, Mrs Mary Stevens.

Picture by courtesy of Wiltshire Newspapers

Swindon v State House football match

The first Swindon v State House football match was played on the British Rail Sports Ground, Swindon, on 6 April, and resulted in a 3–0 win for the Swindon team. The Swindon goals were scored by Ian Midson (2) and Martin Lansdowne (1). After the match Ron Rivers, Chairman of the London Sports and Social Committee presented Swindon Captain John Cima with a cup.

Life in a railway factory

A man who could observe that a fan blade turning at considerable revolutions a minute could be seen on a quick upward glance, likening it to a snapshot (and thus, I believe, recognising a strobing effect), is not so far removed from a Council scientist. Even such a man, however, would have been surprised if told, when writing his book "Life in a Railway Factory",* at about the turn of the century, that in 1974 the Science Research Council, which had interests so varied as Astrophysics and Astronomy, Radio Wave Propagation, Nuclear Physics and Space Research, would set up an office in the Swindon Railway Factory, to which his book was devoted. He would have been surprised, yes, but keenly interested and certainly not surprised that man's ingenuity and intellect had made such rapid strides since the times and conditions for fellow factory workers he was so well recording.

The tunnel through which the author tramped with 10,000 others and sometimes, as a lad, ran after lingering rather late in bed following perhaps a late night reading or study session, is probably the self same tunnel that so startles newcomers to the Council's advance office when entering the factory from Bristol Street. He would have appreciated the new strip lighting that has been installed in the tunnel and may have likened the convenience of the catering dispensing machines in various areas of the factory and our offices to the coffee stalls at the entrance where, before the 6 am start, for a ½d "a cup of steaming beverage could be obtained and for a further ½d a large slice of 'lardy' or current cake" might be bought to fortify the worker against the labours of the day. He could, of course, if he were prepared to be a few minutes late – but before the close-out until after the breakfast break – have had a quick draft at one of the local Public Houses, which opened at 6 am. It seems the smiths were the more likely to need the stronger drink.

The principal office staff, even in those days, did not start until 9 am and there was a wide gulf between them and the factory floor workers. On the floor there were also significant social barriers between groups of workers. For instance the Carriage Finishers were classed, and considered themselves to be, well-to-do. They managed to buy houses in a better part of Swindon and liked to dress smartly. On the other hand should a man in one of the lesser trades attempt to emulate his betters by, perhaps, wearing a slightly smarter suit in Swindon on a Sunday, the author writes he was quickly reminded by his foreman on Monday that he was getting "up-pish".

Alfred Williams was obviously intellectually far above most of his fellow workers and a study of his life alone would make interesting reading. For instance he later spent sometime in India and mastered Sanskrit. Throughout the book he makes references to and gives quotations from literature. This knowledge was gained by extensive reading and one wonders how on earth he found time and energy for this and to write the book when he was employed for such long and arduous hours at the factory.

He obviously was keenly interested in observing other people and gives many descriptions of workmates. His description of the smiths as large, strong, slow-moving, easy but effective men, of modest temperament and few words, was much the same as given by many writers before and since. No doubt, this is because smiths are generally the same throughout the country and any true descriptions must be similar. However, the author goes beyond describing the smith and other workers at work and takes us into their leisure hours. He describes the behaviour of apprentices; youthful energy rising above pretty grim conditions and finding time for quick games of football during the breakfast and dinner-breaks. He mentions that the Frame-shed men were best at Tug-of-war and there are other insights of the simple pleasures of those hard times, including the year's climax of the "Trip" in the summer. The "Trip" came when the factory closed for the summer holiday and the railway bosses laid on special trains to take the workers and their families on a day's excursion to the sea. To this day many in Swindon refer to the "trip" meaning the BR Works holiday close down.

Anyone interested in reading of the conditions under which workers were employed at the turn of the century and interested in looking about the factory at Swindon would find Williams' book well worthwhile. In Swindon, Williams enjoys a reputation second only to Richard Jefferies, a journalist and writer, whose house has been opened as a Museum at Coate on the southern outskirts of Swindon, near his beloved Liddington Hill. Both men's names are likely to crop up at most unusual places and I notice that details and pictures of them are displayed in the new hut that has been erected at Barbury Castle Country Park on the downs. Of the two, my admiration goes to Alfred Williams and I recommend his book, which is in the Swindon Public Library but deserving a better portion than the reserve stock.

**Life in a Railway Factory by Alfred Williams initially published by Duckworth in* 1915 *but published again in* 1969 *by David and Charles.*

Peter Cook, the author of this review, is Contracts Officer at Swindon Office.

RGO's Swimming Pool

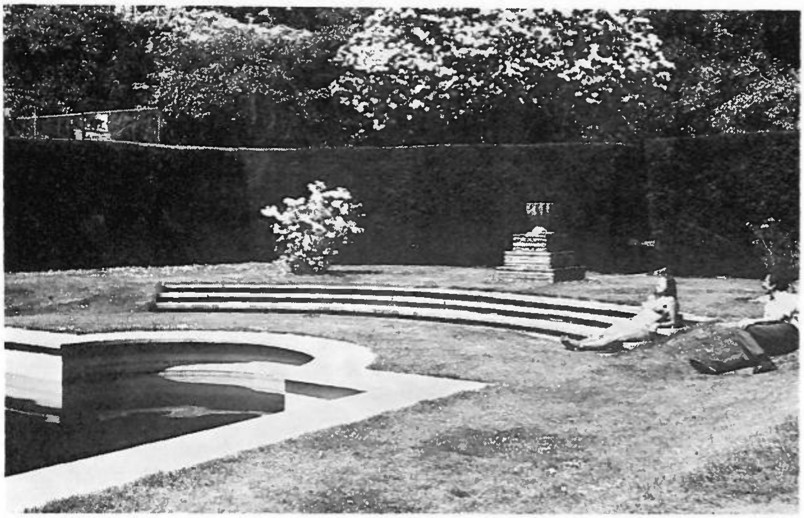
When people retire, it is customary for their colleagues to give them a farewell present. However, when the former Director of the RGO, Dr Alan Hunter, retired at the end of last year he reversed normal procedure and gave a present to his colleagues. It was Dr Hunter's wish that any money donated by the staff should be spent not on a personal gift but on a filtration system for the swimming pool (see picture below) in the observatory grounds. This pool is run by the RGO Sports and Social Club. In addition, Dr Hunter generously volunteered to contribute to the fund himself an amount equal to the total sum collected by his staff. In this way about £220 was raised for the fund towards the filtration system which has now been bought.

COMPUMAG '76

A three-day international conference on the computation of magnetic fields – COMPUMAG – was organised by the Rutherford Lab in April at St Catherine's College, Oxford. It was attended by more than two hundred delegates from fifteen countries.

Highlight of the conference was the specially set up magnet design workstation, shown right. Based on a GEC 4080 computer linked by a 4800-baud Post Office line to the Rutherford Lab's IBM 360/195 computer, the workstation enabled delegates to use the Lab's GFUN magnet design software running on the IBM computer together with additional computer-aided design programs running on the GEC 4080 machines.

Magnet design work began at the lab as part of its High Energy Physics development programme, but its potential for applications in



Picture shows progress made on the Nuclear Structure Facility (NSF)

Progress on the NSF

One of *Quest's* cover pictures last year showed the Nuclear Structure Facility (NSF) under construction at the Daresbury Lab. Dominant was the tower to house the 30 MW tandem electrostatic accelerator which is the focus of the Facility. This picture shows the progress in construction made by the beginning of May this year. The services tower, like the circular accelerator tower, rose very rapidly using the slip forming technique, to a height of 71·5 m. The accelerator tower will be topped by a circular ion source room, with access from the services tower, and the large crane has been installed to lift construction materials for this room. At the foot of the accelerator tower can be seen the semi-circular experimental hall, divided into three areas. The first area is now clear of scaffolding and should be ready in June to be used for assembly of the accelerator stack sections.

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other fields was soon realised, and the GFUN software has now been used by several outside organisations and research centres including British Rail and International Research and Development Co, for applications in such fields as magnetic levitation and Tokamak magnets for fusion experiments.

Royal Society Soirée

Exhibited at the Royal Society's Annual Soirée at Carlton House Terrace in May, was a new idea for using superconductors to provide magnetic levitation ('Maglev') which has been demonstrated in experiments at the Rutherford Lab. The result of initial work at the UKAEA's Culham Laboratory, the new development offers significant advantages over other Maglev systems which have been proposed for transport development studies throughout the world. In particular, the Rutherford/Culham system provides full lift force at all speeds, eliminates electromagnetic 'drag' and maintains a large clearance gap between vehicle and track.

Graham Homer, Rutherford Lab (right) explains the Maglev demonstration to journalist C L Boltz

Photo: UKAEA

Solution to Maxim 11

L	I	N	G	T	A	D	P	O	L	E	S	E
I	R	A	T	E	N	I	T	R	O	G	E	N
C	O	M	I	N	G	S	L	A	N	T	E	D
O	N	E	R	O	R	E	I	N	G	S	K	U
S	Y	N	O	N	Y	M	A	G	A	P	E	R
E	N	E	T	I	C	B	B	E	W	A	R	E
M	A	C	E	P	O	O	L	S	T	R	O	D
O	S	T	L	E	R	W	E	X	O	T	I	C
A	P	A	C	E	N	E	P	I	T	A	P	H
C	I	R	S	W	E	L	L	O	S	L	O	I
I	N	I	T	I	A	L	A	T	H	O	L	L
N	I	N	E	T	E	E	N	A	P	P	A	L
G	T	O	P	S	I	D	E	S	T	E	R	A

The winner was R D Eberst (ROE) who wins a £2 book token.

A land often heard but seldom seen

Last year, when browsing around the "Holiday 1975" exhibition, I came across a tour company offering holidays in Albania, apparently the least accessible country in Europe. With my interest already whetted by Radio Tirana (their national broadcasting commission, whose powerful transmitters broadcast abroad in seventeen languages), I was hooked.

Albania is situated where the Adriatic Coast meets that of the Ionian between Yugoslavia and Greece, across the water from the 'heel' of Italy. Only a few hours by air from London, it is not as remote geographically as it is politically. Unlike the other Eastern bloc states, Albania has completely rejected the Russian de-Stalinisation policies. Although a small country of some two million people, roughly the size of Wales, it has become a big voice in the international propaganda game. Albania is also an active member of the United Nations.

Mural at Fieri, Albania

At last the day came. Tirana Airport seemed hardly that of a capital. After London or Belgrade, it looked more like a country stately home. In groups of three, we went through customs; every case was opened and searched for books. No "Playboys" or Bibles are allowed into Albania! A few lads whose hair was even shorter than mine had to be trimmed by an airport barber and they had to pay!

Then we boarded our 'Albturist' coach. As we drove through flat farming country down to the sea, we were given a brief history of the modern People's Republic and told how to make our stay in Albania happier – don't photograph anything military, don't give tips, or give chewing gum to children!

Our hotel, in the resort of Durres on the Adriatic, was right on the beach. It was a grand stone building, not one of the latest concrete blocks, with long terrace-like balconies on each floor overlooking the sea. It was early in the season and the resort was almost a ghost town as the other hotels were not yet open.

Durres town, the country's main port with 60,000 inhabitants, was a few miles away but out of bounds to tourists except on excursions. I had booked an excursion on the first morning and visited the Liberation War Museum and the Roman amphitheatre. Every convenient point was decorated with slogans and posters proclaiming "Glory to the People's Republic of Albania", "Long Live the Party of Labour" (Communist Party) or "Enver Hoxha" (the President) and so on! Throughout the holiday, we would see them almost everywhere, even in the countryside.

In the morning we set off towards the hills. After Elbasan, an industrial town, the scenery became more mountainous. We had been following a railway, which was now being pushed onwards by volunteer labour towards the Yugoslav border. We frequently waved to gangs of workers digging, levelling and earthmoving, many of them women. (Albania's railways have all been built since Liberation and much of the country is still uncovered. There is no connection with the railways of the neighbouring countries.)

Next on to Korca, the largest town of Eastern Albania, with a population of some 60,000. It was a dusty, old town of little yellow stone houses and a few wide, trafficless boulevards in the centre. Trafficless, that was, apart from buses, lorries, a few donkey-carts and a great many bicycles. This is typical in this country, where family cars are virtually unknown. There were not very many shops and those that we saw were uninspiring, selling little more than essentials.

There was a day-long excursion to Tirana, the capital of Albania, which has a population of some 200,000. Our first call was to an exhibition of "Albania Today", which I greatly enjoyed, with displays of industrial products, machinery, models and consumer goods, etc. Much of it must be for export as little of it was seen in the shops. There was a good display of radio and TV sets; those I had seen so far were made in China or Germany. (Almost all manufactured goods we had seen were made in the People's Republic of China.)

When we returned home to Britain I found I had mixed impressions of China's beach-head in Europe. Although I enjoyed the experience, I don't know if I would go again!

The author, Ian Wadman, is an Assistant Scientific Officer at the Rutherford Lab.

Schoolboy Scrambling

What?, you may say! Well, motor-cycling by school children, mostly boys, of course, is a sport which has grown rapidly in popularity over the last two or three years. This year our son's club has just over two hundred members from an area stretching from Essex to Kirkcudbrightshire. There are at least thirty similar clubs in the country and many run events under nationally-agreed regulations which allow riders and machines in the ranges:

Age	Class	Max. engine cap cc	Typical quoted hp
6 to 7	Cadets	50	7
8 to 10	Juniors	80	11
11 to 13	Intermediates	100	16
14 to 16	Seniors	125	23

Counting the cost

It is possible to scramble on a bike bought for less than £100. However, the excellent competition bikes now available in suitable sizes, say of 100 cc, start at over £500 new, though good second-hand ones can be obtained for £300 to £400. Other sizes cost roughly pro rata. Is it complete madness to put a £400, 16 hp, 10,000 rpm, 60 mph bike in the hands of a twelve-year-old? Perhaps it seems so but the growth of skill and achievement is a great reward, the whole family has fun over a long season and makes a lot of friends. The dangers are more apparent than real. Anyway, annual depreciation can be less than the cost of a new push-bike.

Clubs vary considerably in activity but ours gives a good general picture. We put on about twenty scrambles a year between February and November and including a few 'National' events. A typical meeting includes forty-five Seniors, thirty-five Inters, twenty Juniors and ten Cadets.

The tracks

We have eight tracks for proper scrambling plus a nursery track for novices Each proper track covers up to about twenty acres and preferably includes moderately-rough ground with slopes and hills offering rises and falls up to sixty feet or so. A few patches of mud, shallow water and a whoop-dee-doo or two are also desirable. What's a whoop-dee-doo? It's a set of corrugations on the track with a wavelength of about a wheel-base and amplitude up to a foot or so. When not a natural formation, they seem to be generated by the racing and act as very effective skill filters.

Picture shows an 'Inter-Class' (ages 11-13) competition in April 1976. Rider 42 is Tim Hopkins (aged 12½)

Riding techniques

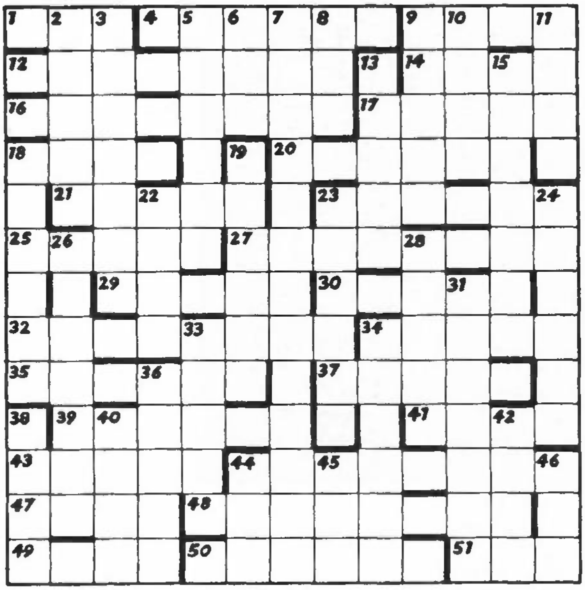
Among the riders themselves, there is much chat about riding techniques including, of course, the 'fun' portions which look spectacular but are not necessarily the fastest method of getting round the track. These are the 'wheelie' (front wheel in the air) and the jump (both). One must admire the ability of lads from six upwards who can put a 150–200 lb motor bike in the air for a few feet or yards, put it down under control and proceed without fuss, all at speeds of 20–40 mph, and with a sharp bend perhaps only a few more yards away.

Educational trade-offs

There are significant educational trade-offs from what may appear to be simply a very expensive and time-consuming way of keeping boys occupied. With a little ingenuity and grasp of opportunity, there are chances to introduce subjects like maths in the cross-section and volume of cylinders, and in gear ratios, problems of gas flow and mixing, combustion and temperature, voltage generation, transformation and transients, frame design and dynamics, springs and shock absorption,cleaning and maintenance of close-tolerance machinery, and so on. Throw in a bit of geography in finding courses in this country and locating motor bike factories around the world, cost accounting in looking after the necessary and you have a ready-made, highly motivational education package for youngsters.

It is well to think of these benefits when, on a bitterly cold day you are up to your ankles in mud, a small boy is winding on deafening power and you are pushing from behind getting facefuls of moist countryside. Somehow, it still all seems worthwhile.

Our contributor, John Hopkins, is an SSO at Daresbury Laboratory, an inveterate member of small societies and committees, and presently the Hon Secretary of the North West Schoolboys Motor Cycle Club, the best in the country, he claims.



MAXIM 12

MAXIM 12

The completed diagram contains nine names to which the only clues given are the owners' titles. However, the central column shows where they all come from.

Clues

ACROSS

1. Source of ready-burned firewood? (3)
4. *Master* (6)
9. How chicken begins to produce an egg of earthenware (4)
12. Try to speed up the receipts (fake) (8)
14. 'His Majesty', in the jungle, knocked about, found on the floor (4)
16. Repair-men produce rubbish when loaded (8)
17. Wrong note, right singer (5)
18. What secretary does when boss is upset? (4)
20. *Mr and Mrs* (6)
21. Called 'Mend a Broken . . . (5)
23. . . . Outcast', song steeped in acidity (6)
25. The three R's, each half-assimilated; not met with so often (5)
27. Carrier of vital fluid must hold up dirt, be in good order (4,4)
29. Hang around nearly all day for re-conditioning (5)
30. Girl left bits: how you might cook them (5)
32. *Miss* (8)
34. Announcer of 18th century, who 18? (5)
35. Was alarmed by something made of iron, with a rusty end (6)
37. Story that come to the point after that other lot (5)
39. *Mr* (6)
41. Water-holes where capillary attraction works in reverse (4)
43. Examinations of solar phenomenon (5)
44. Collectors take in loads after start of auction (8)
47. Score nothing in a six-ball over (4)
48. Garden beside scene of London hangings – in a condition not conducive to eating (8)
49. Always, yet almost not at all (4)
50. *Dr* (6)
51. Maxim is observed (3)

DOWN

2. It's quiet inside, so continue to flirt (5)
3. *Mrs* (7)
5. Better lubricated, or drunk or I lie! (6)
6. Eggs of Auld Reekie? (3)
7. (*See preamble* – 7,6)
8. Bend that goes one way, then another, then repeats (3)
9. About 'His Majesty'? It's obvious! (5)
10. Non-U until broken, then bandage (4)
11. *His Grace* (4)
13. Band divides up (5)
15. Lacking the capability, yet standing out from the crowd (7)
18. Rebellious cur's very loud – grab him by this (6)
19. Tot conducted, in a mess (6)
22. One surrounded by males? But I'm normal! (4)
23. Show compassion about rear of building's unattractive accommodation (6)
24. *Her Majesty* (6)
26. French and English go in Leyland vehicle (7)
28. I rest uncomfortably – it is fatiguing (5)
31. They are flexible and set askew, but renowned for tenacity (7)
33. Viscous river flows round two points (5)
34. Pursued, we hear, but apparently remaining uncaught (6)
36. 'His Majesty', perhaps, known for straightness (5)
38. *His Majesty* (4)
40. Go mad about pop-star in opera (Verdi) (4)
42. A measured region of the near east (4)
44. Notice nothing – with much of this? (3)
45. Half of us want nature's Stakhanovite (3)
46. Stitch in three different directions (3)

The prize will be awarded to the first correct entry drawn. Please state whether you would prefer a book or record token. The solution will appear in the next issue.

Solution to Nutcracker 20

Refuse both the first two posts drawn. After that, accept any post which is as good as or better than the better of the first two. This gives a probability of 0·3856 of getting the best post. There were no correct solutions.

NUTCRACKER 21

It was time for the annual staff reshuffle in the Council's Parascience Division. Each of the five Committee Secretaries moved to a new Committee, no two of them swopping places. Fuddle moved to Telepathy, whilst the Secretary of Ufology moved to the Committee vacated by Idle. Goggle moved to the Committee vacated by the Secretary who moved to the Committee vacated by Huddle. Jumble moved to the Committee vacated by the Secretary who moved to the Committee vacated by the Secretary who moved to the Committee vacated by Fuddle. The Secretary of Radiesthetics moved to the Committee vacated by the Secretary who moved to Spoonbending (the Secretary of which incidentally, was very disappointed not to have got Huddle's old Committee). Who became Secretary of Vampirics?

The prize will be awarded to the first correct entry drawn. Please state whether you would prefer a book or record token. The solution will appear in the next issue.

Cribbage pairs competition

Two members of the London Office Sports & Social Club Committee, Veronica Harris and Graham Tidmarsh, were runners-up recently in the London Region CSSC Annual Cribbage Pairs Competition. A tie in the first round was followed by a 2–1 victory in the quarter-finals but after a convincing 2–0 win in the semi-finals the tables were turned in the final and they lost 2–0.

Safe Driving

The Royal Society for the Prevention of Accidents has announced its 1975 National Safe Driving Awards. Our congratulations to the following Rutherford Lab drivers

Mr H G Patterson – Bar to 15 Year Medal (19 accident free years)

Mr E A Smith – Oak Leaf Bar to 10 Year Medal (13 years)

Mr A H J Hill – Oak Leaf Bar to 10 Year Medal (12 years)

Mr J Culley – Oak Leaf Bar to 10 Year Medal (11 years)

Mr D A Stock – Bar to 5 Year Medal (9 years)

Mr B T Field – Second Year Diploma.

Herstmonceux Conference

The twentieth annual Herstmonceux conference was held at the RGO on 30 and 31 March 1976. The theme was "Astronomical Results from New Instruments and Techniques". In addition to RGO staff, about ninety-five visitors, including astronomers from seven overseas countries, attended the conference.

Special Promotion

Congratulations to Dr R J Dickins (RGO) and Dr J B Forsyth (RL) who have been promoted to Senior Principal Scientific Officer on the recommendation of the Individual Merit Promotion Panel.

Energy Savers

A joint project to save energy and cut the cost of heating and lighting Oxford's schools and colleges is being undertaken by the County Council and the Department of Education and Science. The Rutherford Lab will be collaborating with Oxford Polytechnic's Department of Architecture to carry out studies for the project.

Wanted

Rugby players, soccer players, athletes, etc., to represent the Council in Civil Service 7 and 15 a-side Cup Competitions. Willing volunteers and enquiries to Gordon Rowe, State House, ext 7.

Finite elements

'Finite elements', a 10-minute colour film which is the first engineering film to be generated entirely by computer, had its premiere at the Royal College of Art in May. The film, which was made by the Atlas Computer Division of the Rutherford Lab in collaboration with the Royal College of Art was produced using the specially developed ANTICS computer animation software on an ICL 1906A computer, together with a computer-controlled microfilm recorder. The same techniques were also used to generate the sound-track music.

As well as introducing the engineering technique of finite element analysis, the film sets out to demonstrate the potential usefulness of the computer in solving practical engineering problems. It also illustrates the use of computer animation and film making as a general research tool, showing how masses of numerical information can be analysed and how models can be tested in all sorts of possible situations.

Observatory directors

Dr Michael W Feast has been appointed as the new Director of the South African Astronomical Observatory (SAAO). Dr Feast, who was educated at Imperial College, London, was an astronomer at the Radcliffe Observatory in Pretoria from 1951 to 1974, when he joined the SAAO. He succeeds Sir Richard Woolley, who is retiring at the end of the year.

Professor Donald Morton has been appointed as the new Director of the Anglo-Australian Observatory. Professor Morton, a Canadian, is senior research astronomer and lecturer and also director of graduate studies in the Department of Astrophysical Science at Princeton University, New Jersey, USA. He is expected to take up his new position in September. He succeeds Professor E J Wampler who will return to the Lick Observatory in California.

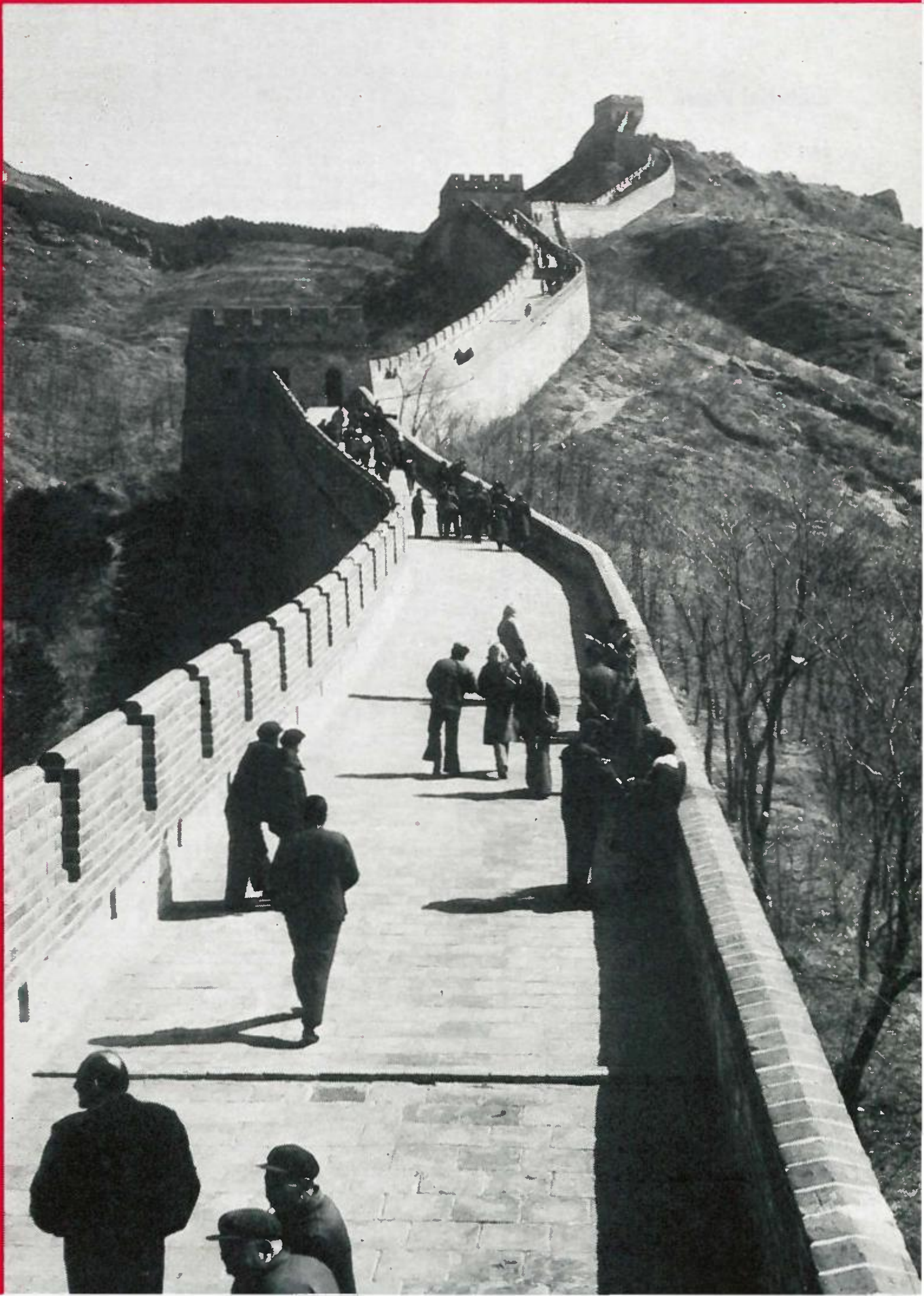
QUEST

The 'Locstitch Machine'

New techniques for oil extraction

Recollections of China

Vol 9 No 3



QUEST

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1976

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Cover
Cover shows the Great Wall of Ten Thousand Li', stretching like a Roman road with dragon's teeth for four thousand miles or more from east to west across the inner northern border of China. (See 'Recollections of China'—page 5)

Quest will be issued four times this year by the Science Research Council for members of staff only. The Council is not necessarily associated with any individual views expressed.

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(The following statement was issued by Council on October 21 when its annual report for 1975-76 was published)

Precautionary measures in view of current financial uncertainty

Page 3 of the Annual Report describes the programme which the Council had planned to follow on the allocations indicated in the last Public Expenditure Survey and the Second Report of the Advisory Board for the Research Councils. After the summer cuts in public expenditure, it became clear that the SRC's budget will fall more quickly, and that the Council will have to revise its plans in a number of ways.

The nature of the work supported by SRC makes it difficult to adjust expenditure rapidly. In order to operate effectively, the Council need long-term assurance of the level of funding. They will make new plans to develop research and training to best national advantage, as soon as they have an indication of the resources likely to be available.

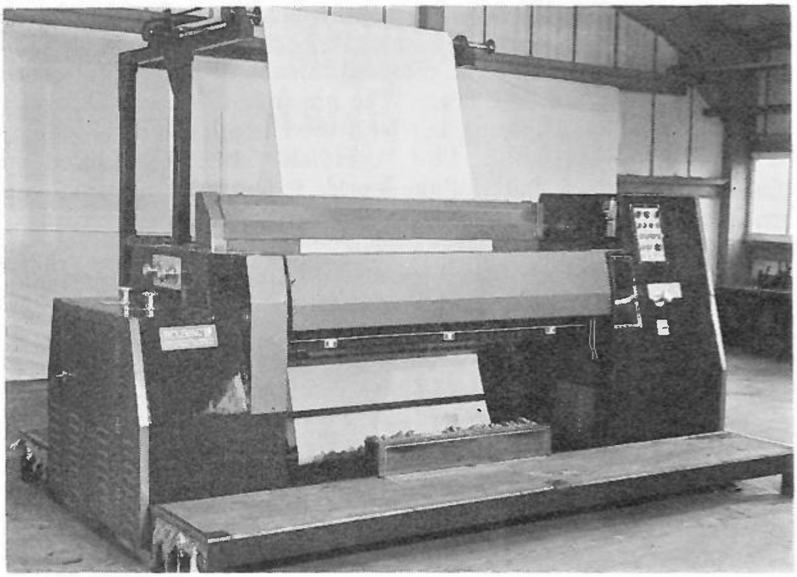
Meanwhile, the increasing cost of international subscriptions due to changes in exchange rates is presenting problems for the current financial year and could present similar problems in the next financial year. These payments now account for almost one-third of the SRC budget. The Government is considering how to deal with this situation and the possibility of savings in the international contributions is being explored. However, until we know the basis on which variations in exchange rates are to be handled and also what funds will be available to the Council in 1977/8, uncertainty will remain.

I hope that this uncertainty will be resolved before long, but meanwhile, as a matter of prudence, the Council has decided that they should, so far as is practicable, defer making new commitments. Therefore, until the financial situation is clearer:

a. the special restrictions on recruitment to fill vacancies which occur among the Council staff will continue in force;
b. commitments at SRC establishments to expenditure in 1977/8 on supplies, services and equipment will be limited to 80% of the sums requested in the Council's Estimate proposals for next year;
c. the announcement of research grants for new programmes, which would normally be made in November or December, will be deferred; and
d. consolidated grants and grants for rolling programmes will continue to be announced in the normal way but holders will be asked to defer the filling of vacant posts and the making of new commitments for capital expenditure wherever this can be done without serious damage to the work.

A further statement will be made about future operations when the financial situation has been clarified.

Contents



The prototype 'Locstitch' machine, designed in the Department of Mechanical Engineering, Loughborough University of Technology, by the inventors, G F Ward and G R Wray and built by Pickering Locstitch Ltd in 1971

The 'Locstitch' machine

Newcomers to the machinery involved in the manufacture of textiles are often surprised by the variety of mechanisms used.

Most of these have evolved during a period of intense mechanical engineering activity in the early nineteenth century. As a result many of the machines used today for the manufacture of yarns, fabrics and garments, have clear origins in highly ingenious devices thought of over a century ago; designers have extended traditional practice but until recently little modern mechanical engineering technique has been applied.

Since 1966, a research and development programme at Loughborough University, under the supervision of Professor Gordon Wray, who holds a personal chair in the Department of Mechanical Engineering, has developed a machine which now offers great flexibility and potential over conventional weaving methods for manufacturing pile fabrics.

'Locstitch' machine

Known as the 'Locstitch' machine and based largely on the university-designed prototype, it is now currently operating successfully in several parts of the world. The production speeds are some thirty times faster than traditional pile-fabric weaving.

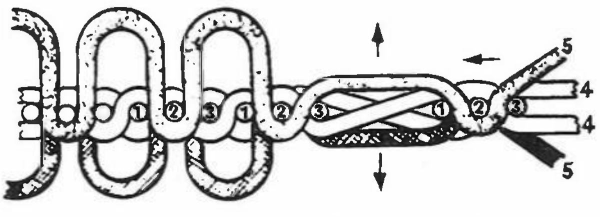
The story is somewhat unique in the field of manufacturing machinery.

For Professor Wray and his colleagues, the story of an investigation which resulted in a new machine and process for British industry, started on the back of a British Rail menu card. For SRC the involvement was grant aid of £11,567.

The invention, research, development, testing and prototype design stages were all conducted within the department in four years.

Pile fabrics

Traditionally pile fabrics – the sort of material we all



1, 2, 3 web yarns **4 ground weft yarns** **5 pile warp yarns**

use in terry-towelling, velvets, carpets, upholstery fabrics and blankets is based on the principle of the interlocking of pile warp yarns (see fig (page 1) section 5) with ground warp yarns (4) and weft yarns (1, 2, 3) to produce the complete pile fabric in one weaving operation. The operation is slow mechanically, the resultant fabric not very stable and a pull may cause the pile to "run" or the fabric to fray.

In 1961 while working at UMIST, Professor Wray visited Czechoslovakia and East Germany, and saw two unconventional fabric machines using a base fabric into which stitches were inserted by compound knitting needles at high speed.

This method too had limitations in that pile loops could only be produced on one side of a base fabric. The complex stitching system limited production values even though this exceeded conventional pile weaving.

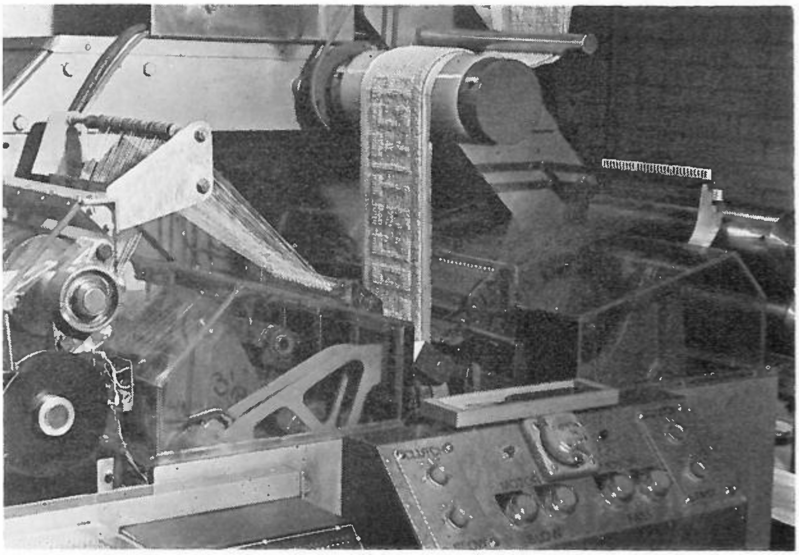
Ideal equipment

Discussing the problem the following year with Mr G F Ward, a colleague whose industrial experience in boot and shoe stitching machinery design complemented his own in textile machinery, Professor Wray and Mr Ward came to the conclusion that the ideal construction was a stitch in which looped pile could be generated on *either* or *both* sides of the base fabric, the loops being of a similar character and securely locked so that they could not run or fray. The ideal locked-loop double pile stitch was given the trade name 'Locstitch' and the idea came to them during a meal on British Rail while returning to Loughborough from London.

First practical embodiment of the stitch was performed by two domestic sewing machine needles using different coloured threads to penetrate a cardboard base fabric. The principle is in fact similar to hand-knitting but with eyed needles and through a base fabric. Now 'Locstitch' fabric is produced in many parts of the world. It will not fray when cut and is ideal for brushing or cropping blankets, rugs, furs of similar materials.

Current versions of the "Locstitch" machine produce plain unpatterned fabric. A further SRC grant (£23,000) has enabled Professor Wray and his colleagues (Mr R Vitols and Mr J E Vine) to develop a sculpture-patterning system in which individual loops are preselected from a pattern painted on a continuous transparent film. The sensing of this pattern is done by photo-electric circuitry. The circuitry activates individual solenoids to "interfere" with a looper orbit mechanism. Thus, either a high or low pile height is produced according to the electric signal perceived.

This approach however has limitations and Professor Wray and his colleagues are still refining their techniques on a remarkable technical innovation with which Council is pleased to have been associated.



Sculpture-patterned pile-fabric emerging from the research rig

Mr Ward is now technical director of Pickering Locstitch Ltd who developed the Loughborough process under NRDC licence and is therefore able to devote himself to the commercial realisation of the machine of which he was co-inventor.

Think on these things when next you try out that non-run deep pile fabric in the local department store.

Council Commentary

May to July 1976

Membership
At the July meeting the Chairman thanked the retiring Council members (Professor Callan, Mr Ferguson, Dr Pringle and Professor Stibbs) for their services and announced that the Secretary of State had agreed to the appointment of the following new Council members: Professor G Allen (Imperial College), Dr J P Birks (BP Trading Ltd), Dr P F Chester (CEGB), Professor Sir Granville Beynon (Aberystwyth), Professor W E J Farvis (Edinburgh) and Professor Sir George Porter (Royal Institution).

New Grant Regulations and Procedures
At its July meeting Council approved a new grants 'package' which should simplify the administration of research grants and give grant-holders considerably greater freedom. Under the new arrangements investigators holding 'normal' grants will be allowed to transfer funds between headings virtually without restriction and grants will automatically be compensated for national salary awards; there will, however, be no further supplementation allowed or extensions (save a 6-month flexibility in starting date). Certain grants which are 'special', because of their size, duration or nature whilst having the above features will also be subject to review and may be of a 'rolling' kind (e.g. initially a 4-year grant reviewed after 2 years to determine the future level of support.

Joint SRC/SSRC Committee
In June the Council considered the Joint SRC/SSRC Committee's proposals for implementing the recommendations of its second report on broader postgraduate training. To underpin and sustain this kind of training the Committee wishes to award limited research grants to provide a stronger research base in this area. The Committee also proposes a planning target of 200 studentships (involving extensive use of CASE) by 1981. The Council accepted these proposals as a general guide subject to the normal annual review of allocations.

Polytechnics Committee
Also in June the Council had a preliminary discussion of the first report of the Polytechnics Committee. Because of the marked differences between Polytechnics and Universities the Committee believes SRC must give special consideration in helping Polytechnics carry out those important functions which they are best able to undertake, such as vocational training (and here the support of part-time students may be particularly important) and collaborative research and training with local industries and public bodies. The Council discussed the Committee's report with Board representatives at its weekend conference in September.

SRC Fellowships
At its July meeting the Council approved the creation of an Advanced Fellowships scheme. A small number of these fellowships will be awarded for up to five years to outstanding research workers who are well-qualified for academic careers but who do not hold tenured posts. They will fill a gap between the Council's existing postdoctoral fellowships and senior fellowships.

Central Computing
At its July meeting the Council approved a proposal for upgrading the Daresbury IBM 370/165 at a cost of £670K plus VAT. At present insufficient funds are available to undertake the whole of the upgrading and the Council therefore, authorised the Chairman to approve the placing of orders for the individual items if and when funds became available. The Council also noted that discussions were being held between SRC, International Computers Limited and the Department of Industry on a computing project (The Distributed Array Processor).

Establishment and Facility Committees
In June the Council approved the setting up of Establishment Management Committees for each of its Establishments. The Committees are to advise the

Chairman of Council and the appropriate Boards on the resources required to undertake various programmes and to advise Establishment Directors on the carrying out of these programmes. The Committees will have delegated powers of financial approval. Additionally the Council agreed the membership and terms of reference of a Laser Facility Committee, a Neutron Beam Research Committee, an Interactive Computing Facility Committee and (in July) a Facility Committee for Computing. These Committees will advise the appropriate Board (and in the latter case the Council) and the appropriate Establishment Directors on the use of the facility concerned.

Radio Wave Propagation Research at the Appleton Laboratory

At its June meeting Council agreed that support of long-term research in radio communications at the Appleton Laboratory was more logically the responsibility of the Engineering Board rather than the ASR Board (as at present) and agreed to transfer this responsibility.

Astronomy, Space and Radio

(i) *Fulmar Sounding Rockets*

The Council has approved increases in cost in the procurement and launching of six Fulmar rockets. The revised cost estimates are now £339,000.

(ii) 3.8*m Infra-red Telescope*

The Council in July approved cost increases (due to exchange rate variations and inflation) of £365K for the construction of this telescope. The revised cost estimate is £2·562M.

(iii) *First phase of the Northern Hemisphere Observatory*

In July the Council considered and approved a proposal to proceed with work on a first phase of the Northern Hemisphere Observatory at a capital cost of £4·904M. This phase will comprise the moving of the 2·5m Isaac Newton Telescope, a new 1m telescope and some site works.

(iv) *Grants*

The Council approved a consolidated grant not exceeding £225K to Professor Sir Bernard Lovell at Manchester University for radio astronomy research at Jodrell Bank and approved a supplement of £129K for work on a stratospheric and mesopheric sounder for Nimbus G satellite.

Engineering

(i) *Marine Technology*

Council, at its July meeting, considered the report of the Marine Technology Task Force set up by the Engineering Board to advise it on priorities and funding requirements in marine technology. The principal recommendations of the Task Force are that SRC should support a major coordinated programme in marine technology related to the extraction of offshore hydrocarbons and that SRC funding should be focused on a limited number of centres of expertise, with work being concentrated initially on six priority areas identified by the Task Force. The Task Force saw the need for a programme costing £24M over five years with an additional £10M for capital items. The Council recognised the need for such a programme, although of course the actual level of its funding will need to be assessed taking into account the competing claims from other areas of the Council; to provide the central coordination clearly required for such a programme the Council agreed to the formation of a Marine Technology Directorate. Meanwhile, in order to deal with existing proposals for work in this field, Council also approved the setting up of a Marine Technology Panel with the delegated powers of a Committee to make research grants.

(ii) *Interactive Computing Facility*

In November 1975 Council agreed in principle to an interactive computing facility being established under the auspices of the Engineering Board. The Council has now approved the first steps in its establishment by agreeing to the enhancement of the PDP 10 computers at Edinburgh University and UMIST (which will be part of the network which will form the facility) and to the purchase of an initial instalment of terminals.

(iii) *Grants*

The Council approved grants of £182K to Professor F J Bayley (Sussex University) for a thermo-fluid dynamics research laboratory, of £152K to Professor N A Dudley (Birmingham University) for support of a programme at the 'teaching company', Matrix Machine Tools Limited and of £113K to Professor R J Sury (Loughborough University) for support of a programme at the 'teaching company' Herbert Morris Limited.

Science

(i) *Neutron Scattering Experiments at High Pressures*

In July Council approved a proposal for the construction of a high pressure sample cell and pressurising system for neutron scattering experiments at a cost of £63K.

(ii) *Synchrotron Radiation Source*

Also in July Council approved increases in the capital cost for construction of the Synchrotron Radiation Source; the revised approved cost is £4M.

(iii) *Grants*

Council approved a supplement of £6·1K to an award of £130·8K to Professor D J Bradley, Imperial College for work on vacuum ultra-violet gas lasers.

New Techniques for Oil Extraction

Experimental techniques aimed at developing new methods to recover oil from reservoirs are being tested by a team of engineers and scientists at Heriot-Watt University, Edinburgh. Current methods of extraction employed by the petroleum industry may leave behind as much as forty to fifty per cent of oil and, if the methods being investigated by the University research team prove successful in application, the life of an oil well, presently estimated at twenty years, could be almost doubled.

Council has backed the research with two 'priming' grants, totalling £24,250, under the direction of Professor Cecil Nutt, Head of the Department of Chemical and Process Engineering at Heriot-Watt University, together with Professor James Brown (Chair of Petroleum Engineering), and Dr Roger Burley, Dr Terry Bale and Dr Adrian Todd.

Use of foam

The first of two methods being investigated involves the pumping of a foam into an oil reservoir. At present, oil is extracted by natural pressure supplemented by injecting water or gas. Water and oil, however, do not mix and this technique leaves considerable quantities of oil behind, trapped in rock pores. It is thought that a foam will displace the oil more efficiently than water or gas separately and so the University researchers believe that considerably more oil can be extracted, by using foam in this way; little, however, is known of the problems which would be involved.

"Our present methods of extracting oil are pretty poor," comments Professor Nutt. "The so-called 'depleted' oil-fields of America, for instance, still hold great quantities of oil. Earlier methods of extraction skimmed off the cream, estimated at only fifty to sixty per cent of the total, leaving the rest behind, and have perhaps made it more difficult to extract the residue in the future. The foam method looks promising, and we are trying to learn something about the fundamental properties of the foam and what will happen when a foam 'plug' flows through porous rock."

A £5,700 equipment grant from the Council earlier this year enabled the research team to test the performance of the foam under laboratory conditions, using artificial beds of sand or rock core in columns several feet high.

Chemical method

The second method, research into which received a further grant of £19,550 from the Council in July, tackles the same problem but from a different approach. Instead of foam, the research team is investigating the use of chemicals, somewhat similar to soaps or detergents which emulsify the oil (in much the same way as a washing-up liquid cleans grease off a plate), and the way the surface-active soaps displace oil from the rock pores.

"Crucial to the economics of both methods," comments Professor Nutt, "is that rather expensive foaming and detergent chemicals tend to be lost by absorption in the rock stratum or by dilution in residual water. Our investigations will help to predict more accurately the behaviour of chemicals in these conditions, to minimise waste. At a later stage, our Department of Economics, under Professor Donald MacKay, may be involved in quantifying the economics of the new methods.

"It is essential that Britain gets involved in this field of research if we are to ensure that quick methods of extraction of oil from the North Sea reservoirs are not going to be unnecessarily wasteful."

Recollections of China

ANGELA KILLICK

The surrounds of the Summer Palace outside Peking are famous for their man-made vistas which are superb, even in the rain

"You have spent 18 days seeing our country," said the Chinese comrade next to me on the train from Canton to the Hong Kong border, "and I should like to know what you think are the major problems facing China."

Pausing to collect my wits – after all, 18 days in a country does not qualify one as an expert– I suggested rather tentatively that one major problem was how to handle over-manning, another was how to stimulate the economy without causing upsetting distortions elsewhere, and a third was whether the Chinese system could be made more flexible so as to take advantage of favourable opportunities such as in trade.

China has a population approaching 800 million, of whom more than half have been born since the Communist takeover in 1949. The first objectives of the Chinese Communist Party (the CCP) have been to feed and clothe this population – which they have done. Now their objective is to create a classless society. There would be no point, they say, in simply exchanging one class for another as has happened in the USSR.

Dissatisfied customers

It is extremely important to assess the People's Republic against the background of old China. To me the achievements seem immensely impressive. However, as with everything in this life, there is always a price to pay. The Chinese themselves say that possibly 8–10% of the population may be opposed to the present regime. They point out that in a western style democracy this would not be an unacceptable proportion of dissatisfied customers and than add that in China, 10% is 80 million people. Most of these, they suggest, bow like the reed in the wind; perhaps 3% are actively opposed. Some of these will risk their lives trying to get to Hong Kong; some apply to leave China and are allowed to go (China would let more go if Hong Kong would let them in); some no doubt are sent to do lao jiao (education through labour) and others, more seriously, to lao gai (reform through labour) which may well be in prison; others remain in their jobs and homes but have their civil rights withdrawn and are under local supervision. The Chinese say they have fewer people in prison now than before the Cultural Revolution in 1966. I am certainly not in a position to know the realities of the Chinese prison camp system but my best guess is that it is probably less vicious than the Gulag Archipeligo.

Children and staff at a factory kindergarten in Shanghai

One of the spectacular figures from the Avenue of Stone Statues on the route from Peking to the Ming Tombs

And the other 720 million? Eighty per cent of these are peasants. It was my impression when speaking to students that, if a cachet attaches to any particular job in China, it is to the peasant's, though clearly one would have to live in China to verify this. In a country where manual labour has traditionally been despised this is indeed noteworthy. Mandarins in old China used to grow their nails to such a length that it was clear they could not work!

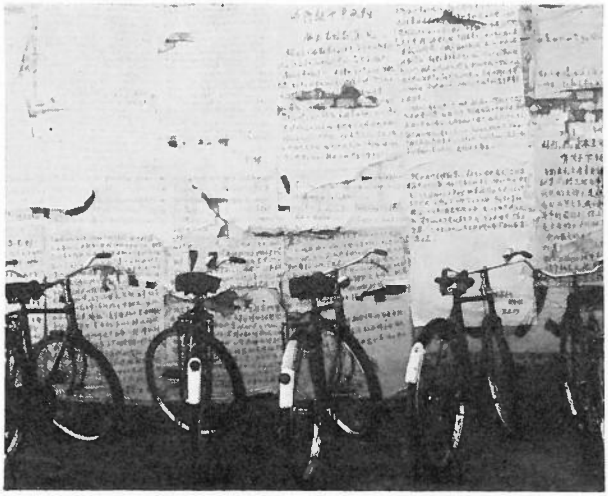
Pre-revolution conditions

A great many peasant homes do not have glass windows, electric light, running water or private lavatories. However, a great many do have mud brick walls and mud tile roofs compared with the daub and wattle and thatch of thirty years ago. To most people in old China personal liberty was academic. It became difficult and often impossible to stay out of debt. Landlords charged interest on loans, and interest on interest so that in time the debt grew larger instead of smaller; at one time under Chiang Kai-Shek taxes were paid 40–70 years in advance. The collapse of the yen was even more dramatic, and consequently traumatic, than inflation in the Weimar republic. People starved in hundreds of thousands, if not by the million. To be obliged to sell one's child or even parents was common. Against this background, to be free from the fear of hunger, of homelessness, unemployment, war and debt, to have some prospect of saving money (on which the government will pay them 4% interest), and a modicum of educational and medical facilities – is for many like living in the kingdom of heaven.

Two years after the revolution, or liberation as the Chinese call it, the communists boasted that every woman in China now had a comb, a handkerchief and a pocket mirror; today they boast (I was told) that every family in China has a wristwatch, a radio, a bicycle or a sewing machine. I repeated this to one of our guides; he thought for a moment. "No," he said, "it isn't quite true: we are working towards this objective but we haven't got there yet."

No wonder that Mao Tse-tung has virtually become a god. Ironically for someone opposed to all superstition he may have been assisted a little by his wart which in old China would have had great significance as a cyst on the chin or forehead denoted the benediction of heaven. It is not too surprising that the little statuettes of "the Buddha to come" that used to be sold at the spring festival have metamorphosed into representations of Mao-Tse-tung.

There is no doubt that Chairman Mao is a giant among men, but it is disquieting to see the eulogism carried to excess. The four apostles are Marx, Engels, Lenin and Stalin; the room in which the Chinese communist party was formed in 1921 contains twelve chairs, and the table is laid for what looks for all the world like the last supper. Mao is at times depicted with streams of light, adulating crowds at his feet – everything in fact bar a halo. "Our Great Leader Chairman Mao" became OGLCM in my notebook to join GPCR (Great Proletarian Cultural Revolution) and MLMTT (Marxist-Leninism-Mao-Tse-tung-Thought).



Bicycles and wallposters outside the machine tool workshop attached to a teacher training college near Peking

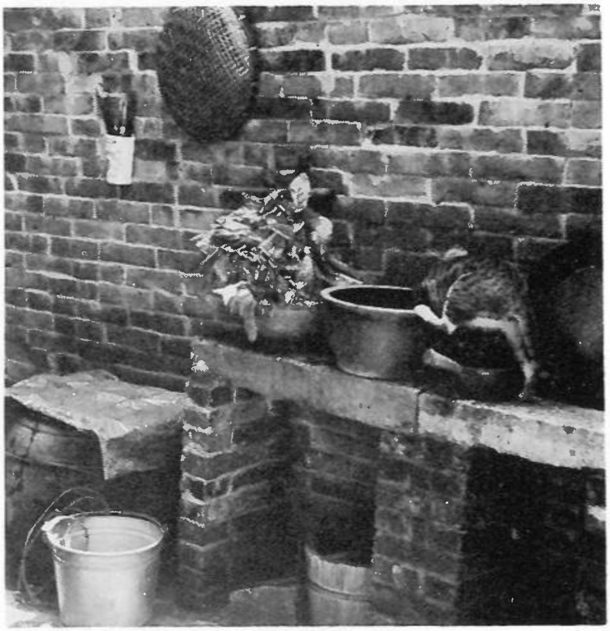
Song titles at Chinese concerts include "Mao Tse-tung sent me to the University", "The cadres don't fear the hardships or dirt in looking after the pigs", and "We listen with joy to the communiqués of the First Peoples National Congress". The retired couple to whom we posed the question "What do you do in your leisure time?" replied "There is nothing in our life that is not political". Old age pensioners participate in three hours political discussion a week, students eight hours, and so on through all walks of life. It has been estimated that in the first decade of communist rule alone, each adult had engaged in perhaps ten thousand hours of regular study sessions.

Sent to a commune

Every urban child on leaving middle school at the age of 16 or 17 is sent to work on a commune. There is no choice about this. The only exceptions are the sick, the disabled and the last remaining child in each family. After 3–5 years each comrade is assessed by his peers and leading comrades for suitability for higher education on the grounds of attitude to the Party, attitude to work, the nation's needs, and his ability – in that order. Presumably the wishes of the individual are taken into account at this stage though everyone we questioned immediately responded by saying they wished simply to "serve the people".

Housing

In Peking, a city of about 10 million people, new dwellings are being built at the rate of approximately 100,000 a year. But if, say, 4 million people need



Part of a peasant comrade's open-air kitchen on a commune near Canton

rehousing then at the current rate of progress this will take 40 years – by which time the early post-war blocks will probably require substantial attention. The present norm is up to five storeys, no lift, two rooms, a kitchen and lavatory for a family, and one bathroom for the block. In a Shanghai housing estate, built in 1952 and in many ways quite attractive in layout, there was no form of heating in the flats which were not self-contained; three families shared a lavatory, a cold water tap in a common kitchen, each family having two gas rings. There was some evidence that if a flat were under-occupied the tenants would be asked by the district housing office whether they might not help house relatives and they might even have another family "billetted" on them. It seemed usual in the towns for a nuclear family to sleep together in a single room. It was a Confucian ideal to have five generations under one roof, and certainly three is common now. China could not cope for the time being with individual homes for individual families.

A typical street scene in Shanghai

Population control

To control the population explosion, the Chinese discourage women from marrying before 25 and men before 28. People seem very well aware that China could not manage with a mushrooming population and we came across couples who said that one child was enough. Divorce is possible but discouraged, and the same applies to abortion. Contraceptives are readily available for married couples but pre-marital sex is strongly discouraged. Propaganda to this effect seems to be extensive and it would not surprise me if the possibility of lao jiao for any "delinquents" helped ensure widespread compliance.

China's wage structure

There is an eight-point wage system in China and since the Great Proletarian Cultural Revolution GPCR!) the aim has been to reduce differentials gradually from 8 to 6 and so on down to nil. The Chinese say that the road to communism is a long one and that at the moment they have attained only socialism (this also saves being disappointed in communism). Under socialism, bourgeois right remains. Broadly, this means that you may keep what you have earned under the previous system provided you did not acquire it by exploitation. Therefore a professor earning an unusually high salary of, say, 280 yuan (£70) a month continues to be paid at that rate and will retire on a pension of 70% of final earnings – thus prolonging the differential till he dies. But a new teacher being recruited today might receive only the usual wage of 40 yuan (£10). There might be increments up to around 100 yuan but probably not much higher. There is income tax and the professor would probably be able to buy a television, and since 1975 a record player, and theoretically even a car. However, cars seemed to be the preserve only of officials and I would have thought a private person might draw unwelcome attention to himself if he possessed one. The Chinese claim they have had no inflation since 1949 and certainly the price of everyday commodities has remained stable and, in some cases, even come down. Rent and utilities amount to 5–10% of wages, and £4 will feed someone for a month. The cotton ration per person is 20 feet a year. (Until 1965 sugar was rationed to 2½ lbs per person a year, and fat to ½ lb per person per month.) Rice is still rationed but I believe the allowance is fairly generous. By our standards the diet is limited but by Chinese standards it is better than it has ever been. Mao Tse-tung, who was the son of a middle peasant, was brought up on two meals of rice a day except for once a month when he had an egg.

Spectacular impressions

If I have to single out the most spectacular impressions of my visit they must be the thousands of blue clothed peasants toiling in the landscape, removing it by the bucket and wheelbarrow full to create new and orderly rice paddies, and drainage channels; and trees planted by the tens of million – the Chinese plan to affect the climate by about 2000 and no doubt they will. Chinese honesty has become well known in the west and it was almost a relief to discover that they do still have thieves: it is rare for a bike to be left unlocked – so they are human after all! In the towns, sad to say, I felt visually very deprived. Beauty in the eyes of the Chinese is, for the present, a factory workshop or a pylon on the landscape, and one day there will have to be a monumental boom in China for white paint! But if there is one aspect more memorable than any other it is the courtesy of the Chinese, their smiles, and warmth, and the amazing lengths to which they would go to please us as "honoured guests".

Angela Killick works in the International Relations Section of the Council Secretariat and this spring she travelled to China for her annual holiday.

Newsfront

New Head for Laser Division
Professor A F Gibson has been appointed as Head of the new Laser Division at the Rutherford Lab. He will manage the Laser Centre, which is being equipped with an 800 gigawatt neodymium glass laser which will be used by university scientists for research into the creation and properties of very dense plasmas and the non-linear interactions between high intensity electromagnetic radiation and matter. Professor Gibson, who is Chairman of the Physics Department at Essex University will take up his new position in January.

Photo Alexandra Studio

Mr Peter Rice
Picture above shows Mr Peter Rice who was appointed Assistant Director of the Council's Polymer Engineering Directorate on 1 October. Mr Rice joins the Council from Harcostar Ltd, a plastics company within the Butterfield Harvey Group, where he was Technical Director. Educated as a mechanical engineer, Mr Rice's early industrial experience was with the development of small diesel engines and injection equipment (Petter Engines Ltd) and as a senior project engineer, carrying out special projects on plastics machinery (John Brown Group). He has been an active member of the Plastics and Rubber Institute and served on a number of committees within the industry.

First SRC Senior Fellowships
Council has made the first awards under the new SRC Senior Fellowships Scheme, which will enable a few outstanding scientists to devote up to five years to research, free from their normal administrative duties. The first six Senior Fellows are:
Dr A Boksenberg (Department of Physics, University College, London)
Professor A Carrington FRS (Department of Chemistry, University of Southampton)
Professor B Clarke (Department of Genetics, University of Nottingham)
Dr P H Gaskell (Pilkington Bros Ltd and Cambridge University)
Professor C A R Hoare (Queen's University, Belfast)
Professor E C Zeeman FRS (Department of Mathematics, Warwick University).

Mr M Dermody
Our picture shows the Lord Lieutenant of East Sussex, the Marquess of Abergavenny, presenting Mr Mick Dermody (RGO) with the BEM at Herstmonceux Castle in June. Mr Dermody, who is workshop foreman at RGO and cares for the big telescopes there, has also been involved in the mechanical commissioning of several optical telescopes in other parts of the world. These include the Egyptian 74-inch reflector at Kottamia (1966), the Spanish 13-inch reflector at Granada (1968) and the South African 74-inch reflector at Sutherland.

SRS progress
With worldwide interest in the use of synchrotron radiation for research rapidly increasing it is satisfying to be able to report that the construction of the Synchrotron Radiation Source (SRS) at Daresbury is progressing well. Since the facility will be using existing buildings evidence of progress is mainly seen in the arrival of items of equipment.

The first signs of construction are now visible in the NINA experimental hall where the linac and booster synchrotron, which in turn accelerate the electrons before their injection into the storage ring, are to be situated. The necessary modifications to the electrical and water supplies located in this area have been carefully phased so that they have not interfered with the high energy physics program on NINA. Service ducts are now being cut through the concrete floor using 10-inch diameter diamond drills. These ducts will connect with the existing service tunnel and give access to the linac and booster areas for power supply cables, cooling water and other services.

Many of the major components for the project are now being manufactured by industry. These include the linac, the booster rf cavity (which, incidentally, is being made by the British Aircraft Corporation at Filton), the booster vacuum vessels, the prototype rf cavity and the 250kW klystron amplifier for the main ring.

After some delay nine blocks for

the booster prototype magnet were delivered and the magnet has now been assembled. At the time of writing the magnet is undergoing a series of mechanical, electrical and magnetic tests.

Meanwhile a prototype power supply has been constructed at Daresbury for the 10 Hz supply for the booster magnets. This has been used to power the prototype magnet and has enabled design of the operational supply to be finalised. Also in the power supply area the fast kicker supplies are under construction following completion of tests on their prototype.

A key feature of the whole SRS will be the computer control system. This has recently completed an important phase in its development, after the commissioning of the booster rf amplifier. This amplifier is being used as a test bed for the control system and has been successfully operated under the control of a mini-computer through a portable console. This portable console is a purpose built unit for the SRS and enables control of any item of equipment through a naming convention.

The project has now reached a stage where much of the design work has been completed and now more effort is being devoted to building equipment and it is encouraging to see these items of hardware appearing around the site.

Swindon office starts to take shape

Picture shows from left to right Mr P Gregory (Rutherford), Mr R B Yates (Daresbury) and Mr J H Richards (London)

Progress at Swindon

Construction of the new offices for SRC and NERC at Swindon is well up to schedule.

The photograph (above right) which was taken from the South bank of the site looking towards Swindon Technical College, shows the situation in mid-August.

The concrete ground slab was *in situ* for the SRC and Centre blocks and preparations were being made to construct the concrete columns to support the SRC's first floor. Off the picture to the left the NERC ground slab was well on the way to completion. At the time of going to press (end of September) the support columns for the entire first floor were in place and the contractor had almost finished laying the concrete slab for the SRC's first floor.

SRC Golf tournament

The 1976 inter-establishment golf tournament was held on June 4 at the Wentworth Club, Virginia Water.

Seven teams from Rutherford, Daresbury, Appleton, London/ Swindon Office and RGO competed for the Brian Flowers Trophy, the best four net returns over 36 holes from each six-man team deciding the winners.

This year the winners were Rutherford 'A' team (Brian Parkinson, Jim Valentine, Doug House, Peter Gregory, Geoff Manning, John Jenkins) with a final score of 593. Rutherford 'B' team came second with 603 and Daresbury 'A' team third with 615.

The best individual scores were:

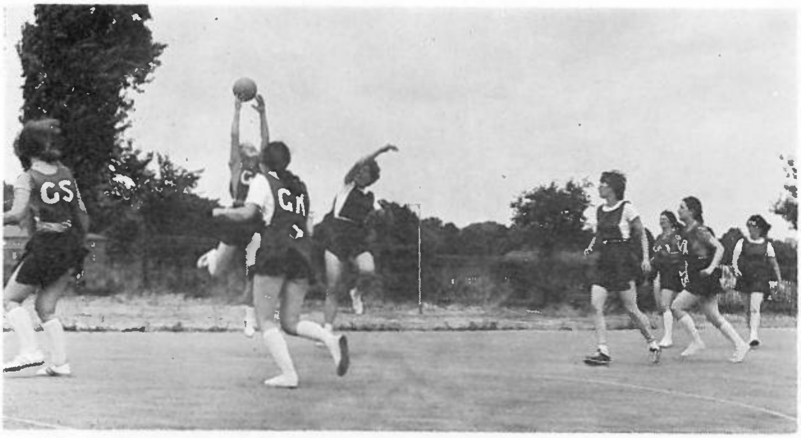
Best gross score over 36 holes
John Delury, Appleton, 166 gross.

Best net score over 36 holes
Jack Moore (handicap 20), Appleton, 142 net.

Best net score over morning 18 holes
Bob Cunningham (handicap 18), Daresbury, 64 net.

Best net score over afternoon 18 holes
Jim Valentine (handicap 10), Rutherford, 74 net.

Daresbury v Daresbury in the six-a-side football competition



Fierce concentration from the netball players

From left to right LO bowls players: Harry Cook, Charles Bradley and Richard Weaver

Sports Day 1976

The annual battle between SRC Laboratories took place at Chiswick Sports Ground on 13 July, and a good time was had by all, both competitors and spectators. Amazingly, in this drought ridden summer, there was a shower of rain towards the end of the afternoon. The Chairman and Lady Edwards came to watch the competitions and we are very grateful to Lady Edwards for presenting the prizes.

A large number of teams entered the football event and competition was fierce, which was sometimes quite painful because of the very dry ground. The eventual winners were the Rutherford "A" team.

Five teams entered the netball competition and the Daresbury team took home the large new trophy.

Tennis is a sport which attracts a large number of competitors. The winners of the mixed doubles were, once again Mrs I Malin and G Wilkins from RGO. The men's doubles were won by P Gardner and D Stanley from the Appleton Laboratory.

This year, the bowls competitions held were Pairs and Triples. The pairs were won by E Kirby and L Harding of Rutherford and the Triples by C Grindrod, A Goode and P White of Rutherford.

The cricket competition was a long one and the eventual winners, Rutherford, finally beat the opposition too late to receive the trophy at the presentation from Lady Edwards.

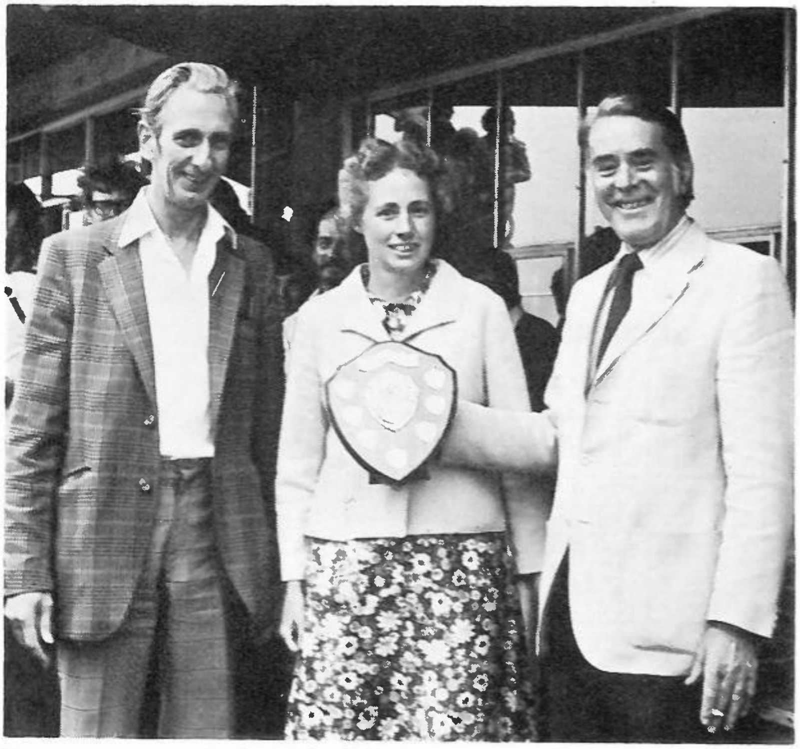
The winner of the chess competition, held in the quieter atmosphere of the marquee, but nevertheless generating excitement, was E I Bramley from Appleton.

Sports Day was also the occasion for the presentation of the Sir Brian Flowers Trophy for the SRC Golf tournament which had been held in June. The winning golf team was from Rutherford.

George Wilkins and Mrs Irene Malin compete in the Mixed Doubles

Lady Edwards presents the Daresbury netball Captain Hilary Mason with the trophy

Even umpiring netball can be a dangerous occupation



Lady Edwards presents the bowls shield to the winners of the Pairs Competition: Eric Kirby (left) and Les Harding of the Rutherford Lab

Herstmonceux swarm

There is no denying the variety of what Council employees do at Research Establishments. We were wandering around the Castle grounds at the Royal Greenwich Observatory one lunchtime when we saw three white-overalled people with strange masks over their heads walking towards the car park. One of them was carrying a step ladder and another a large cardboard box. They were looking up at a large tree so we waited a while to see what was going on. We then became aware of a large number of bees and following the direction of the overalled figures' gazes we saw a swarm of bees clustered around a branch about ten feet from the ground.

The man with the step ladder erected it under this swarm and then climbed up the ladder to be immediately under the swarm. He was handed the cardboard box which he placed immediately under the swarm, gave the branch a sharp tap and the swarm disappeared into the box. It was as simple as that and the man performing this operation wasn't even wearing gloves although he did have a mask over his head.

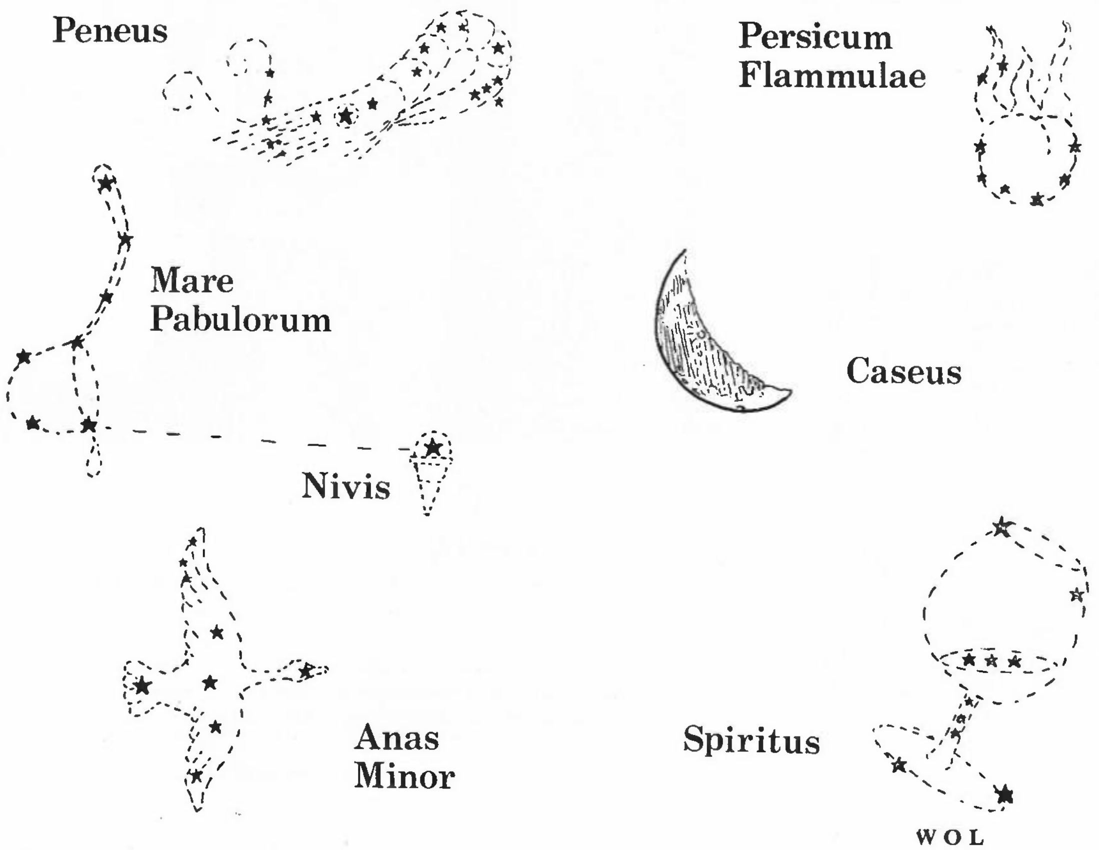
I later mentioned this incident to Ron Baker who has recently joined RGO from Rutherford. He told me that he had an interest in bee keeping and said that this particular swarm of bees would be in quite a good-natured condition since they would have been gathering honey for a number of days. He said the weight of the swarm would have been around 9–10 lbs and, since only a relatively small number of bees would have been actually holding on to the branch, it was a simple matter to break this tenuous hold by striking the branch a quick blow. We took his word that the bees would have been in a good-natured condition but still would not have liked to have done the job.

He also explained that it was usual to remove the swarms at night time since many of the bees belonging to the swarm would have been out gathering honey and to collect them at midday would have meant many of them would have been lost. Also, when these wandering bees returned they certainly would not have been

(Continued on page 14)

Royal Observatory Dinner

Following the menu of the 1889 Royal Observatory Dinner, which was published early this year, readers may be interested in the menu produced for the 20th Herstmonceux Conference Dinner, held at the Observatory in March. (The courses were prawn cocktail, minestrone soup, sorbet, roast duckling, peach flambé, cheese, brandy).



in a good natured condition once they found the swarm had disappeared, and eventually would die. Obviously to meet this situation the bee-keepers that removed the swarm left the cardboard box with a sheet covering it at the foot of the tree and we noticed it was still there when we left in the evening.

The next morning the box had been taken away so we assumed the bee-keepers had returned at nightfall to remove it. We certainly noticed no angry bees in the vicinity and were both pleased for ourselves and for the bees.

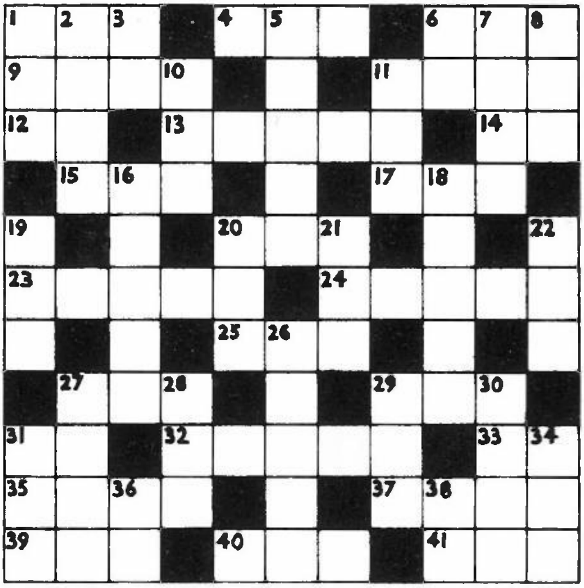
Castle folk dance

The Herstmonceux Castle Folk Dance Group marked National Folk Day on 26th June 1976 by holding an open-air dance in the gardens of the Castle. It was a perfect evening, the air being absolutely still and the temperature pleasant after a very warm day. Dancing went on until 10.15 pm, at which time it was still possible to identify faces.

Among the dancers it was good to see our new Director, Dr Graham Smith, with his wife; and also founder member Harry Cook (now at London Office) with his wife, Janet, who was a former member of staff too.

The caller was Irene Wheatley, a keen supporter of folk dancing from Stonegate, who helped to form the group twenty years ago at the request of its founder, Sir Richard Woolley (then Dr Woolley). The group is a registered group of the English Folk Dance and Song Society and has recently become a section of RGO Club.

Celia V. Hewerdine



NUTCRACKER 22

NUTCRACKER 22

Clues

ACROSS

1. 8D plus 14A
4. 3D times 14A
6. See 5D
9. 31A times 28D
11. 31A times 21D
12. See 34D
13. 31A times 11D
14. See 2D
15. 6D plus 6A
17. 21D plus 11D
20. The digits of 10D in a different order
23. 20A times 10D
24. The square of 6A
25. See 19D
27. 21D minus 31A
29. 14A times 33A
31. See 36D
32. The square of 21D
33. See 38D
35. 25A times 3D
37. 6D times 1A
39. The square of 6D
40. The digits of 6A reversed
41. 39A minus 22D

DOWN

1. 39A minus 6A
2. 1A times 14A
3. See 35A
5. 6A times 21D
6. See 15A
7. Seven times 17A
8. 1A minus 14A
10. See 18D
11. Twice 6A
16. 20A times 6A
18. The square of 10D
19. 20A plus 25A
20. Two more than 20A
21. See 17A
22. See 41A
26. 21D times 11D
27. Seven times 20A
28. One-fifth of 17A
29. 17A minus 31A
30. 9A plus 36D
31. 29D minus 40A
34. 12A times 14A
36. Twice 31A
38. 33A plus 31A

The prize will be awarded to the first correct entry drawn on 1 December. Entries to the Editor, 'Quest', State House. Please state whether you would prefer a book or record token. The solution will appear in the next issue.

Solution to Nutcracker 21

Idle became Secretary of Vampirics. The winner was Carol Armstrong (LO) who wins a £2 book token.

Solution to Maxim 11

A	S	H	H	O	R	N	E	R	C	L	A	Y
S	P	U	R	I	O	U	S	S	L	I	N	O
C	O	B	B	L	E	R	S	T	E	N	O	R
S	O	B	S	I	A	S	P	R	A	T	T	K
C	N	A	M	E	D	E	P	A	R	I	A	H
R	A	R	E	R	D	R	I	P	T	U	B	E
U	L	D	A	L	L	Y	G	R	I	L	L	A
F	L	I	N	D	E	R	S	C	R	I	E	R
F	E	A	R	E	D	H	T	H	E	M	E	T
C	G	R	U	N	D	Y	Y	A	S	P	A	S
O	R	A	L	S	A	M	A	S	S	E	R	S
L	O	V	E	E	D	E	N	T	A	T	E	E
E	V	E	R	F	O	S	T	E	R	S	A	W

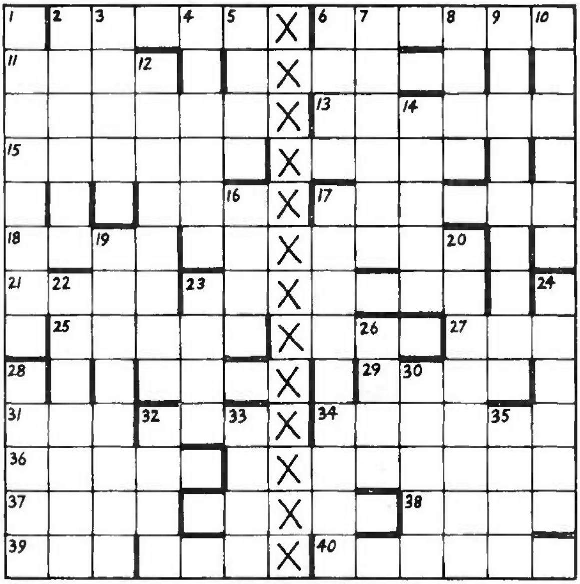
The winner was K P Duffey (Atlas Computer Division) who wins a £2 book token.

Suggestion Scheme Awards

Mr Edmonds, Chairman of the scheme's Co-ordinating Committee, made a presentation at Swindon Office on Friday 17 September to Mrs B E Stevenson of Salaries Section and Mr J J Madden of D Registry.

Mrs Stevenson, formerly of SUGA Current Awards Section was awarded £50 for her suggestion that the British Rail Selective Prices Manual be acquired to reduce the time spent by SUGA on the checking of students travel claims and Mr Madden was awarded £30 for a suggestion which reduced the time spent on checking file sequences in D Registry by the use of a colour tagging system.

Mr Edmonds observed that it was gratifying to find two such worthwhile suggestions coming from London Office. The administrative side did not generally provide opportunities for making substantial savings so it was all the more meritorious when such useful ideas were put forward.



MAXIM 13

MAXIM 13

Not Maxim's pools coupon, put in the wrong envelope by mistake, but a crossword containing X-words – thirteen of them, clued once each, in no particular order, in the imaginary quotation given, whose punctuation should be ignored.

Clues

X-WORDS

'Economist: unusual animal, tail-less where tail used to be; to encourage disease, probe gas-corroded surface' – *Fools' Dictionary*.

ACROSS

6. Given the opportunity, I'd mute this bore (6)
11. Instructed by ear, under stress (4)
13. Hearts make these, to steal away in most of this (6)
15. Attention! The Queen's progress (6)
17. Essential strength starts demonstrating guts (6)
18. Is held back by body providing 'get-you-home' service in the Continent (4)
21. Shelter of hard-bitten traveller (4)
25. Where gulf stream comes from, I take left helical motion (5)
27. Bun that starts to get appetite going (3)
29. Another helical motion, about city, to the left (4)
31. A quid or that's the end of it. Good gawd! (3)
34. The last, the ending, the terminal bit of the show (6)
36. The object is to start owing; make a donation (5)
37. Grain stocks held, oils unsteady (4)
38. Beast of burden returns with nothing. It's all right for some! (4)
39. Will names what can go in 37 (3)
40. Thomas Hardy nastily produced several of these (6)

DOWN

1. So double-act performed musical notes separately (8)
2. Clans a-rioting in ways like Caledonian (6)
3. Take wrong route and become accentuatedly extravagent (5)
4. Snap, crackle and pop that we hear one after the other (6)
5. Agreed to take 1976 as an example (4)
6. To put on a note in official betting shop (4)
7. The unfortunate 50% nicety of the people (6)
8. One stratagem used by hagiolaters (4)
9. I'm ill! – a cub makes use of this to stay with mother (9)
10. To put to the wrong purpose is in the spirit of inventiveness (6)
12. The carpet on the chap in charge, in the nature of a burden (8)
14. Turner's 'Gangrene and Gold' (5)
16. Wind about easterly, on the left (4)
17. I drive fit to bust – how would you describe my glasses? (9)
19. Make in-law dry out in secret (8)
20. Species of bear sank in land-locked state (8)
22. Former country in east of France? Further! One where Asia starts! (7)
23. Where you find topless towers, and destroy (4)
24. Quiet, in shabby surroundings, just like Gonzalez (6)
26. Current I'd dissolve in! (4)
28. Get some meat from the waffle shop (5)
30. World-sized body and molecule-sized body, joining together (5)
32. Toilet on Motorway is a means of getting weaving (4)
33. What's turned up for lunch-time? The same again! (4)
35. Nearly the smallest meadow-land (4)

The prize will be awarded to the first correct entry drawn on 1 December. Please send your entry to the Editor 'Quest' at State House and state whether you would prefer a book or record token. The solution will appear in the next issue.

Quest

If members of staff who are about to retire would like to continue receiving copies of *Quest*, would they leave their name and address with their local *Quest* representative (Astrophysics Research Division: Bill Burton; ROE: Jim Campbell; Appleton: Geoff Gardiner; Swindon: Adrian Dent; Rutherford: Harry Norris; Daresbury: Ian Rabinowitz; RGO: John Alexander; and State House: Carol Methven.

Nil Nisi Bonum

A recent press statement on the economy cuts advised us that among the public economies to be effected was the withdrawal of grants for 'silly' researches.

In case any readers should be tempted to browse through the Yellow Book (List of Research Grants) we must ensure that they do not remain under the impression that 'silly' grants were ever made. To show how easy it would be to gain this impression we have extracted a few genuine grants titles and list them below with explanatory comments:

Synaptinemal complex assymetry in the grasshopper	There can be nothing 'silly' about this – it is extremely serious.
Investigation of the identity of aggression-controlling pheromones in mice	Imagine being shut up in a room with an aggressive 'mouse'!
Ethology and ecology of Saharan gerbils	They used to be called 'Desert Rats'.
Studies on the B chromosomes of the mottled grasshopper	Isn't this gout in Homo Sapiens?
Perception and motivation as variables in the social behaviour of birds	They *can* see where they are flying after all.
Salt and water transport in the male gential tract	It's a blue flower as long as the 'i' follows the 't'. If it does not then it is a 'p'.
Encoding characteristics of human memory	Tales of misspent youth.
The control of ventilation in dragon-flies	Flatulence.
The control of flagellar activity	Use of new belt provided for punishment in schools?
Fundamental investigation of the transient behaviour of brass wind instruments	Do they really blow out straight?
Acoustics of stringed instruments	Everyone knows they screech.
Three dimensional structure of fish schools	42 x 40 x 42.
Direct measurement of surface drag	42, 36, 28 and a wig.
Response of vehicles to road surface roughness	They bounce about.
Road behaviour of car in response to steering	It turns.
Unreinforced conditional autonomic fear responses	Frightened to death.
Motor control mechanics in the dogfish	Do they have carburettors, too?

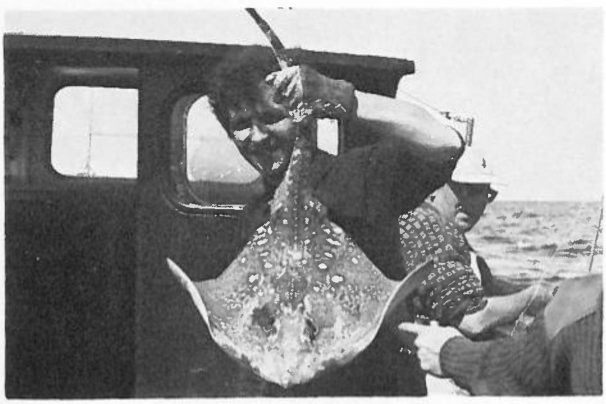
The Science Research Council is not without its romantic vein as the following examples show:

The processing of visual information	See no evil.
Auditory information in the courtship behaviour of drosophila melanogaster	Hear no evil.
Investigation into ring rolling	Speak no evil.
Creep in brickwork and blockwork	Peeping Tom – he crept out again.
Investigation into the behaviour of a Passerine bird	What Peeping Tom saw.
Triplet trapping	How the Passerine Bird catches the male.
Aggressive behaviour in the Guppy	He was caught.
Fundamental aspects of fretting corrosion	Frustrated Guppy.

Finally to hopefully cure our SRC shortcomings:

Extension of Memo function facilities	How to pass the buck.
Excitation in disordered systems	The Estimates and Forward-Look panic.

PHILIS TINE



Daresbury Angling Club

A ten man, eight-hour fishing trip from Conway aboard the 'St Clair' on Friday, 16 June, was very successful thanks to bright sunshine, a light breeze and suicidal Mackerel. In addition to the many hundreds of Mackerel caught there were a few Whiting, Gurnard and five Thornback Rays. 'Ray' (!) Lawton accounted for the best Thornback of 18 lbs and the photograph shows Phil Moore respectfully handling another. Entertainment was provided by the boat skipper who gave fishing lessons after the manner of Captain Bligh.

QUEST

Vol 10 No 1

RGO exhibition

Lions of the Serengeti

Energy Research Support Unit

QUEST

House Journal of the Science Research Council

Vol. 10 No. 1
1977

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Quest will be issued three times this year by the Science Research Council for members of staff only. The Council is not necessarily associated with any individual views expressed.

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Our cover picture shows (from left to right): Professor F Graham Smith FRS, Director of the RGO, Mr Patrick Moore and Sir Sam Edwards, Chairman of the Council talking about plans for the new Northern Hemisphere Observatory, which are displayed as part of the RGO's permanent exhibition on astronomy.

The exhibition, which covers the history of the RGO, Herstmonceux Castle, telescopes, astronomical instrumentation, time and navigation, astrophysics and astrometry, was opened by Mr Moore on Monday 4 April before an invited audience of, among others, local and county authorities, members of the astronomical society and the press.

It opened to the general public on Good Friday and will remain open this year until 2 October. The hours of opening are: Monday to Friday 2 pm–5.30 pm (last admission 4.30 pm) and weekends/public holidays 10.30 am–5.30 pm. The admission charges are: adults 50p, children and OAPs 25p. There is free car parking.

Photo: Keystone Press

Contents

Lions of the Serengeti

B BERTRAM

In this article Dr Brian Bertram of Cambridge University describes the ecology and social organisation of lions in the Serengeti National Park, Tanzania. Dr Bertram spent four years in Tanzania and in 1973 his place was taken by David and Jeannette Bygott who are continuing the work with the help of a £16,000 Council grant.

Few species of animal can have attracted so much interest and awe as the lion, yet until recent years almost nothing was known about this large mammal in its wild state. The Englishman in the street here knew that lions were large, cunning and ferocious animals which preyed on other animals, and which were liable to attack the hunters who tried to shoot them for sport. The African knew that they were large animals which usually avoided him but very occasionally fed on his cattle or his companions. It is only with the development of tourism and the change in Society's view of animals that it has become possible to find out how lions really live, because to do so requires the existence of National Parks where animals are not disturbed or molested by humans, whom they therefore no longer either attack or avoid.

Serengeti Research Institute

The Serengeti National Park in Tanzania is indubitably one of the finest such parks in the world, and was one of the first to encourage scientific study of its flora and fauna. The Serengeti Research Institute, established in 1966, provides a base for, and co-ordinates the research of, about fifteen scientists investigating a variety of topics relevant to the area, from soil to scavenging, grass to giraffes, termites, trees, hyaenas and hartebeest. The large predator species have always attracted at least their share of attention. At present David and Jeannette Bygott are the resident "lion-ologists", studying the ecology and social organisation of lions in the Serengeti.

First full study

Their lion work has a long background. In 1966 Dr George Schaller of the New York Zoological Society started the first full study of wild lions anywhere. He concentrated particularly on lions in open country—the nomadic individuals which frequent the famous open Serengeti plains, and two large resident prides at the woodland edge. When I replaced him in 1969 (financed by NERC, the Royal Society and the African Wildlife Leadership Foundation) I continued to monitor these two prides but turned my attention mainly to the lions of the woodland regions in the north of the National Park. There, for four years, I radio-tracked both lions and leopards, to discover what they were feeding on and what effect their predation had on their various prey species. The Bygotts are continuing studies on this fascinating and complex animal.

The author attaches a radio-transmitting collar to an immobilised lioness
(Photo courtesy of Dr J M King, AWLF)

Records of two large lion prides, numbering around forty animals, have now been kept for eleven years, which is longer than for almost any other wild mammals. All the lions in these prides are known individually, being recognisable by natural markings such as scars, nicks in their ears, and whisker spots, and so we know who produced how many cubs, when, and what became of them and why. It is partly from such long-term records of these two prides that we have discovered many of the details of lions' social organisation.

A lion pride

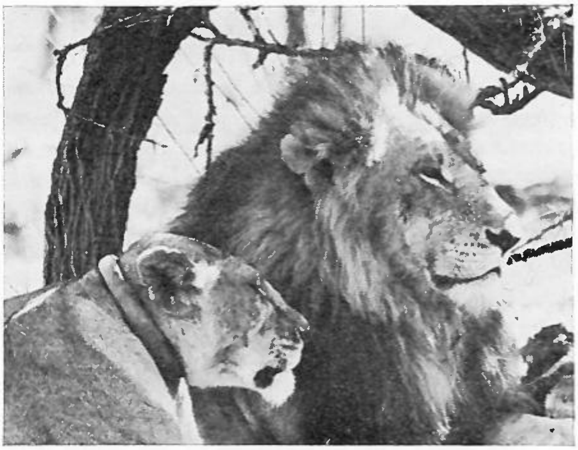
A lion pride is not just a loose grouping of animals like a flock of birds, but is much more similar to a human family. Lionesses, if allowed by their elders to do so, remain all their lives in the pride in which they were born, and never allow strange females to join. Thus over the generations—and prides probably do last for many generations—all the females in the pride are relatives. There must be every possible kind of relationships among them: mothers, daughters, half-sisters, grandmothers, second cousins and so on.

Adult male lions are more transient. A group of two or three of them takes over a pride by fighting with and ousting their male predecessors. They breed with the females, feed on prey caught by those females, and defend the pride's territory. After about three years they in turn are expelled by the arrival of a new group of younger and stronger males who dispossess them of their pride, their area, their meal ticket and sometimes their life.

Very social animals

Lions are very social animals in many ways. The females in a pride tend to be synchronised with one another in when they come into heat; during that period, which lasts for about three days, they mate on average every fifteen minutes. In spite of such sexual energy, though, most of their mating periods are unsuccessful. Nonetheless the lionesses in a pride are roughly synchronised in when they give birth. They each bring their cubs to join the rest of the pride, and they suckle them communally. Thus in the course of an hour or so a cub may get milk from his mother, his grandmother, his aunt and his cousin. Lionesses rear their cubs collectively, which improves their chances, but nonetheless well over half the cubs die, succumbing to starvation, accidents, or the teeth of other large predators, including strange lions.

Lions hunt co-operatively: several females spread out and each stalks individually towards a prey animal. This improves their success rate, which is low. Most hunts fail, usually because the prey detects the lions before the latter are close enough for a short, fast rush. Almost all their prey animals can run even faster than lions, and can keep it up for much longer, so the



A lion and lioness rest beside the remains of her kill in the shade of an acacia tree. She wears a radio-collar, which enabled her to be found and observed whenever necessary

A lioness chases away vultures coming to feed on the carcass of a wildebeest

only chance for a lion to make a kill is to get within a critical distance of the victim undetected. Natural selection has of course produced prey species which are alert, speedy and not easily caught.

Lions feed mainly on zebra and wildebeest, often glutting themselves when the Serengeti's huge herds of these species are migrating through their territory, and having a lean time when they can prey only on the much less abundant resident species—buffalo, impala, warthog, and hartebeest. To feed on different prey species and in different areas requires a flexibility in the strategies lions use, both in moving around their area in search of prey and in the tactics used in hunting it once found. One of the Bygotts' tasks is to study this adaptability. By radio-tracking lions and by observing them continuously for several days and nights over full-moon periods, and by following prides which live in different habitats, they hope to determine some of the ways in which habitat, food distribution, hunting behaviour and social organisation interact.

The Bygotts are also studying an apparent increase in lion numbers. Over the past few years, the dry seasons have been less dry, and as a result of the greater availability of grass the numbers of most lion prey species has shot up. It begins to look as though the lion numbers have also increased, although more slowly, not so much by an increase in the size of the prides, as through the occupation by new prides of areas which were previously uninhabited by lions. To document these changes, and to know where each lion has come from, requires the lion-observers to be able to recognise literally hundreds of different individual lions, which is possible to do with the help of photographs, perseverance and identity cards.

The value of the study can be assessed at a variety of different levels. As social carnivores, lions are adapted to an environment and a way of life similar to that which another social carnivore—early man—had to deal with at one stage in his evolution a couple of million years ago; his experience at that time may have played a part in shaping his behaviour and the rules of his society, so an understanding of lion social organisation may well help us toward a better understanding of our own.

The conservation of wildlife areas is generally accepted as vital for future generations, as well as providing a major source of revenue to underdeveloped countries. To conserve as superb an area as the Serengeti must be close to the top of the priority list. Yet with human pressures from outside and ecological pressures from within, it is no longer possible to conserve an area solely by drawing lines round it on a map and preventing human depredations. We may well need to manage wildlife areas, and we must know whether management is really needed, how it should be carried out, and what other effects it might have. To do this we must understand the intricacies of the innumerable ways in which the lives of predators and prey, and grass and grazers, are inter-connected. Lion studies in the Serengeti are contributing towards the clarifying of this fascinating, complex and important subject.

Energy Research Support Unit

An Energy Research Support Unit (ERSU) has been set up at the Rutherford Laboratory.

The unit will offer support to universities and polytechnics by assisting with (i) the design and development of equipment and instrumentation; (ii) computing and data handling and (iii) measurements and tests. It will provide additional laboratory facilities, seconding staff where appropriate. There will be an information service to foster the exchange of ideas between researchers, and meetings, discussions and conferences will be held.

The new unit will use Rutherford's existing expertise and facilities to complement the energy research work being carried out in the universities and polytechnics. This part of the unit's activities covers additional development work to enable university projects to be carried over and adopted by industry. The unit will also help universities to undertake preliminary studies for the proposed Energy Research programmes.

ERSU is already collaborating on a project involving four universities investigating a proposed waste energy recovery system in which a high-speed turbine, running off heavy vapour (rather than steam) drives a high speed generator. Possible applications are stand-alone generators combined heat-and-power sources and production of electricity from waste heat. The final test programme would be undertaken at Rutherford.

Several research groups involved in energy research in buildings are seeking assistance with instrumentation and data handling. One group is concerned with energy conservation problems in a local school; another is investigating the effects of different levels of insulation in houses and the year-round efficiency of domestic heating boilers.

ERSU has also been asked to carry out the engineering design and to arrange for the manufacture of a windmill for the Autonomous House project being carried out at Cambridge University by Alexander Pike and his team.

Norman Lipman will be in charge of the unit, which will be part of the RL's Instrumentation Division.

Council Commentary

September 1976 to February 1977

Council's September Conference
A week-end conference of Council members and Board representatives was held at Gonville and Caius College, Cambridge in September 1976. The Conference discussed follow-up to the Richards Report on Academic-Industrial Collaboration in Engineering Research, the second report of the Polytechnics Committee and future SRC policy for postgraduate training. The main conclusions of the Conference were endorsed by the Council in October.

Finance
(i) *Moratorium on Research Grants*
In October, the Council noted with concern the increasing costs due to depreciation of sterling of UK subscriptions to international scientific organisations, eg CERN, met from the SRC budget. At the time there was the danger that SRC expenditure in financial year 1976-77 would exceed the funds available since there was uncertainty as to whether the Government would provide the additional funds required to meet exchange-rate variations. As a result the Council decided to implement restrictions on commitments in SRC Establishments for 1977/8 and introduced a moratorium on the announcement of approved research grants. SRC has since received compensation for exchange-rate variations in 1976/77 and the Council agreed that the moratorium should be lifted from 1 February 1977.

(ii) *Estimates 1977/78*
In November, the Council approved a provisional 1977/78 Estimate submission which has now been updated to £138.0M at 1977/78 prices. This figure includes additional earmarked funds for the increased cost of fees for postgraduate studentships and for dispersal and it allows for reduction of about £1M imposed on the SRC budget as part of the December reduction in public expenditure. The "cash-limits" procedure applies to this figure as was the case in 1976/77.

(iii) *Forward Look Guidelines*
In December the Council agreed the financial guidelines to be used by Boards in preparing the 1978/79-1982/83 Forward Look. It was then expected that SRC resources would be reduced by about 2.7% a year in real terms over the period; however the recently published public expenditure survey implies an effective rate of decline of about 2% a year. Council will complete its Forward Look in April 1977, for submission to the Advisory Board for the Research Councils.

Spallation Neutron Source (SNS)
In December, Council considered the scientific case for the conversion of Nimrod to provide a machine and target station for a Spallation Neutron Source at the Rutherford Laboratory at a capital cost not exceeding £7.6M at January 1976 prices. The proposal is to construct a high-intensity facility designed for thermal neutron scattering, based on the use of a proton-synchrotron to generate very intense neutron pulses from the spallation source. Such a source could be of considerable value to a wide range of scientists and would be complementary to the high-flux neutron facilities at the ILL at Grenoble. The Council approved the proposal in principle but wished to consider further the manpower and financial implications of the project as part of its Forward Look exercise, before giving final approval.

Postgraduate Training
(i) *Postgraduate Awards, 1976*
The Council had planned to award 3300 studentships in 1976, of which at least 310 were to be CASE awards. In the event, the demand for awards particularly for CASE, greatly exceeded the expectations and with government approval the SRC provided nearly 3400 studentships in 1976 of which 553 were CASE awards. The Council regretted that SRC was obliged to reject about 750 qualified candidates for SRC studentships in 1976.

(ii) *Policy Statement on Postgraduate Training and Plans for 1977*

Following the September Conference, the Council in December approved its statement of policy on the support of postgraduate training and its plans for studentships in 1977; this has since been published in the SRC Bulletin (February 1977). In 1977 3400 studentships will be made available of which at least 600 will be CASE awards.

International Organisations

Subscriptions to international organisations take a large part of the SRC's budget and in November and December the Council considered reports on all the organisations concerned. The three largest organisations are CERN, the European Space Agency (ESA) and the Institut Laue-Langevin (ILL) and the Council agreed that where possible it should seek a reduction in the subscription payable to CERN and ESA. The Council also considered reports on the Anglo-Australian Telescope, the European Incoherent Scatter Facility (EISCAT), the South African Astronomical Observatory (SAAO) and the Institut des Hautes Études Scientifiques and endorsed the scale of current SRC activity in these organisations.

Reports from the Select Committee on Science and Technology

(i) *University-Industry Relations*

In December the Council considered a request from DES for comments on the Select Committee's report on university-industry relations. A number of the recommendations in the report related to SRC and covered postgraduate training, academic-industrial collaboration in research, and universities and the national need.

The Council agreed its comments on the report in January; these have now been submitted to DES and will be taken account of in the Government reply.

(ii) *Advanced Ground Transport*

The Council has also considered a further report from the Select Committee on Advanced Ground Transport which remained critical of the earlier SRC decision to reject a proposal from a consortium of universities to use the facilities left at Earith when Tracked Hovercraft Ltd was closed down. Council's comments will be incorporated in the Government reply.

Energy Research

In November Council following the recommendations of the report of the Energy Round Table agreed to establish an Energy Research Support Unit (ERSU) at the Rutherford Laboratory, under the control of Energy Proposals Committee. This unit will provide technical and other assistance to university groups engaged in energy-related research, will assist the Energy Proposals Committee as needed and will provide the secretariats for the Committee and the Energy Round Table. The Council approving inclusion of £407K (at 1976 prices) in the 1977/78 Estimates for the Energy Proposals Committee which will provide for research grants and for support of the ERSU. (See page 3.)

Working Group on Collaborative Research

Arising from the discussions on the Richards Report at the Cambridge Conference, the Council approved in February the membership and the terms of reference of the Working Group on Collaborative Research, which will examine the extent to which and through what machinery the Council should support collaborative research between a university/polytechnic and an outside organisation engaged in the provision of goods and/or services. The Working Group will be chaired by Professor W E J Farvis (Edinburgh University).

The Report of the Teaching Company Working Party

The Council in February discussed the Report of the Working Party which had followed up an initial joint SRC/Department of Industry report on "The Teaching Company" by implementing a small number of pilot schemes. The Working Party had recommended the gradual expansion of the scheme over a five year period with joint funding by SRC/DoI and proposed that the budget should rise to £2M in 1982/83. The concept of the scheme is that a team of company staff, permanent academic staff and graduates on two or three year appointments (industrial associates) plan and carry through advances in the manufacturing methods of selected firms called Teaching Companies. The graduates undergo advanced training both through carrying out the research projects and also through carefully structured courses of instruction at academic institutions.

The Council agreed that the Teaching Company scheme should be developed as a special initiative for a five year period within the financial limits proposed by the Working Party. It also agreed that a Director/Coordinator and an SRC/DoI Management Committee should be appointed for the scheme.

Grants

(i) *ASR*

The Council has approved grants of up to £213K to Professor Willmore and Dr Simnett (Birmingham University) for work involved in provision of a hard X-ray imaging spectrometer for operation on the NASA Solar Maximum Mission Satellite, and up to

£180K to Professor Houghton (Oxford University) for Satellite Data Handling Analysis for experiments on Nimbus G and Pioneering Venus Orbiter Satellites.

(ii) *Engineering*
A package of five grants totalling £647K has been approved for a series of research programmes in Marine Technology involving Glasgow/Strathclyde Universities, Heriot-Watt University and London University (Imperial College and University College).

The Council has also approved grants totalling £205K under the Polymer Engineering Programme to Imperial College, Liverpool University and Manchester Polytechnic for a combined programme on the fracture of plastic pipes.

(iii) *Nuclear Physics*
The Council has approved up to £1.043M for grants to the Film Analysis Centres at Birmingham, Glasgow, Liverpool, Imperial College and Oxford.

Computer Networks

Two computer network units have been set up at the Rutherford Lab.

The Network Unit of the Computer Board and Research Councils has been set up to look into the short-term development of communications links between computers at universities and Research Council establishments throughout the country. Although it operates from the Rutherford Lab, the unit, called the Network Unit for short, is not part of the SRC. It is funded jointly by the Computer Board for Universities and by the SRC on behalf of all the Research Councils.

Director of the unit is Mervyn Williams, formerly Director of the Post Office's Telecommunications Development Department. Mr Williams has been a member of the SRC Computing Science Committee, the Department of Industry's Computers, Systems and Electronics Requirements Board and the Computer Agency Council.

Networks between university establishments and Research Council Institutes have been formed mainly within geographical regions. There are also United Kingdom wide connections to the three large computing centres in the Universities of Manchester and London and the Rutherford Lab. The aim of the unit is to lay a foundation for rationalising and extending existing networks in a form that will be compatible with one another and with national developments being undertaken by the Post Office and the Department of Industry.

The other unit is the Secretariat of the Department of Industry's National Committee on Computer Networks. Chaired by the ex-director of the former Atlas Lab—Jack Howlett, this committee has been set up to look into national computer network requirements in the 1980's. The Secretariat at Rutherford is headed by Donald Audsley, formerly head of the Technical Operations Division of the Space Documentation Service of the European Space Agency.

Recently the NCCN Secretariat has been involved in contacting computer mainframe, mini-computer and terminal manufacturers to stress the importance of formulating and adhering to standards in data communications. The object of the exercise which has involved contacting some 140 UK manufacturers and more than 60 editors of national and international computer and communications journals, is to ensure that the problems of setting up networks with computers of different makes are minimised

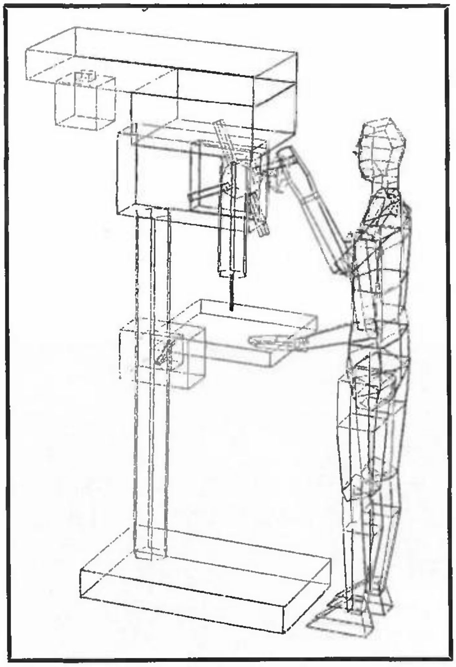
Computer aided work place and work task design

A team of engineers at Nottingham University under the direction of Mr M C Bonney is studying the computer aided design of work places and work tasks with the aid of a £112,000 award from the Council's Manufacturing Technology Committee. The particular emphasis of the project is to assist designers when human factors are important for reasons of comfort, safety, productivity and economics. As such, the work is a natural development from a project known as SAMMIE—System for Aiding Man-Machine Interaction Evaluation.

The prototype SAMMIE has been used in preliminary studies concerned with hospital and dental equipment layout, cockpits and cabins of vehicles. Through these early studies, a good working association has been built up with several design groups, and it is intended to carry out more extensive work in some of these areas.

SAMMIE provides a method of representing proposed designs in three-dimensional form on a visual display screen linked to a computer. The dimensions and positioning of the component parts of the workplace may be changed easily by the designer working in conjunction with the computer. The evaluation of ergonomic criteria is assisted by the use of a computerised man model which can be displayed simultaneously with the workplace model. The man model is capable of representing the physical attributes of particular operators, or of ranges of operators drawn from the potential user population. In this way an anthropometric evaluation can be made to establish the range of operators that can perform the required task in the proposed workspace. Assessments include whether the operator can fit into the workspace, whether he can reach controls, and assessments of comfort, sight lines, movement patterns and strength capabilities. Any necessary design changes made may be quickly re-analysed.

The complete system is intended to provide designers with a quick and easy method of assessing human factors criteria at any stage in the design process. Its use in the early stages of a design could ensure that equipment is designed with its eventual operator in mind, and that human factors are considered in a complementary rather than supplementary way with other important design criteria such as production methods and economics.



Drilling machine and operator

As a result of the award, interactive computer graphics equipment was installed in Nottingham University's Department of Production Engineering and Production Management in the Spring of 1975. This equipment comprises a Prime 300 mini computer with a refresh display terminal. Software is written mainly in Standard Fortran IV, and uses the GINO-F graphics software developed by the Computer Aided Design Centre, to facilitate implementation on other interactive graphics configurations.

The SAMMIE software, having been completely redesigned for implementation on the new hardware, is now soundly based and will provide a suitable vehicle for a range of applications. It is expected that the process of selecting relevant design areas and building application-specific sub systems will be the principal means by which SAMMIE is developed in the future.

Climbing Trango Tower

M HOWELLS

Malcolm Howells, who researches in the physics of solid surfaces and is a keen climber, relates his experiences last summer climbing Trango Tower, a 20,530 ft peak of the Karakoram range in the Himalayas. In 1974 he made a two month overland trip to the Himalayas and described this climbing holiday in an earlier edition of Quest (see vol 8 no 3). In mid-March Malcolm left Daresbury Laboratory to join the Department of Materials Science in the State University of New York at Stony Brook.

Trango Tower seen from the Trango glacier

Martin Boysen hung on his jumars* and looked up. The crack was vertical to begin with and overhanging further up. It looked just the same as last year, in fact there was no possible way it could have become any easier.

Twelve months earlier the crack had nearly killed him, made him part of the Trango Tower forever. He had wedged his knee in the crack—a normal enough thing for a climber to do—and then found it was stuck solid. After hours of struggling it was still there and beginning to swell. The prospects were obvious and terrifying. Mo Anthoine stood below holding the rope, powerless to help, while Martin worked, straining in the awkward position, panting and gasping because of the altitude. Using a piton,** which is about as sharp as a cake knife, he eventually managed to chew through his climbing breeches until the knee part could be pulled away. At last the knee popped out. There had not been enough supplies for any further attempts and the party had retreated.

An elemental battle

Now Martin was back ready to settle the score and the recollections of last year were not going to make it any easier. He could easily have let one of the rest of us try it. He could have drilled bolt holes up it, but he had not come all the way to the Himalayas to evade the problem. He thinks of climbing as having to do with men, and their ability, and strength of will, measured against the problems of the mountain, as an elemental battle not an engineering problem. He wanted to climb it, and the rest of us hung back and let him get on with it.

The crack was five inches wide and this time we brought pegs that fitted. We simply brought them the same width as Martin's knee. It was a pity we only had two. He took these and the rest of the paraphenalia and set off.

Again Mo was holding the rope—no doubt adding to the sense of déjà vu. He made steady progress for 100 ft, passed the knee jam using the last peg, and carried on. But the difficulties did not relent, and worse, it was essential to use knee jamming to make progress. The climbing was strenuous and he was gasping the thin air repeatedly after every move. It was clear that he would have to free climb the last section. He steeled himself, and with every muscle straining and lungs bursting, made it to the top of the crack. Triumph.

* rachet clamps used in pairs to climb fixed ropes.

** steel peg which can be hammered into rock cracks.

The Braldu River. Most of the approach march was along the north bank of this river

These events took place about halfway up the main face of the Trango Tower, and they represented our first steps into the unknown territory beyond the previous year's high point. The advantage of prior knowledge however, did not mean that we got to Martin's crack without any problems.

The Karakoram range is a desert area. Nothing grows and no-one can live there except in places where streams run down from the high snows. Travelling through this terrain is hard work and very expensive. Although portering is part of local life, it is gruelling work and the prices demanded are high. Balti porters get a daily rate similar to a professor in Karachi University. This means that the major problem of organising a Karakoram expedition is raising the money to pay the porters. The Mount Everest Foundation, The British Mountaineering Council and Barclays Bank gave us generous help, but most of us will still be paying off expedition debts for a long time to come. It is something you learn to live with or you don't go; a matter of priority.

Eight day journey

To get to Trango Tower you go to Rawalpindi in Central Pakistan and fly north to Skardu, the capital village of Baltistan. A 50 mile jeep ride takes you to Dusso and from there it is 75 miles of hard, dry walking. It took us (with our porters) eight days.

A rock climber's dream

We were rewarded with our first sight of the tower and it really did make all the effort seem worthwhile. I was immensely relieved that this mountain that I had never seen but had come 5000 miles to climb was so obviously worth it. It was some kind of a freak shape, a great pinnacle on a Himalayan scale, a rock climber's dream. But we stand gazing at it from the Trango Glacier 3000 ft below the bottom, so there follows another punishing period of load carrying to establish a camp at the foot of the face. This is sheltered by a huge boulder about the size of the average cinema and becomes known as the boulder camp. From here it is an hour to the foot of the ramp which slants up/right-wards to a small snow field in the centre of the face.

Now the climbing begins in earnest. The ramp is a mixture of easy angled snow pitches with steep steps in between. These are rock with a layer of ice on top. We operate in two teams: Mo Anthoine and Joe Brown; Martin Boysen and myself. The two cameramen, Tony Riley and Jim Curran, keep up with us filming. Some of the fixed ropes from last year are still there, some are buried in ice. None can be used except with extreme caution. If a fixed rope breaks there is no second line of defence. You go right to the bottom.

After three days we have the ramp fix-roped again and have dug out a flat space on the snowfield big enough to squeeze in two small tents. They are sagging and distorted down to half their normal size, and everything gets wet, but we are safe from falling stones.

Intolerable weather

Above the snowfield the face is more or less vertical right to the top. Martin and I start work on it the next day, leading pitches in turn—sometimes the old fixed rope is helpful, other times it is totally buried. The next day Mo and Joe push on further. They are two pitches below Martin's crack when the weather, which had been breaking all day, suddenly becomes intolerable. It begins to snow heavily and they retreat down the ropes to the snowfield. There are now five of us here and we spend a cramped night with all the vital things like our spoons and mugs outside getting buried. Snow piles up round the tents and in the morning we have a real mess to contend with. The mountain is plastered in new snow which periodically drops off in big heaps, and it is still snowing heavily.

Left to right: Howells, Boysen, Brown and Anthoine on the bivouac below the summit chimneys

Brown jumaring up the summit chimneys looking up at the overhanging cracks above which he is about to lead

We dig out what we can find of our stuff and rush down the ramp to the safety of the boulder, collect a few things, then down to the glacier.

A safe bivouac

The bad weather keeps us waiting there for three days. The rest is much needed and when the time comes to go back up we are refreshed and fit. We have seen ledges above Martin's crack through the telescope and we decide to gamble on getting up the crack and finding a safe bivouac there on the first day. We will then be well placed for an attack on the summit chimneys. Mo and Martin start early and jumar up to the crack. They climb it and another pitch above and reach the ledges. They are fairly good. There is an overhang for shelter but we have to sleep on snow. Tony follows the lead pair, filming, and Joe and I come behind hauling a bag of food and bivouac equipment. The ledge is just big enough to allow four to lie down and is surrounded by a great deal of space: a tiny perch above the void.

The summit chimneys

Next morning I attack the first pitch of the summit chimneys. We are all hoping they will give a soft route to the top, but I soon find they do not. The climbing is steep and strenuous with ice clogging the cracks at the back of the chimney. I do free moves, peg moves, axe moves, all the time panting with the altitude. Finally it is done and Joe comes up and goes ahead. Another mixed pitch overhanging nearly all the way. He gets into a wide crack and has to keep leap-frogging the two pegs we have that fit. Finally it opens to a V shape that will not take the pegs. He makes a desperate free move to a hand jam and places the next peg hanging from that. Then it is me again, mostly free climbing once the holds are dug out of the snow, round a corner to a ledge and horror of horrors: an impasse. It looks impossible above. Either a chimney about a foot wide and a foot deep, full of hard water ice, or an overhanging corner, black with verglas. Depressed we both go down and give a pessimistic report to the others.

The black corner

We sleep fitfully and next morning Mo attacks the black corner. It is not impossible but it takes him three hours of hard pegging. Martin comes up and takes over. They are hoping like hell that the difficulties relent because the weather has broken again and there is no more food at the bivouac. This is probably our last chance. It soon becomes clear that far from relenting, the difficulties are redoubling.

Martin is in a deceptively steep and long V chimney full of ice. He free climbs to start with then takes to pegs when the effort becomes too much for the amount of air he can breathe. He runs out of pegs and goes free again. Next time he can't get enough breath; he falls off. The rope holds him and more pegs are sent up. The tools of war: he fights it again. Again he falls off. A setback, but his willpower is not quenched. He goes up again, and once more at the limit of his strength manages to pull out a bit extra and does it. Another three hour pitch. By now it is late afternoon and there is not much time but at last the mountain relents. The angle eases and they race up three more easier pitches to the top.

The summit

Suddenly all the straining, panting, shouting, worrying, is over. Just a clear, still evening, a blue sky and range after range of mountains as far as the eye can see. They think their thoughts and enjoy the moment. For Martin it has been something of a blood feud and now the summit is there at his feet. They go back down to Tony who has been filming from just below the summit. There is a lot of smiling and joking as the tension relaxes and they go down to the bivouac. More laughter and stories. There is no food, but no one minds.

Next morning Joe and I set off early to retrace the route to the top. The weather is still getting worse and it is snowing, but we expect no problems and find none. We get our summit although not the view and then go down. Everybody gets down to the glacier by the afternoon and after that it really is all over.

when read to Dave would mean: over the next blind brow keep the accelerator flat on the floor, then in 50 metres there is a fast left bend, in 100 metres a sweeping bend to the right, followed by a blind brow over which he should drive carefully because it leads immediately into 90° left and 90° right bends.

The great day

Very soon the great day was upon us and at 15.53 on the Saturday afternoon we were on the start line in the main street of Tobermory. As we sat there waiting to go, the tension built up and I am sure that we had enough adrenalin to keep us going for days. Leaving the start was quite a relief but the competitive motoring didn't start until 10 miles down the road.

At the start of the first special stage neither of us spoke as we went through the rituals of donning crash helmets, checking watches, adjusting seat belts and so on. I was the first to speak as I repeated the start marshal's count down over our intercom. (It is so noisy in the car that we needed an intercom to hear each other.) At last, in a crescendo of noise and a spray of mud from the spinning wheels, we were off, our nervousness gone. We could now concentrate on accurate driving and putting up a reasonable time.

The second special stage followed immediately and this time we were looking forward to it. There was only one more special stage in the afternoon section which gave us a few hours in which to rest before the real meat of the event, the night section. The sunny afternoon gave way to a dull evening and by the time we started the first 7 mile road section at 23.23 it was raining heavily. It was so bad on the exposed mountain tops that visibility was very poor, even with 300 watts of quartz-iodine lighting up front.

The road used for the second of the night stages is one of the longest continuous stretches of road to be used competitively in Great Britain. The photograph, left, shows us about to start the twenty-three miles of tortuous road, with precipices into the sea on one side and cliffs on the other. We covered this road in just over 30 minutes which was still fully 3 minutes slower than the fastest car. At the end of this I was losing my voice and Dave was in danger of dissolving in a pool of perspiration. There was no respite however, as the next section was only a mile or so away and we had another 30 miles to do before we could rest briefly at the petrol halt.

The pressure was maintained throughout the night during what was effectively two circuits of the island (200 miles) interspersed with the 20 miles of forestry stages. There was a sting in the tail of the event as we had to tackle the 23 mile section for a third time, but on this occasion in the opposite direction, then a demanding 7 mile section with many hairpins to the finish.

Final sections

Whilst driving the final sections we could see that there were not going to be very many finishers as the route was littered with broken down and crashed rally cars. At one place I recall there was a car which had gone straight on at a 90° left, and parked very neatly about 6 inches away from it was another which had arrived afterwards—on its roof! Although there were a good many crashes there were no injuries apart from minor cuts and bruises. Though this may seem surprising it is not unusual in rallying because one is firmly strapped by a full-harness within a substantial roll cage and is surrounded by fire-proof bulkheads.

We learnt later in the morning that we had finished thirty-first from the 120 starters (56 finished) which was quite pleasing since neither of us had done a big rally for over two years. We had a slight excursion into the scenery in one of the forests on the night section which cost us many minutes—but that is what rallying is all about!

The presentation

At the prize presentation in the evening the rally organisers received a vote of thanks from the islanders for bringing the rally to the island and for providing such an enjoyable event for everyone. This was typical of the goodwill on the island towards the rally and it makes a very pleasant atmosphere which I look forward to sampling again this year.

John Poole works in the Theory and Parameters Section of the SRS Group at Daresbury Laboratory. He has been chairman of the Knutsford and District Motor Club for 3 years and has been involved with motor sport since moving to Daresbury in 1968.

Newsfront

New Year Honours
Our congratulations to Professor James Baddiley and Dr J Eric Small who were made Knight Bachelor; Professor F R Bradbury and Mr P T Dunican who received the CBE; Mr G A Harding who was awarded an OBE; Mr K E Welch who was made an MBE and Mrs D M Haas and Mr R D Prince who were awarded the BEM.
Professor James Baddiley is a member of the Biological Sciences Committee.
Dr J Eric Small is a member of the Advisory Board for the Research Councils.
Professor F R Bradbury is a former member of the Joint SRC/SSRC Committee.
Mr P T Dunican is a former member of the Transport and Civil Engineering Committee.
Mr G A Harding is a Senior Principal Scientific Officer at the Royal Greenwich Observatory.
Mr K E Welch is a Higher Executive Officer at London Office.
Mrs D M Haas is an Assistant Chief Photoprinter at London Office.
Mr R D Prince is a Skilled Labourer at the Appleton Laboratory.


Mr Ness (left), an experimental worker at the Daresbury Laboratory receives a cheque for £250 from the Deputy Director Dr Voss (see below left)

Suggestions award
Mr G K Ness, an experimental worker in the Engineering Division at Daresbury, has recently received £250, the largest sum yet at the laboratory under the Suggestion Awards Scheme. His suggestion concerned the cleaning and polishing of 29 NSF tandem bulkhead plates of 1.764 m diameter.

These bulkhead plates had been manufactured from aluminium alloy and in the delivered state were covered with a film of aluminium oxide. Mr Ness suggested that instead of using standard polishing or pickling methods to remove the oxide film, the plates could be laid flat and polished with the aid of a standard commercial floor polishing machine. The suggestion was tried and the results showed that the method was quick, easy, and produced a finish of a high quality.

In presenting the cheque, Dr R G P Voss, Deputy Director and Head of the NSF Division, congratulated Mr Ness upon his award and said that his suggestion had resulted in the polishing work being carried out not only at a much reduced cost, but also with the minimum of disruption to this aspect of the NSF construction programme.

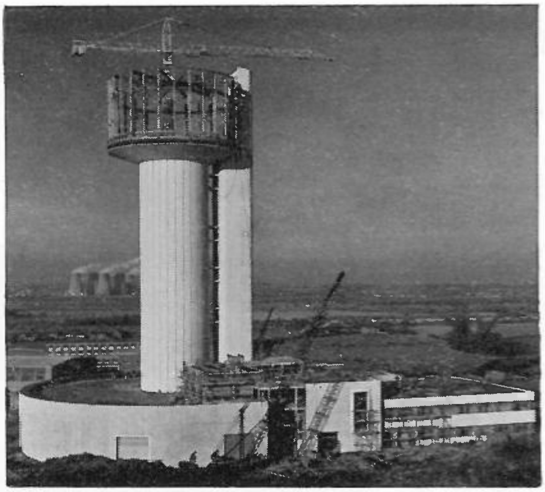
Miss Joy Penny
Miss C J A (Joy) Penny retired from RGO in October 1976. She had worked in the Time Department, apart from one short break, since joining the Observatory at the Edinburgh outstation in 1944. She was perhaps best known both at the RGO and throughout the Council as a formidable fighter for the rights of the staff. She was a member of the Staff Side of the RGO Whitley Committee for over 25 years and a member of the Staff Side of the SRC Whitley Council since its formation in 1965. On 24 February Miss Penny was presented with an IPCS Special Award for Long Service at its Annual Delegate Conference of the SRC Branch in London.

New Secretary for MRC
Dr J L Gowans CBE FRCP FRS has been appointed Secretary to the Medical Research Council. He succeeds Sir John Gray FRS who retired at the end of March.

Professor Gowans was formerly Royal Society Research Professor in the Sir William Dunn School of Pathology, University of Oxford, and also Honorary Director of the MRC Cellular Immunology Unit.

Progress on the NSF

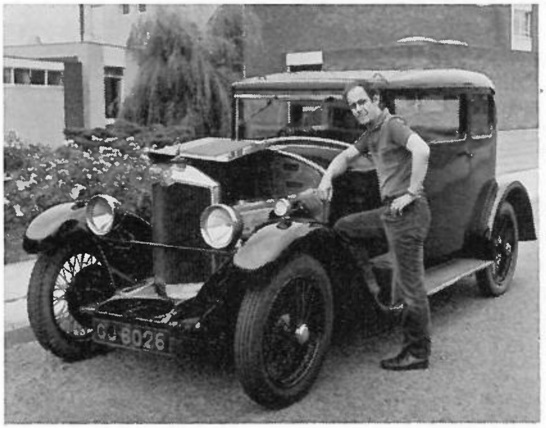
The photograph (right) shows the progress at the end of December on the Nuclear Structure Facility (NSF) under construction at Daresbury Laboratory. The semicircular building at the foot of the circular tower is divided into three experimental areas, the first of which was finally handed over in October for use by the Laboratory. Completion of the steelwork for the ion source room at the top of the tower will be followed by the installation of the roof and wall panels. Delays on the main building, seen on the right foreground, and on the experimental areas, have hampered the construction and installation of plant and equipment for the tandem.



Picture (taken in December last year) shows the progress made on the Nuclear Structure Facility (NSF) at Daresbury

Inside the circular tower the pressure vessel has been hydraulically tested and its surface cleaned and primed. Painting of its final coat began in January. Assembly of modules of the insulating stack has started in the completed experimental area and, following consistently good performance of submodules of the accelerating tube, testing of a full tube module is now underway.

In preparation for the experiments to be carried out using beams from the 30 MV tandem, approval has been given by the NSF Management Committee for a data acquisition system which will be based on GEC 4070 computers. Also an NSF Programme Panel, under the chairmanship of Professor G C Morrison of the University of Birmingham, has been set up. It will shortly be calling for proposals for the initial experiments.



Picture shows John West, an atomic spectroscopist at Daresbury Laboratory with his 1929 Crossley Sportsman Coachbuilt saloon

Pictured above with his 1929 Crossley Sportsman Coachbuilt Saloon is John West, an atomic spectroscopist at Daresbury Laboratory. The car is immaculate to look at, which would suggest a history of care and attention, but in fact it surfaced on a scrap heap in Leicester in 1959 when a casual visitor bought it and resold it for spare parts for £20. Its purchaser realised that it was too good to scrap, got the engine going and resold it in 1962 to John West and A N Other for £30. When A N Other went to spend a year in Germany, John became the sole owner and has looked after it lovingly ever since. The bodywork, interior and engine are virtually as made.

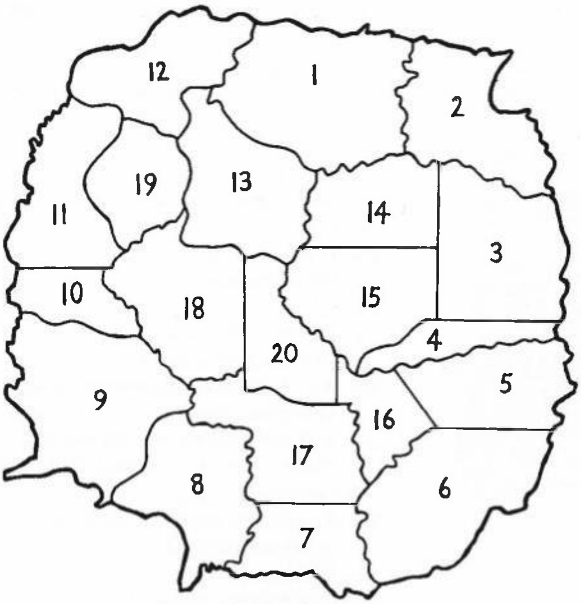
The 2-litre, 6-cylinder car was usually made as a 4-door saloon, and only six were made to the Sportsman design. John runs the car for four months every summer and is a regular participant in the Manchester to Blackpool rally.

Winkfield's new director

Frank Swales, formerly of Rutherford's Nimrod Division, has taken over the post of Station Director of the Winkfield Tracking Station of the Appleton Laboratory.

The Winkfield station is a joint venture between SRC and NASA (the United States National Aeronautics and Space Agency). It is one of twelve such stations around the world linked to NASA which coordinates all the work.

Winkfield operates around the clock and will usually cover 25 passes of unmanned satellites launched by NASA and ESA (European Space Agency) in a 24-hour period. In addition to the normal work of data collection, position determination control by command, the Winkfield station is involved with the design and construction of British satellites.



Nutcracker 23

NUTCRACKER 23

The King of Concilia had conquered the island of M'Shetwanda, and proposed to settle its twenty provinces (illustrated above, and numbered to spare readers their unpronounceable names) with colonists from the four tribes of his kingdom. Each tribe was to have five provinces. So warlike are the tribes, however, that the King was forced to rule that no tribe should have two adjacent provinces, so that no tribe could concentrate forces for an attack on a neighbour. The first four assignments were easy because of natural ties with local populations, and were soon announced—province 3 to the Asari, 7 to the Regeneni, 13 to the Escenci, and 16 to the N'Claure. Soon afterwards, however, one tribe was able to learn the assignment of another province, and immediately deduced the whole pattern. Which province?

The prize will be awarded to the first correct entry drawn on 1 June. Entries to the Editor, 'Quest', Room 1532, State House. Please state whether you would prefer a book or record token. The solution will appear in the next issue.

Solution to Maxim 13

S	C	O	C	C	Y	X	T	E	D	I	U	M
T	A	U	T	E	E	X	O	T	I	C	M	I
A	N	T	H	R	A	X	T	H	R	O	B	S
C	A	R	E	E	R	X	E	N	O	N	I	U
C	L	E	M	A	R	X	V	I	T	A	L	S
A	S	I	A	L	E	X	I	C	O	N	I	E
T	E	N	T	T	E	X	T	U	R	E	C	S
O	S	W	I	R	L	X	R	A	Y	B	A	P
F	T	A	C	O	A	X	I	C	U	R	L	E
L	O	R	L	Y	N	X	F	I	N	A	L	E
E	N	D	O	W	O	X	I	D	I	S	E	D
S	I	L	O	F	O	X	E	S	O	K	A	Y
H	A	Y	M	A	N	X	D	Y	N	A	S	T

The winner was Mrs G Cullinane (State House) who wins a £2 record token.

London region soccer

London Office's five-a-side soccer 'A' team were back in action on 4 March playing in the second round of the London Region Civil Service Competition, with a place in the finals at stake. The team was: Steve Day, Howard Fardon, Paul Gilbert and Phil Osprey with newcomer Guy Read in goal.

Our first game was against the Registry of Friendly Societies 'A' team and after going two goals down in a shaky start we came back to win 4-3.

In the second game we lined up against old rivals Brixton DHSS 'A'. Paul was in unstoppable form scoring all five goals (including four from the half-way line) in our 5-3 victory.

Perhaps because we had already qualified for the finals, we lost some of our organisation and commitment, and an early goal—in our third game against Civil Aviation Authority 'A' team. We lost 2-1 but we had done enough to top our group and we went into Finals Night on Friday 15 April with Richard Weaver stepping in for Guy Read in goal.

Our first game against the Cabinet Office resulted in a 4-2 win with Day and Gilbert scoring the goals. Our second game was against Brixton DHSS 'B' and we won 2-1.

In the semi-final Paul gave us a 2-1 lead at half-time against St Stephen's Press but they countered strongly and we lost 2-3. We went down by the same score in the third place play off against DTI (HQ).

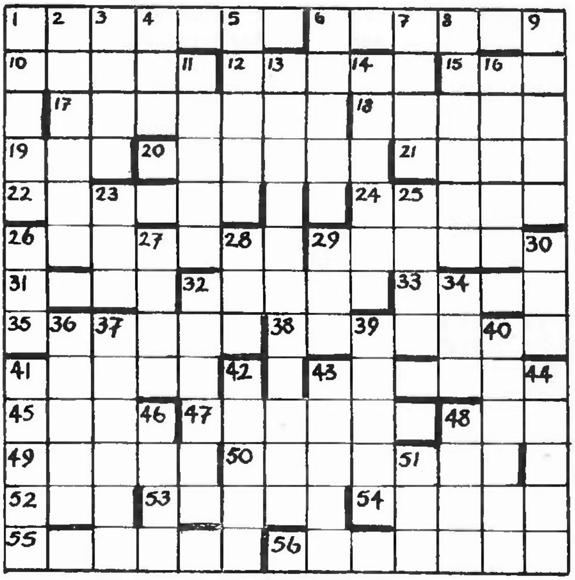
In the final St Stephen's Press beat CAA 'A' by 4-3. Although disappointed that we are not going forward to the National Championship in Birmingham in June fourth place from an entry of 93 teams is still an achievement!

Howard Fardon and Phil Osprey

Solution to Nutcracker 22

3	3	2		2	3	1		2	4	3
3	6	1	2		8		4	4	5	2
3	5		1	3	6	0	8		1	1
	2	6	7		3		6	4	5	
6		5		2	7	1		7		3
5	8	8	0	7		5	9	0	4	9
0		5		3	7	9		8		1
	1	3	1		7		6	9	3	
2	8		2	5	2	8	1		6	3
7	9	5	9		7		7	9	6	8
5	7	6		3	4	2		1	8	5

The winner was R Q Apsey (Rutherford) who wins a £2 book token.



MAXIM 14

MAXIM 14

The nine unclued words have something very much in common.

Clues

ACROSS

1. (7)
6. Groups of chaps ready for a row, e.g. this roughhouse (6)
10. Leers at a display of legs with nothing on (5)
12. Less likely to be dead in European river (5)
15. Woman first seen the day before (3)
17. Ditches bird that is initially satisfactory (7)
18. Enchantress makes father start nervously (5)
19. What's sometimes found in carburettors at front end of internal-combustion engines (3)
20. Good, clean French piece of millinery (6)
21. The mostly up-tight decades (4)
22. Sticks around Royal Society, but the villain's foiled again! (6)
24. A short space to press for result (5)
26. Nothing to add about the broken PSO—he lies low (7)
29. (6)
31. Accompanied by a joker—horrific! (4)
32. Joy is in the bathtub, lissome (5)
33. Transport network that's a product of 40 (4)
35. Tore madly about, very loud—such force! (6)
38. Removes bud. Goes AWOL (4, 3)
41. Idles when subject to order—the rule of the laboratory (5)
43. Type of jacket made by ravelling crochet? (6)
45. (4)
47. 100% storm-tossed in tree (6)
48. (3)
49. What's left to one in about a hundred (5)
50. Look out, mate! Here's junior manager (7)
52. Purpose of American—going towards Europe? (3)
53. Take casual type of this after his mistake (5)
54. Measure implicit in Mohammedan ceremonial (5)
55. (6)
56. Effect of electric discharge—in the end, hurt badly (7)

DOWN

1. Corridor I choose centres on architectural style (5)
2. Urge, with mixed drink, to get top chicken's achievement? (6)
3. Ulcer? Take out, repair, and see what we've got (4)
4. Fish brought up out of the wind (3)
5. Change: sonic change (5)
6. Ford's failure in Leeds election (5)
7. In Greek, it's *charakter* (4)
8. Drunk with rye, she's preaching unacceptable religion (6)
9. (5)
11. Fruit that *doesn't* give you the runs, we hear (5)
13. (11)
14. Steers erratically, the results of alcohol and acid (6)
16. Road with no beginning in time and place (5)
23. Rubbish tipped up the hill (3)
25. Pinches sailor between top and bottom (4)
26. Require to render a return in five working-days (3)
27. Having footwear poorly made, lacking rare earth (4)
28. Middle of July to end of August, a month ago (3)
29. Afterthought, one for a letter (3)
30. Held by sore footballer, when he's not looking (3)
32. Tree that's about right to be at end of gun-barrel (6)
34. It's the part of heroes to produce the next marine generation (3)
36. Self-centred love about shifting ice (5)
37. Where petrol goes back in barrel, lifeless (6)
39. River, blood-coloured, closely examined (5)
40. Currency unit and point, where comma would be used instead (6)
41. Start of melée with stoic wingers (Rugby Union) on top (5)
42. Not good fun—it's not suitable (5)
43. Start, and if you finish by day, make it an annual event (5)
44. Confess to monarch things belong to me (5)
46. What Yanks use instead of having tape in knots, kids (4)
48. (4)
51. (3)

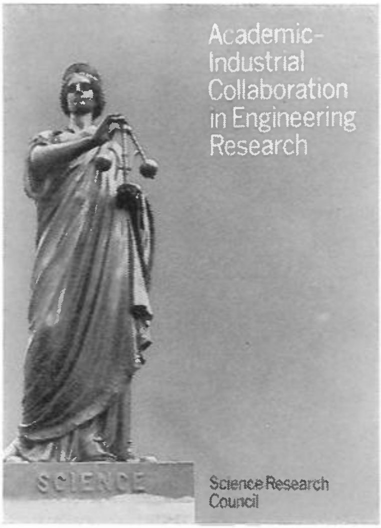
The prize will be awarded to the first correct entry drawn on 1 June. Please send your entry to the Editor 'Quest', Room 1532 at State House and state whether you would prefer a book or record token. The solution will appear in the next issue.

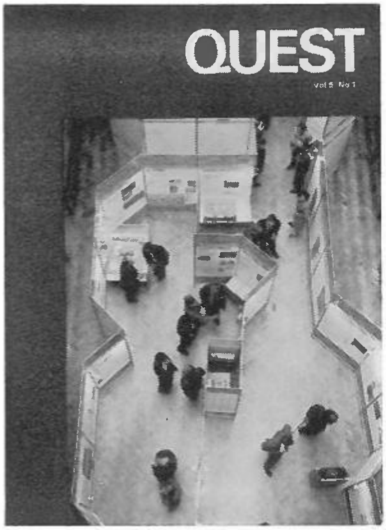
It all began with Caxton

Printing is indispensable to modern life. In one way or another, print is needed by everyone—business men, housewives, schoolchildren, shopkeepers, the government, bankers, musicians, passengers, hoteliers—in fact everybody you can think of. Thus, thousands of different kinds of printed matter are in use today.

It all began in October 1476 when William Caxton set up his printing press in Westminster. In October 1976 the Design Centre and the British Printing Industries Federation held an exhibition of modern print as part of the 500th anniversary celebrations.

Printing designers and printing technicians use their skills and techniques to ensure that each printed job is fashioned in the best way to carry out its purpose and three of the Council's publications (SRC Bulletin, Quest and a report 'Academic-Industrial Collaboration In Engineering Research' — see right) were among the 600 exhibits of good modern printing.





Director for Marine Technology

Mr A M Adye has been appointed Director of the Council's Marine Technology Programme. Mr Adye joins SRC on secondment from British Petroleum with which company he has had an active career in offshore operations, his most recent post being manager of the Abu Dhabi Marine Area project. He has also acted as Chairman of the Underwater Engineering Group of the Construction Industry Research and Information Association (CIRIA) for a period of three years from 1972 to 1976 and has been involved in the developing university activities in offshore engineering, for example as a member of the Board of the Institute of Offshore Engineering at Heriot-Watt University.

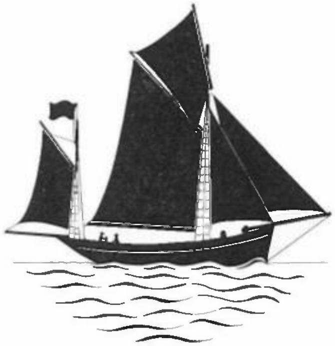
Finite elements

'Finite Elements'—the computer-generated film produced by Atlas Computing Division—has now sold more than 100 copies, to places as far afield as the US, Sweden, Norway, the Netherlands, Iraq, Iran, Switzerland, Canada, Brazil, Denmark, Australia, South Africa and New Zealand.

The film is now being marketed by Compeda, a new company formed by the National Research Development Corporation of London to handle a wide range of computer-produced material for engineers. Compeda will be assigning marketing rights for the film to specialist agents in the US and other countries, and is expected to arrange for foreign language soundtracks to help overseas sales.

Breton Tunnyman

Charles Booth (Rutherford Lab) who is a keen sailor in his spare time and holds a master navigator's certificate, acquired a converted Breton tunnyman 'Biche' last year and SRC staff were among those who sailed to many parts of France and to the Channel Islands. The ship is large,



70 feet in length with a 22-foot beam and 4,000 square feet of sail. Powerfully built of oak she is comfortably converted (two berth cabins, sprung mattresses, showers etc). She will operate throughout the season for voyages from weekends upwards to Biscay, Southern Ireland or wherever chosen, at a cost of around £66 per week. Further details from Charles Booth at Rutherford (building R2/310 tel: 0235-21900 ext 6645).

QUEST

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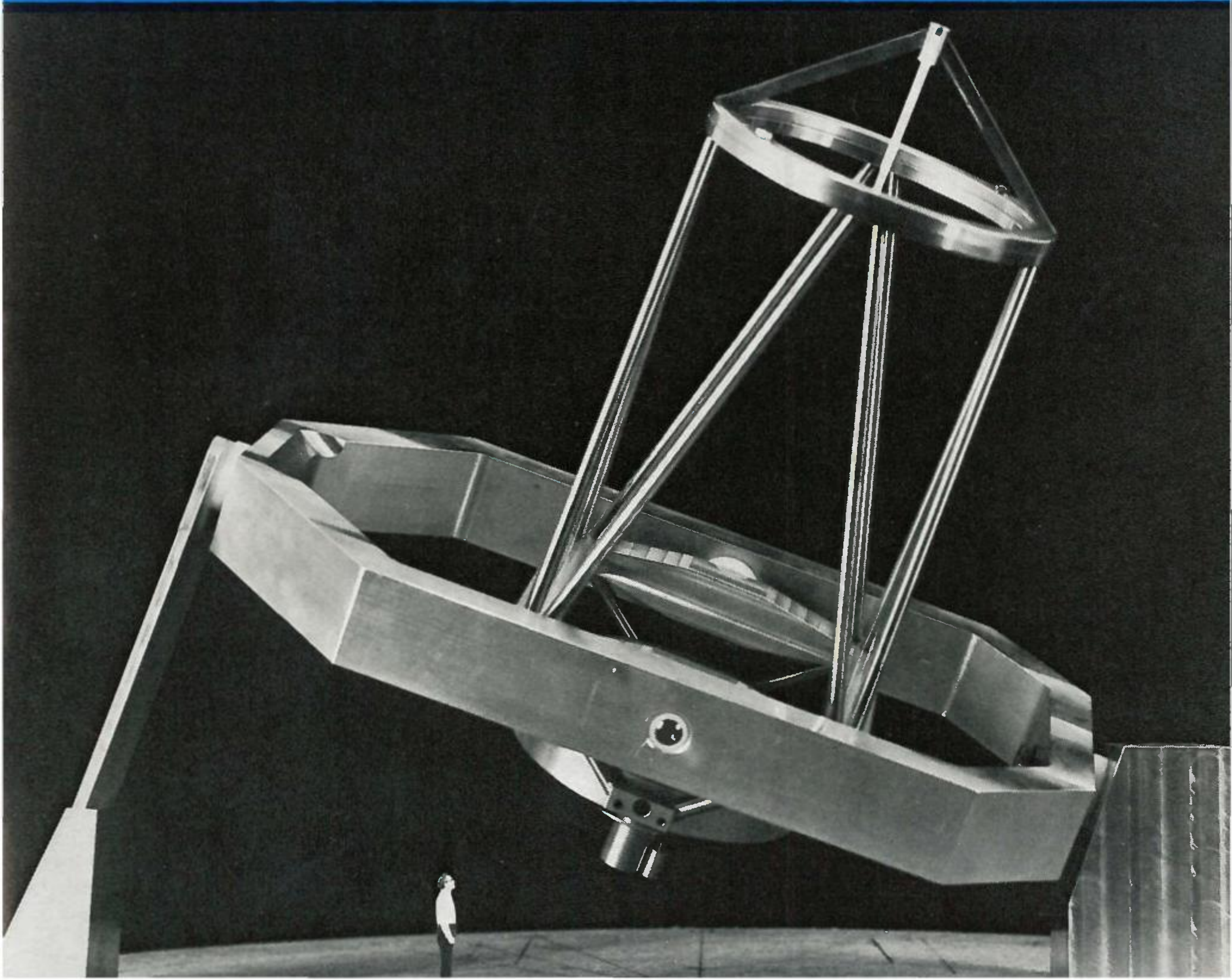
Laser Lab opened

New neutron source at Rutherford

Sports day



QUEST

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1977

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Our cover picture shows the UK 3.8m aperture infra-red telescope, as it will appear when completed on Hawaii in 1978.

As many readers will already be aware, about three years ago the Royal Observatory, Edinburgh became responsible on behalf of the Council for 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 at a height of 4,200m on the Island of Hawaii. The telescope, which will be one of the largest in the world and certainly the largest purpose-built for observations in the infra-red region of the spectrum, was unveiled before the press on June 21 at the Sheffield Works of Messrs Dunford Hadfields.

The building and dome have becn erected on the mountain ready to receive the telescope early next year. Figuring of the primary mirror has been completed at the Newcastle Works of Sir Howard Grubb Parsons & Co Ltd. The secondary and Coudé mirrors are due to be completed by the end of this month.

The design of the telescope is unique in that it uses a relatively thin primary mirror, its weight being only 6 tons whereas a mirror of conventional thickness would weigh approximately 15 tons for the same diameter. Consequently it has been possible to reduce the structural requirements for the telescope and hence to reduce the overall cost by a substantial amount. The primary mirror support system is extremely sophisticated and, despite the low-cost concept, good optical performance is anticipated.

The Project Manager is Dr Colin Humphries of ROE who took over responsibility in this role following the sad and untimely death of Mr Gordon Carpenter. The project is guided by a steering committee of infra-red astronomers under the chairmanship of the Project Scientist, Professor Jim Ring of Imperial College.

Contents

To the staff of SRC from Professor Allen

Professor Geoffrey Allen FRS

On October 1 I took over from my friend and scientific colleague, Sir Sam Edwards, as Chairman of the Council. During my years of service on committees and boards I have made many friends within the organisation. I hope to make many more!

The central task of the Council remains to provide for Britain through the universities and polytechnics an ongoing programme of training and research in the biological, physical and engineering sciences. At his last press conference Sir Sam pointed out that SRC needed more cash to discharge its responsibilities properly. Fortunately, his legacy is a robust programme with exciting initiatives taking shape; it provides a good basis for seeking additional funds. We must build on this and ensure that a sound programme continues to evolve as more new ideas come forward from academe, private industry and the public sector.

I have made plans to visit laboratories in the early months, to develop my own understanding of your activities and to meet people—especially those I don't yet know. Previous Chairmen have enjoyed a reputation for being approachable, I certainly wish to maintain that tradition.

Within the next year we must complete the move to Swindon. I shall retain an office in London and the boards and committees and Council will in general meet in London. I hope that most of the people concerned will elect to go to Swindon. It will be a testing time but also a good time for simplifying some of our procedures and implementing new, good practices.

Putting all these things together, we in SRC now have a unique opportunity to help provide the training and research programmes required in the national interest and to build up a support system for the polytechnics and universities which surpasses even our present endeavours. One of my main aims will be to encourage staff to seize this opportunity and so, despite immediate problems, ensure for themselves good career development.

Professor Geoffrey Allen FRS

Professor Allen is Professor of Chemical Technology in the Department of Chemical Engineering and Chemical Technology at Imperial College. He was until September Chairman of the Council's Engineering Board.

He was educated at Tupton Hall Grammar School, Clay Cross and the University of Leeds, where he obtained a PhD degree for thermodynamic studies of solutions. From 1952-54 he was a postdoctoral fellow working on Raman spectroscopy at the National Research Council in Ottawa, Canada and in 1954 he returned to an appointment in the Chemistry Department of Manchester University. He was appointed Professor of Chemical Physics at Manchester in 1965.

It was at Manchester, in collaboration with Geoffrey Gee that he established his main research in the field of polymer science. From 1969-73 he was director of an ICI/Manchester University Joint Laboratory working on new polymeric materials and from 1970-74 he was seconded half-time to the ICI Corporate Laboratory at Runcorn.

Professor Allen has been consultant to ten different companies and served on the Chemistry, Neutron Beam, Polymer Science and Material Science and Technology Committees. He was elected to the Royal Society in 1976.

He is 49 years of age, married with one daughter. He lives in Wimbledon; his recreations are walking, talking and eating.

A farewell message from Sir Sam Edwards

There is reputed to be a Chinese curse 'May you live in interesting times'. The last four years have certainly been that. When I became Chairman I found SRC with a budget which when translated into current values was £145M, and expected that over my four years it would rise to £162M. In fact it has decreased to £133M. At first sight this appears a disaster but in fact many problems have been sorted out in this period and the Council has passed into a period of intense activity, with all its establishments having substantial programmes at present and with more projects in the advanced planning stage. This has meant a massive rearrangement of the work of the Council's establishments, and must at times have appeared as drastic, even draconian, to the staff, and I must give thanks to the staff for their confidence in the ability of the Council to make the right decisions in this difficult period. I think these decisions have proved to be good ones, for they leave us in the position of having the world's first infra red telescope, the world's first purpose built radiation synchrotron, the world's first spallation neutron source, and Europe's first laser laboratory and interactive computing laboratory.

Provided political problems are resolved, the NHO should soon go ahead, and the next major project for Appleton is planned to be the world's leading millimetre wave telescope. It is an encouraging prospect, but has involved consuming, by cannibalization, all the Council's existing resources.

Thus though the next five years seem assured, the longer term future will depend on some increase in the Science Vote, which will in particular allow the Council's ambitious plans in engineering to come fully to fruition, and allow some reinstatement of a space programme appropriate to Britain's scientific standing.

I am handing over the Chairmanship to an old friend, Professor Geoffrey Allen, who is uniquely qualified to do the job by virtue of his knowledge of science both pure and applied, and both big and small. I feel sure the staff of the Council will give him the support that I have enjoyed from them in these last four eventful years.

Introduction to lasers

The word Laser is an acronym for **L**ight **A**mplification by **S**timulated **E**mission of **R**adiation, ie they are light amplifiers (see Fig 1).

If we imagine taking a sufficient fraction of the output of a light amplifier and feeding it back to provide its own input (Fig 2), the system becomes a self-sustaining light oscillator, ie a source of light. The most commonly available lasers are, in fact, light oscillators. They may, of course, be followed by amplifiers to increase the output power. This is done in the Rutherford Lab laser. (See page 3).

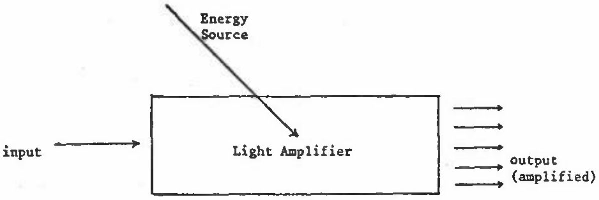


Fig 1 Laser Amplifier

Amplification of light requires the addition of energy, which must be pumped into the amplifier from an external source. The method of pumping varies considerably from one laser material to another. There are many hundreds of known laser materials—solids, liquids and gases—each with its preferred method of pumping.

Main properties of lasers

(a) The amplification is a maximum at some particular light wavelength (colour) which may be in the visible, ultra violet or infra red. This is the normal working wavelength of the laser.
(b) The beam emitted from a laser oscillator has very low divergence (ie it does not spread out like a torch beam) and can be focused to a very small spot.
(c) The power of the light beam can be very high.
(d) Pulses of light of extremely short duration can be generated in some types of laser. By 'extremely short' one means about 1 picosecond (equals 10^{-12} seconds or one millionth of a millionth of a second). A light pulse, which can travel a distance

equal to seven times round the earth in a second, travels only 0.3 mm in 1 picosecond.

Not all the above properties are available simultaneously in all types of laser. Relatively few lasers can generate very short light pulses and all are limited as regards the maximum power they can give, though some are more limited than others. The maximum power is limited by one or more of the following:

(a) *Saturation* The amplification decreases at high light intensities.

(b) *Refractive Index Changes* At high light intensities the refractive index of the material changes so that, for example, a plane glass plate behaves like a lens.

(c) *Damage* High light intensities can burn the laser material itself. This hazard is made worse by (b) above since the beam can be self-focusing.

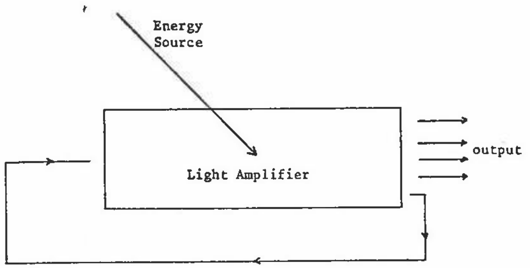


Fig 2 Laser Oscillator

Laser Lab opened

In October 1975 the government gave approval for the Council to provide a high power laser and ancillary equipment for use by university and polytechnic research groups at the Rutherford Lab. By December the following year the first experiments were under way.

In a ceremony at the Lab on 20 June 1977, the Chairman Sir Sam Edwards inaugurated the new central laser facility.

The main scientific objectives of the unit's research programme are:

(i) to create and study plasmas generated by laser compression;

(ii) to study non-linear interactions of intense laser radiation with matter; and

(iii) to develop more efficient and new high power lasers for future experiments in these and other fields.

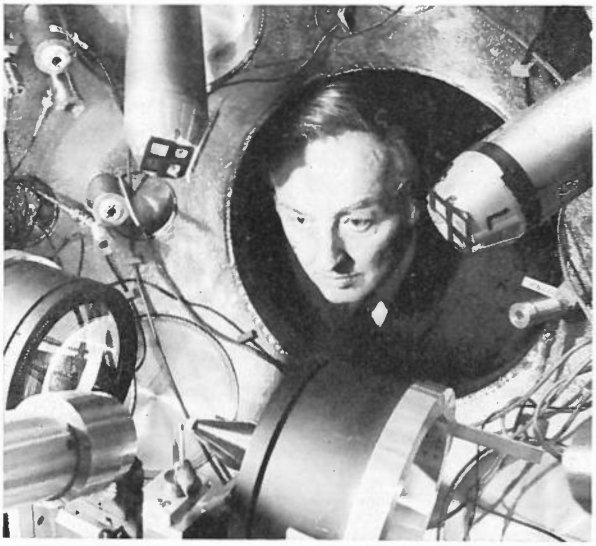
A milestone in the progress of the facility was reached earlier this year when laser 'compression' was recorded with the first shot of the new two beam laser at a glass micro balloon target. The aim of the experiment was to direct very intense laser light at a small target (ie the micro balloon). If two beams arrive at the same time on opposite sides of the target they can create a shock wave that travels into the target, heating it and compressing it as it goes. The resulting plasma is of scientific interest.

Laser Facilities

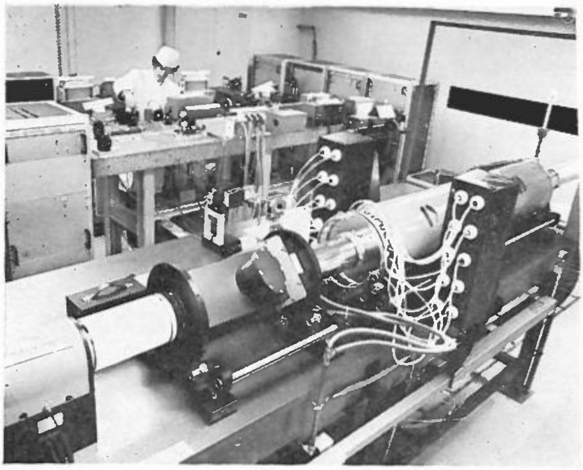
The laser is of the neodymium doped glass type and consists of an oscillator which generates single pulses

A memento of the inauguration day for Mrs Shirley Williams, Secretary of State for Education & Science, is handed over to DES representative Mr Ulrich, by Dr Stafford, Director RL

of radiation of 1.06 μm wavelength (near infra red) followed by a sequence of amplifiers and beam control discs. The duration of the oscillator pulses may be varied in steps in the range 30 picoseconds to 300 picoseconds but 100 ps pulses are most commonly used (1 ps $= 10^{-12}$ seconds). The amplifiers consist of neodymium doped glass rods of steadily increasing diameter up to a maximum diameter of 76 mm. At



Dr Alan Gibson, head of the Laser Facility looks inside the Laser Target vessel showing small stem supporting micro balloon target sphere *Keystone Press*



A general view showing Dr Ian Ross working on the Laser Oscillator *Keystone Press*

this point the beam power is about 100 Gigawatts (1 Gigawatt $= 10^9$ watts) and the beam can be directed into the target chamber for use in experiments.

Dr Alan Gibson presents Sir Sam Edwards with the photograph of the shot he had fired at the inauguration ceremony

Alternatively, the beam is split into two and, after further amplification to reach a power of 400 Gigawatts per beam, the two beams are directed into the target chamber in opposition. This two beam facility is required for compression experiments, the target being near the focus of both beams and compressed between them.

Target and plasma diagnostic facilities

At the entrance to the target chamber the laser beam(s) have their maximum diameter of just over 10 cm. They are then focused by two f/1 lenses onto the target which is mounted in an evacuated chamber since the laser intensity near the focus is more than enough to ionise the air.

Targets may take many forms, depending on the requirements of the users. Targets for compressional experiments consist of hollow glass spheres, about 0.1 mm diameter, which may be filled with gas. A target fabrication facility has been set up.

The target chamber is surrounded by a wide range of diagnostic instrumentation to measure various properties of the plasma created by the laser. Much of this equipment has been built and commissioned by university groups taking part in the programme.

Council Commentary

March to July 1977

Visit of the Secretary of State for Education and Science

The Rt Hon Mrs Shirley Williams, MP, attended part of the July Council meeting. She took part in the consideration of postgraduate training policy and stayed for informal discussions with Council members over lunch.

Visit of the Council to the Daresbury Laboratory

The May meeting of Council was held at the Daresbury Laboratory. Members were given an introductory talk by Professor Ashmore and saw work in progress on the construction of the Nuclear Structure and Synchrotron Radiation Facilities. The Council was impressed by the high standard of engineering employed on these projects and the Laboratory's ability to use its expertise to develop new designs and techniques.

Forward Look

In March and April the Council considered bids from Boards, etc as part of its preparation of the Forward Look. The Forward Look, as submitted to DES, covers the four years 1978/9 to 1981/2 and is based on an effective rate of decline in the Council's resources of 1.7% a year. In drawing up its Forward Look on this basis the Council was faced with many difficult decisions and was concerned that towards the end of the period it might not be able adequately to fulfil its responsibility to sustain standards of education and research in universities. The Forward Look makes provision to increase the number of postgraduate studentships offered to about 3,800 in 1981/82; the increase will, however, not keep pace with the expected rise in the number of qualified candidates. Expenditure on engineering would increase by 25% with the increase being entirely devoted to special programmes of national importance such as the Teaching Company Scheme, Marine Technology and Polymer Engineering. There would be a slow increase in expenditure within the Science Board area to provide important new central facilities at the expense of some reduction in research grant expenditure. Expenditure on nuclear physics is planned to reduce by slightly less than 25% over the period and that in the astronomy, space and radio area by slightly less than 20% over the period.

Spallation Neutron Source (SNS)

In the last edition of "Quest" reference was made to Council's approval in principle of the conversion of Nimrod to provide a machine and target station for a spallation neutron source at the Rutherford Laboratory. In April Council gave final approval to the scheme at a capital cost of £7.86M at prices then current. DES approval of the project has since been announced.

Part-time Postgraduate Training

In July Council considered a report from the Postgraduate Training Advisory Panel on whether different arrangements were necessary to cater for the needs of the large numbers of students taking part-time postgraduate training. At present the support of such students is the responsibility of Local Education Authorities on a discretionary basis. The Postgraduate Training Advisory Panel expressed fears that when higher tuition fees were introduced in the next academic year more students might opt for part-time training and some currently undergoing such training might experience financial hardship. The Council agreed that part-time education should be encouraged and that there might be a case for central Government to meet some of the costs; it asked for discussions to be held with DES and other relevant bodies to pursue the proposal. In the meantime it agreed in future to allocate a few studentships to enable some part-time students to have up to one year's full-time study.

Fabrication Facilities for Solid State Devices Research

To enable universities to play their part in solid state devices research (an area of considerable industrial importance) adequate fabrication facilities are required. In July the Council approved a proposal involving four grants amounting to £683K over four years to enhance university device processing centres to provide a service to all academic devices research groups. It also approved capital expenditure of £530K to establish an electron beam lithography facility at the Rutherford Laboratory. The Laboratory, in addition to operating an electron beam lithography machine, will develop software for its control and implement design programmes on the SRC's central computers to enable universities to design large scale integrated circuits before their manufacture on the machine.

Data Compilation Committee

In 1974 SRC assumed responsibilities for support of data compilation following the demise of the Office of Scientific and Technical Information. To administer this responsibility the Council established a Data Compilation Committee initially for a two year period (later extended to three years). In July the Council considered the second report of the Committee, which described the overall support given to data compilations and actions taken by the Committee to improve the dissemination of data. Council accepted the recommendation in the report that the Committee should be disbanded on 30 September 1977 and that Boards and subject committees should assume responsibility for support of data compilations. An Advisory Data Panel reporting directly to Council will be established to periodically review the working of these new arrangements.

Superconductivity

All the SRC Boards have some interest in superconductivity either as users (eg the Science Board in the Synchrotron Radiation Facility) or because of their support of research on the phenomenon of superconductivity and the characteristics of superconducting materials. In the Rutherford Laboratory, in particular, considerable expertise has been built up in various aspects of superconductivity. In July Council approved a proposal that SRC should take the lead in a national superconductivity research programme. It is appropriate at this stage in the development of superconductivity that SRC should take the lead since, although there is a need to retain a national activity in the field, possible commercial applications of the phenomenon are some way off.

Management Committees for the Marine Technology and Teaching Company Programmes

The Council has approved the appointment of Management Committees for the Marine Technology and Teaching Company Programmes. That for Marine Technology will be chaired by Mr R A Huskisson (Chairman of Lloyds Register of Shipping); Mr A F Masters (CompAir Ltd) will chair the Teaching Company Management Committee. Council's approval of the first substantial batch of grants for marine technology research is reported below.

Grants and other financial approvals

(*i*) *ASR*

(a) a grant of £208K to Professors Rees and Lynden-Bell (Cambridge University) over 4 years for research in theoretical astronomy;

(b) a grant of £185K over 5 years and 7 months to Dr Rees (University College London) for an interferometer experiment for the Electrodynamics Explorer satellite;

(c) a grant of £429K for one year to Professor Boyd and Dr Culhane (University College London) for research at the Mullard Space Science Laboratory;

(d) a grant of £238K for one year to Professor Sir Bernard Lovell (University of Manchester) for radio-astronomy research at Jodrell Bank;

(e) a supplement of £161K to Professor Houghton (Oxford University) for work on a stratospheric and mesopheric sounder for a NASA satellite NIMBUS G;

(f) supplements amounting to £55K to Professor Pounds (Leicester University) for a study of cosmic x-ray sources from the UK-6 satellite;

(g) £166K capital for provision of instrumental facilities on the UK infra-red telescope;

(h) a supplement of £52K to the existing commitment of £151K for feasibility and site studies for a millimetre and sub-millimetre radio telescope.

(*ii*) *Engineering*

(a) grants totalling £3,991K over 3 years for marine technology research. The grants are made to the Marine Technology Centres at London—Imperial College and University College (£1011K); Glasgow University (£557K), Strathclyde University (£336K), Heriot Watt University (£658K) and Newcastle University (£429K);

(b) a grant of £364K over 4 years to Professors Ash, Cullen and Davies (University College London) for devices and systems research in microwaves, optics and high frequency acoustics;

(c) a grant of £180K over 4 years to Professor Hammond and Mr Binns (Southampton University) for investigations of rotating electrical machines;
(d) a grant of £179K over 4 years to Professor Tobias (Birmingham University) for research in metal forming and associated areas;
(e) a third instalment of terminals for the interactive computing facility at a cost of £198K.

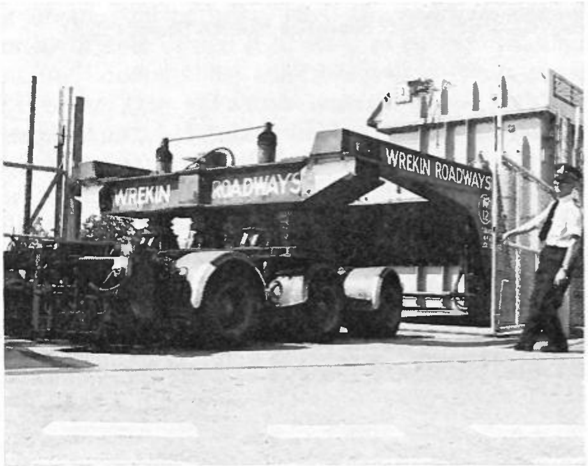
(iii) Nuclear Physics
two grants totalling £434K over 1 year for maintenance of accelerators for nuclear structure research at Glasgow (£164K) and Oxford (£270K).

(iv) Science
(a) a grant of £150K over 4 years to Professors Heine, and Sir Sam Edwards and Dr Inkson (Cambridge University) for research on the theory of condensed matter;
(b) a supplement of £39K to Professor Sir George Porter (Royal Institution) for research on primary photoprocesses;
(c) a superconducting wiggler magnet for the synchrotron radiation source at a capital cost of £236K.

(v) Data Compilation
a grant of £112K over 4 years to Dr Kennard (Cambridge University) for work on the maintenance and development of critical data compilations.

New neutron source at Rutherford

The Government has approved the construction of a new facility to provide intense neutron beams at the Rutherford Lab. The new facility, known as the Spallation Neutron Source (SNS), will serve the needs of university scientists studying the liquid and solid states in physics, chemistry, biology and material science.



The energy storage choke, which was part of the NINA synchrotron at Daresbury Lab, arrives at the gate of Rutherford Lab during July. The 130 ton choke will form a vital part of the power supply for the SNS project

The new source is based upon a high repetition rate (53 cycles per second) high intensity (2.5×10^{13}) protons per pulse proton synchrotron of 800 MeV energy. The proton beam is directed onto a heavy target in which spallation reactions produce intense bursts of neutrons. These neutrons are slowed to thermal energies using an assembly of reflectors and moderating material, and collimated beams pass on to the neutron scattering experiments.

Thermal neutron scattering is a technique used in an increasingly wide range of scientific disciplines. Nuclear reactors have been the usual source of neutron beams for several years, and today about 300 UK scientists use the facilities at AERE Harwell and at Europe's highest flux research reactor at ILL Grenoble. These installations are severely overloaded and there is little possibility of significantly extending the capability of reactors to satisfy the demands of new experiments. However, it is possible to use a *pulsed source* to provide effective neutron fluxes at levels exceeding those of steady state sources but with greatly reduced technological constraints on source cooling, radiation damage etc, and with corresponding financial economies. The SNS is expected to be generally complementary to the existing high flux sources, but for applications well matched to its particular spectral and temporal characteristics will be 100 to 1000 times more powerful.

A Project Committee for the SNS is now operating at the Rutherford Laboratory with Dr G Manning as the Project Leader. Dr L C W Hobbis, Deputy

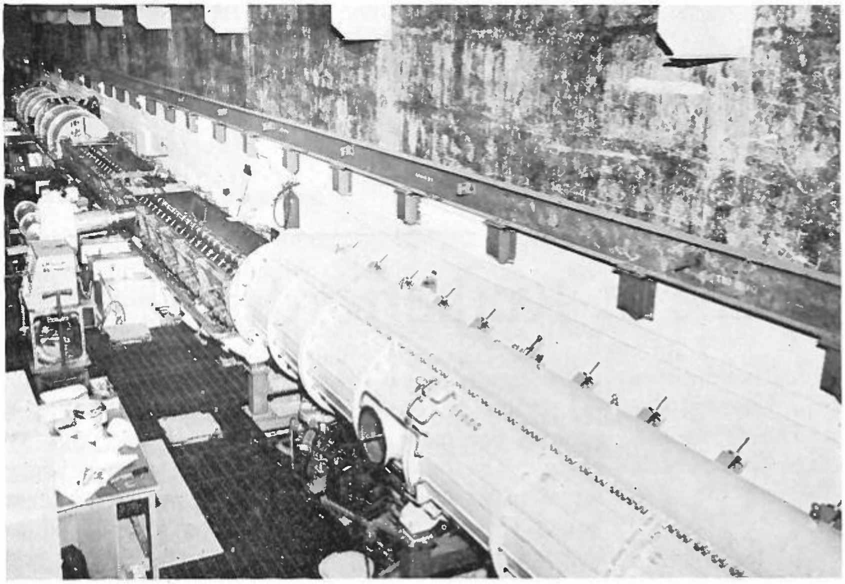
Project Leader, has special responsibility for utilisation. Where appropriate, the Rutherford Laboratory is advised by a Science Planning Group (a Sub-Committee of the Neutron Beam Research Committee) representing user interest and chaired initially by Dr B E F Fender of Oxford University.

The detailed design of the SNS is now well advanced. The construction and installation will start in 1978 following the closure of Rutherford Lab's 7 GeV proton accelerator, Nimrod. The estimated capital cost of the basic facility is about £8 million spread over approximately five years. In addition, up to £3 million will be spent on providing appropriate research equipment. The Science Planning Group is presently assessing the possibilities of the future scientific programme with a view to defining the experimental facilities.

Striking economies have been possible in the cost of the SNS facility by using existing plant and buildings, leading to savings of close to £20 million. It is planned to use the new Nimrod injector, Nimrod beam handling magnets, vacuum and control equipment, the extensive service network, steel and concrete shielding and also the magnet power supply from the NINA accelerator at Daresbury Laboratory. No new buildings will be needed.

The optimisation of the final design parameters is being pursued with tests using the Nimrod accelerator at an energy of 0.7 to 0.9 GeV and sending short pulses into the target area. Experiments performed during August include a series of measurements of thermal neutron yields, spectra, and pulse shapes, for different targets (uranium, lead), moderators (water, polyethylene) and reflectors (beryllium, graphite), in different combinations and geometries. These results will be valuable in determining the final design of the SNS.

The SNS project is at present the most advanced of its kind, and is attracting international interest. The first experiments are planned to begin by the end of 1982.



A view of the new 70 MeV proton linac, recently commissioned, which is to be used as the injector for the Spallation Neutron Source (SNS)

Sports Day 1977

The SRC Sports Day on 13 July took place on one of the cool cloudy days that have been typical of this summer: nice for competitors but not so pleasant for spectators. Sir Sam and Lady Edwards spent part of the afternoon watching the keen competition between the establishments, and prizes to the victorious were kindly presented by Mr and Mrs Walker during the early evening.

One new event was added this year: bridge—and it proved successful enough to be worthy of a permanent place in the future. The other competitions were, as usual, football, netball, tennis, bowls, cricket and chess.

The football competition attracted a lot of competitors, with 15 six-a-side teams entering. The competition was organised in four leagues. The eventual winners were the London 'A' team beating Rutherford 3-2 in an exciting final. This win was particularly worthy of note in that it appears to be the first time that any London Office team has won an event at an SRC Sports Day. (The team went on to win both the knock-out and league Civil Service Subsidiary Championships for the London Region.)

Four teams entered the netball competition, from London Office, Daresbury, Appleton and Atlas. The Daresbury team were the winners, thus retaining the cup that they won in 1976, winning all of the five games that they played and beating the Atlas team by 26 goals to 4 in the final.

Two tennis competitions were held: mixed doubles and men's doubles. The mixed doubles attracted a large number of entries. It was played as an American Tournament with two couples meeting in a three set final where Brian Yates and Eileen Robson of Daresbury beat Richard Smith and Shelagh Akrivos of Appleton. The men's doubles was won by Paul Gardner and Arthur Robert of Appleton, who won all the sets they played.

London Office 'B' team

Daresbury v London Office during the bowls competition

Atlas v Appleton

There were also two bowls events. The pairs tournament was won by Brian Blackwell and Albert Knight who beat Tex Mooney and Albert Wilkinson in an all Daresbury final. The Triples Cup was retained by a Rutherford team: Cyril Grindrod, Peter Knight and Alec Goodsell, who beat the London Office team of Harry Cook, Ron Sommerville and Jack Sawyer in the final.

In the quieter atmosphere of the marquee the chess and bridge competitions were held. The chess was, as usual between teams of three. Seven teams entered and the winners were the Appleton 'A' team of Eric Bramley, Dudley Long and Terry Burns. The best individual performance was from Eric Bramley who won all his five games. The second placed team of Jim Riddle, Peter Hemmings and Andy Williams (Rutherford) lost by only one game. The bridge attracted nine pairs and the Appleton pair of W Bain and D McEwan were the winners with a Rutherford pair, Jim Riddle and Peter Hemmings, finishing in second place.

Rutherford bowling

Rutherford 'C' team take a break

Daresbury v London Office

After the presentation of the prizes a disco was held in the pavilion during the evening. Thanks are due to the Appleton Laboratory for organising it, and also to all the people who organised and refereed the events and manned the first-aid post.

The cricket competition was rather different this year. In previous years the standard 11-a-side tournament had often taken a long time to complete with the winning team missing the prize giving. So to make the event shorter, and more exciting for spectators, we experimented with a six-a-side tournament with each innings limited to four eight-ball overs. There were two leagues of four teams and the winners of each league met in a final, which was won by the RGO 'A' team beating an Appleton team which has not lost a wicket in reaching the final by eight runs.

New Director for Appleton Lab

Dr Fred Horner, former Deputy Director of the Appleton Laboratory became its new Director in succession to Dr Saxton, at the beginning of July.

Dr Horner, who was educated at Manchester University, began his career in the Radio Division of the National Physical Laboratory (NPL) in 1941. This became a separate organisation after the war and has evolved into the present Appleton Laboratory. In 1947 he began a two

Dr F Horner

year tour of duty with the United Kingdom Scientific Mission in Washington DC.

Since 1950 he has been increasingly involved in international matters in radio science, becoming Secretary of the Inter-Union Commission on the allocation of frequencies for Radio Astronomy and Space Research. He is also UK Chairman of Study Group 2 of the International Radio Consultative Committee (CCIR). This study group is concerned with the topics of space research and radio astronomy as they relate to radio communication.

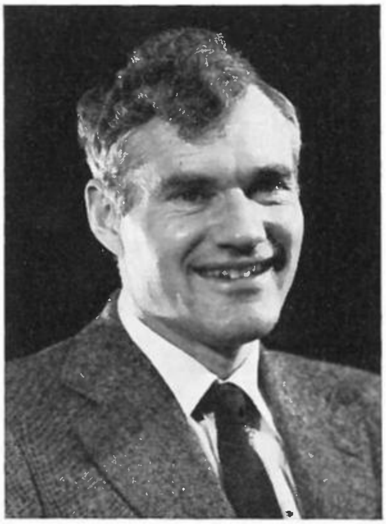
His career in research has been principally devoted to the study of radio noise, particularly that resulting from lightning. This work gained him a DSc of the University of Manchester. He was appointed Deputy Director of the Laboratory in 1969.

An active sportsman, Dr Horner's enthusiasm and skill as a tennis player are well known. Partnered by Mrs Horner he has successfully represented the Laboratory on many occasions.

Dr Henry Rishbeth

We offer our sincere congratulations to Dr Rishbeth on his appointment as Deputy Director of the Appleton Laboratory.

Born in 1931, he attended the Perse School, Cambridge and entered Christ's College in 1951. A period of post-graduate research at the Cavendish under Mr J A Ratcliffe was



Dr Henry Rishbeth

followed by radio-astronomical studies at the Radiophysics Laboratory, Sydney, Australia, after which he returned to Cambridge.

He first came to Ditton Park in 1960 on his appointment as a Senior Research Fellow. During 1962-64 he held a consultant post at the Central Radio Propagation Laboratory, Boulder, USA and returned to join the Staff of RSRS in 1965. In 1971 his work gained him the ScD of the University of Cambridge. In 1972 he was promoted on Individual Merit to SPSO.

As an expert in the theory of the ionospheric F region, Dr Rishbeth has an international reputation; he is the author of numerous papers on the subject and co-author, with Professor Owen Garriott, one of the US 'Skylab' astronauts, of the book 'Introduction to Ionospheric Physics'. His current work includes a major contribution to the development of the European Incoherent Scatter Facility (EISCAT).

Dr J A Saxton

Dr J A Saxton, who retired at the end of June from his position as Director of the Appleton Laboratory, began his long career in government science when he joined the staff of the National Physical Laboratory in 1938. Prior to that, his early research at Imperial College, after gaining a first in physics, was carried out in the field of artificial radio-activity.

Subsequently however, at NPL, his interest was engaged by those problems of VHF radio wave propagation which, in view of the marked influence exercised by meteorological factors, has grown into the very considerable study of radiometeorology. It is in this branch of science that he has become a notable authority.

In 1960 he was appointed the Deputy Director of the Radio Research Station, as the Appleton Laboratory was then known. It had become an establishment separate from NPL in 1956. In the academic world he has held positions as Visiting Professor, first at the University of Texas and latterly at University College, London and has also held high office in the Institution of Electrical Engineers.

The international representation of science has made increasing demands on his time and abilities. In the United States he has been Director of the UK Scientific Mission and

Dr J A Saxton

Scientific Counsellor at the British Embassy. The International Radio Consultative Committee (CCIR) of the International Telecommunications Union has benefited from his advice, as has the International Scientific Radio Union.

Dr Saxton's retirement from the Laboratory is in no sense a retirement from his profession. He acts as Radio Propagation Consultant to the Home Office and continues as Internation Chairman of Study Group 5 of the CCIR.

Pictured right: Mr R D Prince, Appleton Laboratory who was awarded the BEM in the New Year Honours list. With him are Lt Col Palmer, Vice-Lieutenant of Berkshire who made the award and Mrs Prince

Evening Post, Reading

Pictured above is Mr K E Welch, London Office who was awarded the MBE in the New Year Honours List. With him at Buckingham Palace is his daughter Mrs Judith Thompson, ex-SRC

Birthday Honours

Her Majesty the Queen has been pleased to award Honours to the following: Professor F C Frank FRS and Dr R E Richards FRS were made Knights Bachelor; Professor N A Dudley and Professor J C West were awarded the CBE; Professor L Maunder and Mr J F Smith were awarded the OBE; and Mr J M Reordan the MBE.

Professor Frank is a former member of the Metallurgy and Materials Committee.

Dr Richards is a former member of the Chemistry Committee.

Professor N A Dudley is associated with the Teaching Company scheme.

Professor J C West is a former member of the Control Engineering Committee.

Professor Maunder is a member of the Engineering Board, Chairman of the Manufacturing Technology Committee and Chairman of the Working Party for the Teaching Company scheme.

Mr Smith is a Principal Professional and Technology Officer at the Appleton Laboratory.

Mr Reordan is a Personal Secretary at London Office.

"Goodbye to NINA"

At twelve noon on 1 April 1977, NINA, the 5 GeV electron synchrotron at Daresbury Laboratory, was closed down at an informal ceremony co-ordinated by the Deputy Director, Dr R G P Voss. Professor W Galbraith (University of Sheffield), Dr M Ibbotson (University of Manchester and Dr J C Thompson (Daresbury Laboratory) paid tributes to NINA on behalf of the particle physics users and Dr I H Munro (formerly University of Manchester and now Daresbury Laboratory) followed on behalf of the users of the NINA Synchrotron Radiation Facility. Mr G Saxon closed the proceedings by saying: "Goodbye to NINA but long life to the SRS and to the NSF".

In the NINA control room, Neil Kelly a member of the crew for the day, switches NINA off for ever

Farewell to

Mr H M Smith OBE
Mr H M Smith, RGO, retired on 3 June. Mr Smith joined RGO as Head of the Time Department at Greenwich, on 1 October 1936 in which capacity he served until 30 September 1976, thus completing forty years as Head of Department. During his service with the Observatory he held many important appointments in international organisations. He was awarded the OBE in 1973.

Picture shows Nathy O'Hora (left) making a presentation to Humphrey Smith *Photo: Charles Parker*

Mr P S Laurie MBE
Mr P S Laurie, RGO retired on 4 May. Mr Laurie joined RGO as a Temporary Computer on 28 January 1935 and was in charge of the Solar Department from 1957 until 1974 when he became responsible for archives. He was awarded the MBE in 1975.

Professor Graham Smith (left) makes the presentation to Phil Laurie

Mr P J Bowles
Rutherford Lab's Chief Engineer, Mr P J Bowles, retired at the end of June, thus bringing to an end, a 30 year association, first with AERE and since its inception, the Rutherford Lab.

Mr Bowles was educated at Manchester University where he obtained a First Class Honours degree. This was followed by a two year graduate apprenticeship with Rolls Royce; he remained with the firm for a further two years obtaining his M Sc by external thesis.

He joined AERE, Harwell in 1947 and eventually became Head of the Engineering Division and Deputy Chief Engineer. After completing a number of major projects for Harwell, he became Project Head for Nimrod, the 7 GeV proton synchrotron which was built for the newly formed National Institute for Research in Nuclear Science. Not only did he successfully complete this very difficult project but he then went on to build a large part of the Rutherford Lab.

His outstanding services in the fields of both electrical and mechanical engineering (he is a Fellow of both the Institution of Electrical Engineers and the Institution of Mechanical Engineers) resulted in the award of the OBE in 1966.

Although now retired from the Rutherford Lab, he still has one major project to complete—the new SRC headquarters at Swindon a project far removed from his wartime experiences with Rolls Royce but perhaps not so very different to his first job at the age of 14 with a firm of builders!

From left: Dr Stafford, Director RL and Mr and Mrs Bowles

Special Promotions

Congratulations to Dr K Nandy (ROE) who has been promoted to Deputy Chief Scientific Officer and to Dr L Thomas (AL) and Mr C W Trowbridge (RL) who have been promoted to Senior Principal Scientific Officer on the recommendation of the Individual Merit Promotion Panel.

Dr K Nandy
Dr Nandy joined the ROE in 1963 after completing his Ph D at Edinburgh University. His work has been mainly concerned with the composition and spectral distribution of interstellar dust. What is the chemical

composition of the dust that dims and polarises the starlight? Where and how are they formed? Does this composition of dust vary across the galaxy? How does the extinction and polarisation of starlight vary with wavelength? These questions have been systematically investigated at first from the observations obtained with the small telescopes at Edinburgh. Gradually the observations have been extended using larger telescopes in the UK and Europe and the results have been widely published, including the ultra-violet interstellar extinction obtained from the analysis of the extensive data available from the S2/68 experiment in the TD 1 satellite.

Dr Nandy has now transferred his interest to extragalactic astronomy. He and his colleagues have developed a reliable method of determining radial velocities of faint galaxies to the detection limit of the objective prism photographs taken with the UK Schmidt telescope. These measurements undertaken with the fast measuring machine Cosmos (see Quest Vol 7 no 3) have provided for the first time the radial velocities and angular diameters of a large number of faint galaxies. In addition, Dr Nandy is a Fellow of Edinburgh University (1972) Fellow of the Royal Society of Edinburgh (1972) and an Honorary Research Fellow of the University College London (1976).

Dr Nandy has just returned from a visit to the Vilnins Astronomical Observatory in the USSR. As a hobby he is editing film which he has taken during his visits to countries throughout the world.

Dr Lance Thomas
Dr Thomas graduated in Physics at the University College of Wales at Swansea in 1950 and continued research there, obtaining a PhD for his ionospheric studies in 1953. He joined Ditton Park in 1959 and was soon able to advance his work further, making valuable contributions to a number of investigations in atmospheric and ionospheric physics. In 1970 he took over leadership of the Laser Group, which benefited greatly from his knowledge

of mesospheric and stratospheric theory.

He was awarded a DSc in 1972 and is now a leading authority on the theory of the middle atmosphere, being much in demand to advise on the use of lasers in atmospheric research, eg from Spacelab.

Mr C W Trowbridge

Mr Trowbridge obtained an external London University Honours degree in Physics after joining AERE Harwell as a Scientific Assistant in 1957.

At the Rutherford Lab, his work on ion source development and optics calculations for the Oxford Electrostatic Generator (1961-67) involved the extensive use of digital computers for the solution of electrostatic field problems.

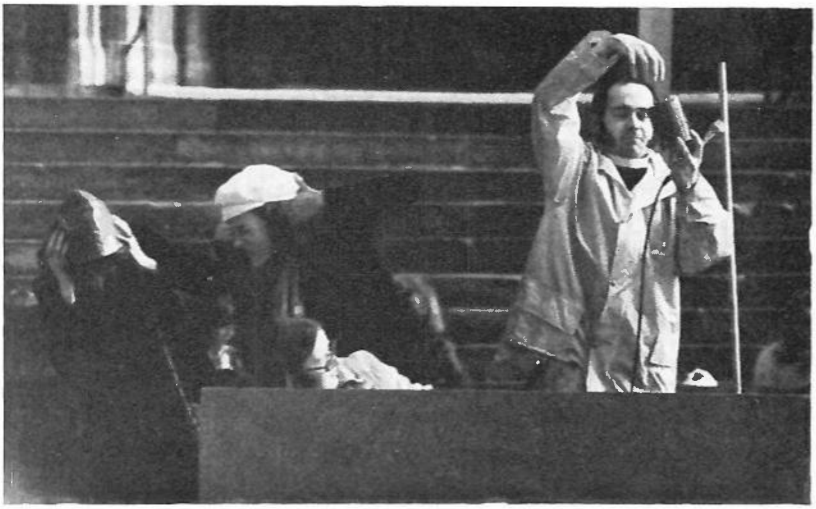
In 1967 he became leader of a group dealing with computational aspects of work in Applied Physics Division. The introduction of interactive graphics techniques in computer aided design of apparatus, also the development of new algorithms for the solution of three-dimensional non-linear electromagnetic fields, has led to the use of these techniques in laboratories throughout the world.

Last year he chaired the first International COMPUMAC Conference on the computation of magnetic fields held at Oxford.

Murder in the Cathedral

or The Mummer's Tale

The Travelling Salvation Road Show had been in preparation for perhaps five months. We had devised the show, written the script (and most of the songs), made the set, rehearsed, panicked, and rehearsed again. Above all, we had put together a tour with, as a grand climax, a performance in Canterbury Cathedral. Now we are eating a hasty tea before our public dress rehearsal. A car pulls up, and people get out, looking lost. It rapidly transpires that our audience have been told different starting times, ranging from 7 to 8 o'clock, with a majority vote for 7.30. We give the early arrivals a cup of coffee. A reasonably good show—someone actually thinks the jokes are funny.



The intrepid author tackles an unexploded bomb

Next day we perform at West Wycombe. Our one real piece of scenery—a bus side—is travelling on a car roof rack belonging to one Michael Jakins. Michael arrives with roof rack in a collapsed state, but no bus. We discover that roof rack, bus, and all suddenly took off and landed in a ditch, whence the bus was rescued by our Director following behind. Damage fortunately is minor. We rehearse. Nearest loo is ¼ mile away down a steep hill. We were offered the use of the gardens, but these are floodlit at night, so we have a temporary Elsan in the bell tower. At tea-time (one unsatisfactory sandwich each) there is a mass expedition in search of alternative facilities. The more sensible seek them, and further sustenance, in the nearest pub. A packed house.

Next Sunday we perform in Finchley. No disasters, and an audience that will laugh at anything.

Good Friday, and the grand Kent tour begins. We travel to Dover and rehearse in a great barn of a building, struggling against appalling acoustics, and taking most of our lines at half speed. An audience who didn't quite know what to expect—"I thought it was some kind of service" said one in the interval.

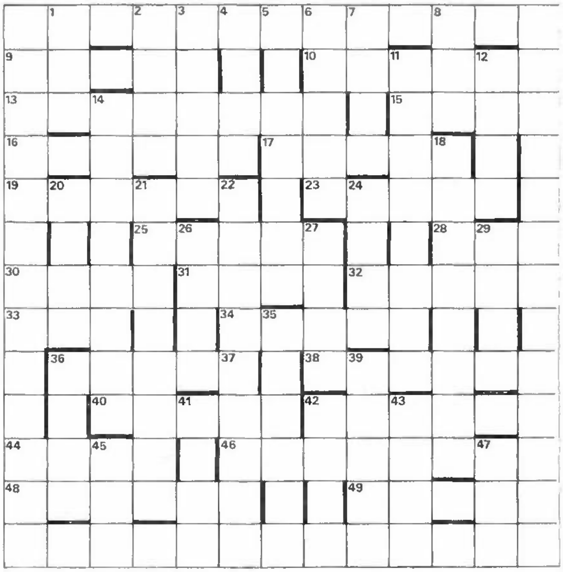
Next day we are at Deal, having to erect our own stage in very limited time. It is rather too small—beware of the edge—and almost all the entrances have to be made from the wrong side up a narrow set of steps. Somehow, everything works and the audience do all the right things.

A day's rest, then we go to Canterbury, to perform to several hundred footsore teenagers who've walked there from all around. As I arrive, the Director corners me. "We've been told the second half mustn't be longer than 45 minutes, and it's running at 50. Look through and decide what to cut". We decide to drop one song from the middle of a sketch. Very little rehearsal, and we're into the first half. It's murder. The acoustics are terrible, and the audience (probably because they can't hear each other) don't seem to be reacting. All round—on both sides and behind us—tourists are walking, chatting, and generally distracting. We soldier on. At the end of the first half, there's a lunch break.

We return to find no audience. (They're still in the cloisters listening to the Archbishop). We're also missing Jeanette (an actress and singer), and Rob (musical director and lead guitarist). Our Director says we'll start anyway. We manage the first song (mainly piano and rhythm guitars), and the first sketch, and fumble through the second song with our pianist making a valiant, but doomed, attempt to fill in Rob's part. Into the next sketch, and we're in a state of panic. The Director's wife is trying frantically to learn Jeanette's part for the following sketch, for which she is absolutely central. Rob and Jeanette arrive just in time—they got the starting time wrong. We sigh with relief, and go into Jeanette's big sketch, and the one after. Suddenly the Director appears. "We're cutting the next sketch". No-one's told the people on stage, and the microphones are all in the wrong place. Someone carries them across and we go into a song. At last we manage to coax reaction from the audience and we stumble on to the end.

Beckett didn't know how lucky he was—he should have tried *acting* in the Cathedral.

Peter Casey, author of this article, is Private Secretary to the Chairman.



MAXIM 15

MAXIM 15

The border of the diagram is to be filled with a closed loop formed from a clockwise-running chain of overlapping six-letter words. (Example: ....BIL / LET / HAL / VES / PER / SON / NET....). The 16 words involved are clued in *alphabetical* order.

Clues

Chain

1. Stopped 2. Dose 3. Pesticide 4. Sieve 5. Achieve 6. Fireplaces 7. Reduce 8. Guardian 9. Bird 10. Growing 11. Detector 12. Tennis-player 13. Outing 14. Shorter 15. Roof-support 16. Pests

ACROSS

9. Dull start to day and latter part (5)
10. To get cosily settled down for the night, the accent's on some chocolate (6)
13. Fix blame on our latest letter to depict lions, unicorns, etc (8)
15. Explosive gas combination locks (4)
16. Write about a friend in a truthful way (6)
17. The 'rose-red city', recently built by German physicists (5)
19. Decline the application, it's rubbish (6)
23. Where a maiden might find pollution in her river (5)
25. Monkeys on a pole, they're involved in necking (5)
28. Incline that's ripped up, we hear (3)
30. It's just like Kojak to take part in tribal dance (4)
31. I'd be in a quandary and have to wait (4)
32. Popular religion is work I'm about to start undertaking (5)
33. Prophet found wandering in 47 (3)
34. Badly-adjusted trace seen by box-watchers? (5)
36. Where to see ebb and flow in bar (5)
38. How to get souped-up? Retune, retune! (6)
40. Vapour surrounds California city festivals (5)
42. Caught in the larder, answering back (6)
44. 'Aqua' is example of water-collector (4)
46. Red Indians who'll take one miles off course (8)
48. Does LT mean least temporary? It can do (5)
49. Dam, lost head! Not that! (5)

DOWN

1. One joins the marines, the navy or the air force (3)
2. When fig-leaves started covering the whole human race (4)
3. High places in Russia cast a slur (5)
4. Often found reclining in symmetrical azymptote (4)
5. Was booed loudly and cut off (7)
6. A circle like this is a tube, and a tube like this is a circle (5)
7. Gave up temporarily, and at a suitable time (4)
8. Letter from Greece delivered by jet aeroplane (3)
11. Small-fish gatherer. Quiet now, take the little devil to the queen (8)
12. Lead-acid starter I possess is electrically unsafe (4)
14. Body that advances science meeting very noisily with Heath —mysterious! (8)
18. A. N. Other, I mistake for Jimmy Porter, or someone like him (8)
20. French articles picked up by foreign airline (2,2)
21. One of the French so far dead—that's what wave-forms do (8)
22. A long story depicted without its start or end (4)
24. A big laugh, and how it ends up as well (4)
26. Having the facility to bale out (4)
27. Tea's served—take this (4)
29. River that sounds to be slow about flowing (4)
35. Provide something second-hand, or else held clumsily in both hands (6)
36. What wife is to adoring husband —what's heard at wedding before start of liaison (4)
37. Thanks to the way of the orient, how to distinguish sweet and sour (5)
39. Join! (You've no choice if the shop's closed) (5)
41. She's no star in Las Vegas (4)
42. Sticks up and becomes complacent (4)
43. It's up to one to be opposed to .... (4)
45. .... verse in modern context (3)
47. Flower arrangement exchanged for goods in Rumania (3)

The prize will be awarded to the first correct entry drawn on 1 December. Please send your entry to the Editor, 'Quest', Room 1532 at State House and state whether you would prefer a book or record token. The solution will appear in the next issue.

Solution to Maxim 14

D	E	C	E	N	C	Y	E	I	G	H	T	S
O	G	L	E	S	O	D	D	E	R	E	V	E
R	G	U	L	L	I	E	S	S	I	R	E	N
I	C	E	B	O	N	N	E	T	T	E	N	S
C	U	R	S	E	S	O	L	E	N	S	U	E
O	P	O	S	S	U	M	P	R	A	Y	E	R
W	I	T	H	B	L	I	S	S	B	R	I	E
E	F	F	O	R	T	N	I	P	S	O	F	F
S	L	I	D	E	U	A	B	O	L	E	R	O
C	O	L	D	E	N	T	I	R	E	L	A	W
R	E	L	I	C	F	O	R	E	M	A	N	N
U	S	E	S	H	I	R	T	D	A	N	C	E
M	A	R	K	E	T	T	H	U	N	D	E	R

The winner was F Row (Rutherford Laboratory) who wins a £2 book token.

NUTCRACKER 24

Concilia uses the same calendar as Britain, but naturally the days of the week have different names (of Celtic origin). One day the King's secretary was trying to arrange a meeting of his great lords for a date in the following month. "I cannot make any day before the half-way point except the first Lughtig and the second Erustig and Taranistig", said the Earl of Lichton. "I cannot make any date before the first Machatig or after the fourth Lughtig", said the Laird of Ben Druigh. "I am away on the 9th, 17th, 18th, 22nd, and 24th", said Lord Polegate. "I cannot make the first Erustig or Badtig, the third Nudentig or Machatig, the fourth Erustig or the fifth Distig", said the Baron Eppontal. "Er, let me see, the second Lughtig is my birthday, so I certainly can't make the day after", said Lord Moore, "and the third Erustig and Badtig are out too". This left the secretary with only one possible date. Which?

The prize will be awarded to the first correct entry drawn on 1 November. Please send your entry to the Editor, 'Quest', Room 1532 at State House and state whether you would prefer a book or record token. The solution will appear in the next issue.

Solution to Nutcracker 23

The solution is province no 12.
The winner was C V Sukumar (Daresbury Laboratory) who wins a £2 book token.

Jubilee Medals

EIIR

BUCKINGHAM PALACE
7th June 1977

By Command of

HER MAJESTY THE QUEEN

the accompanying Medal is forwarded to

to be worn in commemoration of

Her Majesty's Silver Jubilee

6th February 1952 : 6th February 1977

Some fifty members of the Council's staff were among those awarded the Queen's Silver Jubilee Medal. Only about 30,000 of the medals were issued, about a third of them going to the Armed Services. In general, two criteria were adopted in choosing recipients: that preference should be shown to people who had given service at least throughout the Queen's reign or to those who had some special connection with the Queen or the Jubilee. The medal, struck at the Royal Mint, is in silver and was designed by David Wynn, the sculptor. It is to be worn on all occasions when decorations are called for and the accompanying ribbon is watered white with a central strip of cardinal red, garter blue on each side and finishing edges of cardinal red. The photographs above show the medal and its accompanying scroll.

SRC Golf Tournament

The 1977 Inter-Establishment Golf Tournament was held on Friday, 24 June at the St Pierre Golf and Country Club, Chepstow. Eight teams of six players competed for the Brian Flowers Trophy, comprising three teams from Rutherford and Daresbury and one each from Appleton and London Office.

A splendid day was had by all concerned in the magnificent surroundings of the Country Club. In accordance with well established tradition, the Rutherford and Daresbury Laboratories dominated the team scores, with the Brian Flowers Trophy being won by the Rutherford 'B' team (J Connolly, G Manning, G Walker, R Roberts, A Slater, V Thorp). The sparkle of the Rutherford and Daresbury Laboratories' efforts was only dimmed by the performance of Reg Stokoe, representing RGO, who had two magnificent rounds of golf and but for the one individual prize only rule, would have won three trophies outright.

To enable those other golfers who achieved trophies to maintain their pride, we record the recipients of the other minor trophies:

Best net score over 36 holes:
J Connolly (Rutherford)

Best net score (old course):
K Quinton (Rutherford)
D Falconer (Rutherford)
M Jefferies (London Office/Swindon)

Best net score (new course):
G Manning (Rutherford)

QUEST

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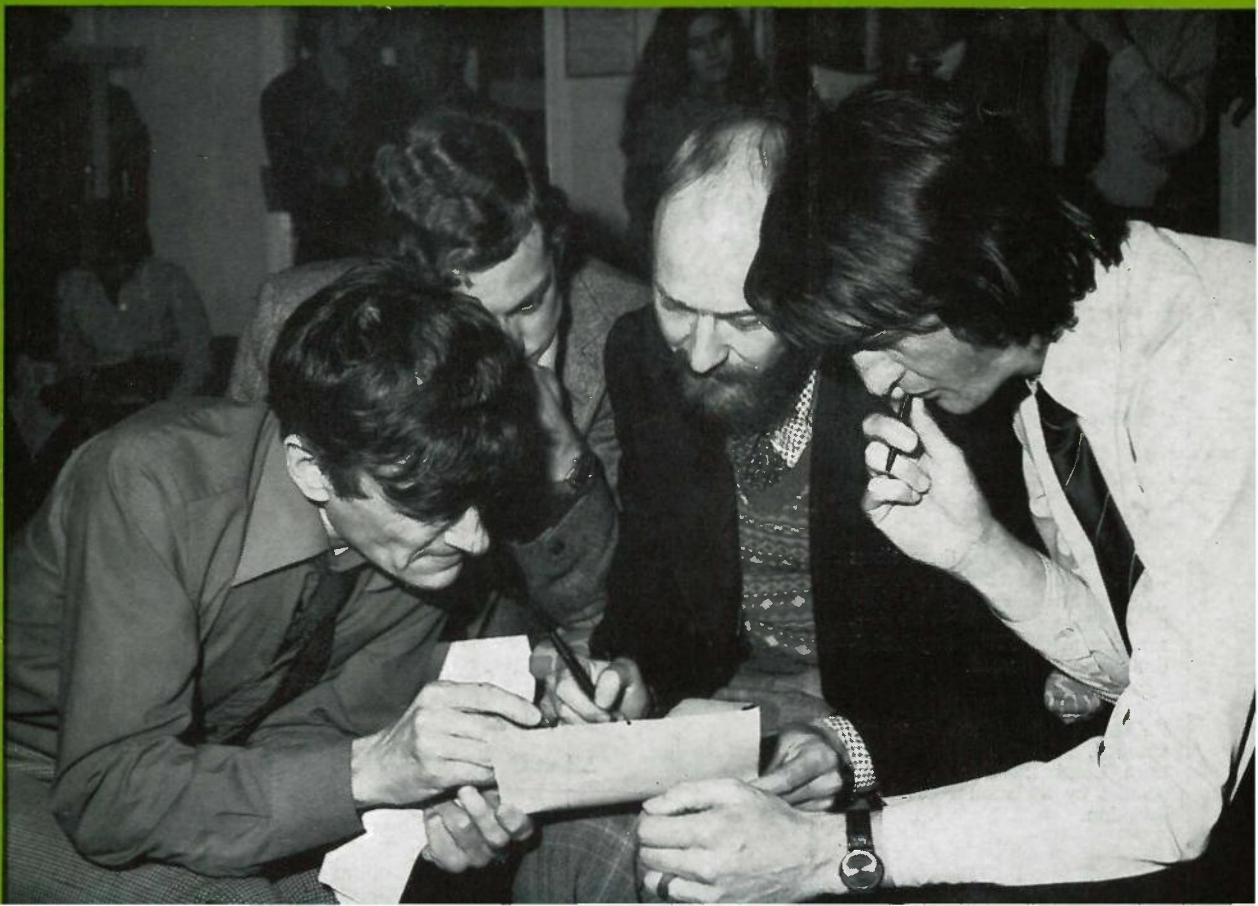
Progress on the SRS

Spacelab 2



QUEST

House Journal of the Science Research Council

Vol. 11 No. 1
1978

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Editor

Our cover picture shows the winning team in the contest for the Hilda McIntosh trophy at the Advance Office, Swindon. From left: Geoff Strange, Adrian Dent, Peter Davies and Jim Franklin (see inside back cover).

Contents

Quest will be issued three times this year by the Science Research Council for members of staff only. The Council is not necessarily associated with any individual views expressed.

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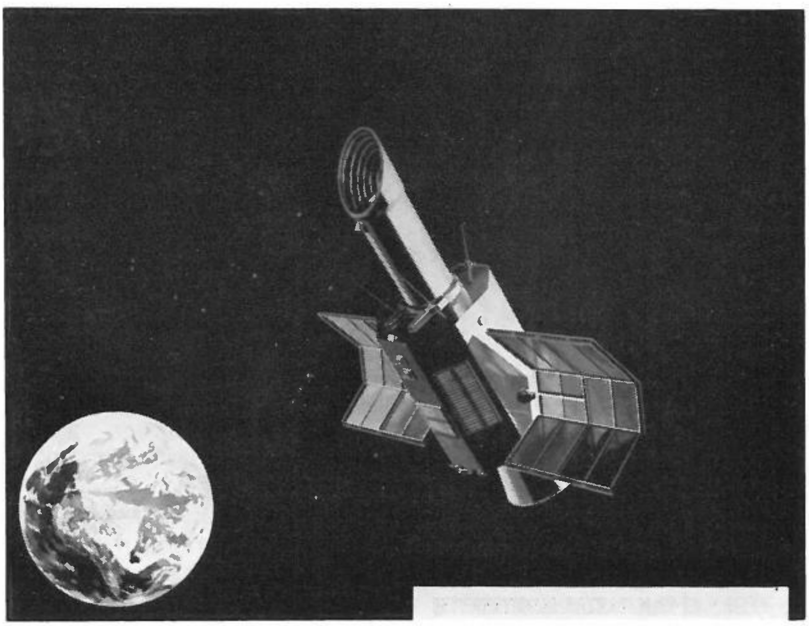
IUE satellite launched

The International Ultra-Violet Explorer (IUE) satellite was successfully launched from Kennedy Space Center, Cape Canaveral, Florida on 26 January 1978.

With a stiff breeze blowing down-range and muffling the roar of the 237 tons of thrust from the Delta 2914, the 116 feet tall launch-vehicle with IUE on board lifted sedately from Pad A, Complex 17 at the US Air Force Eastern Test Range, Cape Canaveral, Florida. As it streaked away, curving eastward, into a brilliant mid-day sky it was just possible to see the nine strap-on boosters fall away, after their 38 second burn, before the Delta disappeared from sight.

Another milestone had been passed on the road which—beginning with the UK proposals to ESRO for the large astronomical satellite (LAS) and later for the Ultra-Violet Astronomical Satellite (UVAS)—a few of us had been pushing along for something like thirteen years. NASA's attention was drawn to the potentialities of the UK's 1968 UVAS concept and key features of UVAS were adopted to form the basis of NASA's IUE project (known at its inception as SAS-D) in which NASA invited the collaboration of the UK and ESRO (now ESA). The achieved aim of the project, which is sponsored by the Council in the UK, NASA in the USA and ESA, was to place an observatory satellite, incorporating a telescope and ultra-violet spectrophotometer, in a geosynchronous orbit. The observatory can be operated from two special ground stations, one in the USA and one in Europe. It is not restricted to night-time viewing and will provide many exciting opportunities for astronomers in Europe, the USA and elsewhere.

After the first tense days of orbital operations, during which engineering commissioning was carried out and the UK-provided UV detector cameras were each successfully turned on, scientific commissioning began. By making astronomical observations of calibration and sample high-priority targets it is currently being confirmed that IUE will indeed provide the planned, complete system for research in UV astronomy.

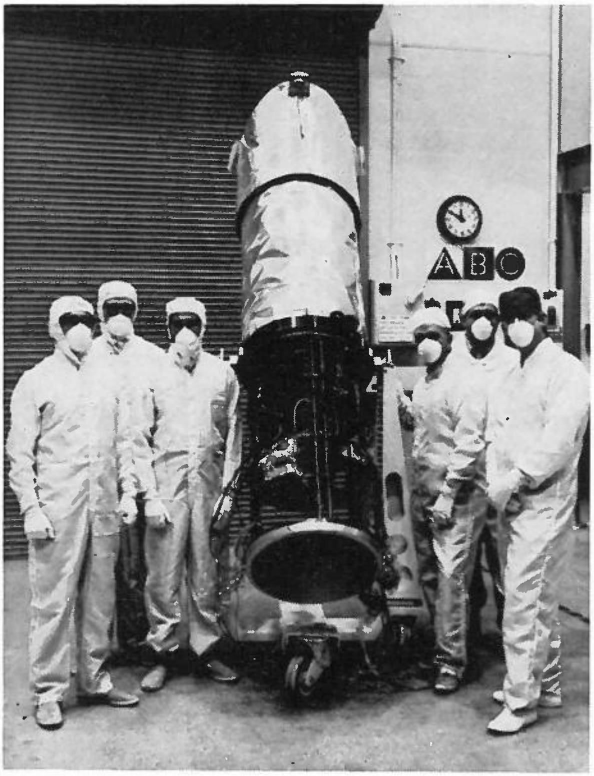


An artist's impression of the IUE. The spacecraft, an octagonal structure with the telescope protruding from the top and a single fixed solar array on each of two opposite sides, is designed to maintain one face towards the Sun when stabilized, with a set of thermal louvres on the dark side of the spacecraft to regulate the satellite's heat loss to space. Total weight, including the apogee boost motor, is 671 kg (1479 lbs). It is 4.3 m (14 ft) tall and with the solar arrays unfolded in space it is 4.3 m (14 ft) wide.

In its geosynchronous orbit 46,000 km (28,000 miles) by 25,000 km (15,700 miles) the spacecraft will appear to drift back and forth over the equator during its expected three-year lifetime, ranging to about latitudes 29° North and South in constant view from the US ground station and for at least 10 hours a day from the Madrid station

Scientific aims of IUE

Until about 20 years ago when space flight was first achieved, most astronomical discoveries were based on observations from ground-based observatories. Subsequently, by using sounding rockets, high altitude balloons and spacecraft it has become possible to make scientific observations from altitudes above the absorbing effects of the Earth's atmosphere, in the infra-red, ultra-violet (UV), X-ray and gamma-ray



International Ultra-Violet Explorer scientific instrument. The instrument consists of a 45 cm diameter F/15 Ritchey-Chretian telescope, which collects radiation from astronomical sources and directs this to one of the two spectrographs. There a spectrum of the input radiation is recorded by a UV-sensitive television camera and converted to video signals for Telemetering to the ground. There are two UV cameras in each spectrograph—one 'prime' and one 'back-up'

regions of the spectrum. This has expanded enormously our understanding of the universe.

The spectral region which IUE is designed to examine covers the fundamental frequencies of many of the most common elements in the Universe, such as hydrogen, carbon, nitrogen and oxygen. IUE observations are expected to provide basic information about many of the wide range of stars that compose our galaxy, how they are born, the changes that take place during their life-time, and how they die; about the material between these stars—from which the stars themselves are believed to have been formed and are still forming; about many of the strange objects which emit radio waves and X-rays; about the relatively sedate nearby galaxies and the distant, violent quasars; and about our planetary neighbours and their satellites.

Already over 200 scientists from 17 countries have been allocated observing time and their studies will cover most of the major problems in modern astronomy.

Project organization in the UK

In the UK, the project, which is mainly funded by the Council, is a collaboration between Appleton Laboratory and University College London.

Appleton Laboratory is responsible for overall UK technical programme and financial management; and liaison with Goddard Space Flight Center (site of the US ground station/observatory) and ESA. The Laboratory undertook development of image correction and calibration computer programs and management of UK industrial contracts (Marconi Space and Defence Systems Ltd).

University College London, with the assistance of staff seconded from Appleton, undertook detector tube evaluation and optimization of operating parameters, provision of a vacuum-optical calibration facility and operating computer programs, telescope light-baffle efficiency assessment, development and testing of procedures for ground and in-orbit optimization and calibration of cameras, conduct of life tests on detector tubes and scientific support to Goddard Space Flight Center.

UK Project Director: Professor R Wilson CBE, FRS, University College London and Science Research Council
UK Project Manager: Mr Peter Barker, Appleton Laboratory
Deputy Project Manager (Technical): Mr Peter Vaughan, Appleton Laboratory
Deputy Project Manager (Scientific): Mr Michael Sandford, Appleton Laboratory
Image Processing: Dr Barry Martin, Appleton Laboratory.

Council Commentary

October to December 1977

Finance

(i) *Estimates* 1978/79

In November, Council approved a provisional 1978/79 Estimates submission which, updated to 1978/79 prices, will amount to about £145M. This included an additional £2.7M allocated to the Council from a recent £4M increase in the Science Budget. The additional funds will make up for a higher than anticipated CERN subscription, provide for the additional postgraduate studentships awarded in 1977 and supplement new priority programmes being developed by the Engineering and Science Boards.

(ii) Construction Industry Funds

The Council has been allocated £1.75M for 1978/79 only from the funds the Government has made available to help the construction industry. Since the money must be spent before 31 March 1979, Council in December asked that quick action be taken on appropriate schemes. Most are likely to be in the Council's Establishments but a few will be in academic institutions.

(iii) *Forward Look Guidelines*

In November the Council also approved financial guidelines to be used by Boards in preparing the 1979/80—1983/84 Forward Look. The basic guideline assumes a decline of 1.7% a year in real terms to 1981/82 and a level budget thereafter with the possibility of seeking additional funds in competition with other government programmes. The Council will complete its Forward Look in April 1978, for submission to the Advisory Board for the Research Councils.

Postgraduate Training

(i) *Studentships 1977 and 1978*

The Council planned to make up to 3,600 studentship awards available in 1977. On 3 November, 3,616 studentships were on offer, including 770 CASE studentships; these are provisional figures and it is likely the final take-up will be somewhat below 3,600. Some 350 qualified applicants for SRC studentships had to be rejected in 1977. For 1978 the Council plans to make up to 3,680 studentships available, including at least 810 CASE.

(ii) *Short Duration Collaborative Training Awards*

In December the Council approved an Engineering Board proposal to introduce a short duration collaborative training awards scheme for a trial period of three years. The awards would be for periods of 12-15 months and the project work would be carried out in collaboration with industry—particularly medium sized firms. The projects would include design and manufacturing problems as well as research in engineering science. Students would be expected to gain a masters degree. The scheme will supplement existing successful SRC collaborative training schemes such as CASE where studentships are usually provided for three years. For many collaborative projects three years is too long and the new scheme is designed to meet the need for shorter periods of training particularly in engineering. It is hoped that up to 30 studentships will be available when the new scheme starts this year.

UK Millimetre Wavelength Astronomy Facility

In October the Council approved in principle a proposal to construct a Millimetre Wavelength Astronomy Facility at an estimated cost of about £4M plus in-house expenditure of about £1½M at July 1977 prices. Specific approval was given to the funding of the design and development phase at a cost of £285K plus in-house effort at the Appleton and Rutherford Laboratories. The plans are for a 15 metre diameter telescope capable of operating down to wavelengths of 0.75 mm in order to study the mechanics by which galaxies evolve. The observations will be important because they are the only source of detailed information about the cold material in the universe; they are expected to have an impact on all branches of astronomy. Negotiations for a suitable dry overseas site are continuing.

The Appleton Laboratory will be responsible for the construction of the facility which will take about four years. The Rutherford Laboratory and some university groups will also be concerned with the project.

International Organisations

In November and December each year Council reviews the work of major international organisations to which SRC subscribes and considers the scale of SRC's contribution. In November, Council discussed recent reports of work at CERN and the Institut Laue-Langevin (ILL). It supported the aim of the UK delegation to secure reductions in future CERN budgets.

Heavy Ion Fusion

In December Council received a report on the evaluation studies of heavy ion fusion being undertaken at the Rutherford Laboratory. It agreed that the evaluation work should be continued under the aegis of the Energy Proposals Committee and that suitable universities should be encouraged to take an interest in the subject.

Superannuation Arrangements

In November the Council adopted a new resolution on superannuation arrangements since it decided to apply to contract out of the new State Scheme because provisions under the SRC and UKAEA schemes are as good as, or better than, under the new scheme.

Grants and Other Financial Approvals

(i) Nuclear Physics Grants

The Council approved grants to the Film Analysis Centres at Birmingham (up to £506K), Cambridge (up to £253K), Glasgow (up to £527 K), Liverpool (up to £409K) and Oxford (up to £515K) and for nuclear structure research at Oxford (up to £252K).

(ii) EISCAT

The Council approved a revised SRC contribution of up to £3.32M to the capital costs of the project which will provide a system of radar stations in Northern Scandinavia. The project will produce detailed information about the structure, temperature and dynamics of the ionosphere.

(iii) Mullard Radio Astronomy Observatory (MRAO)

The Council approved an SRC grant contribution of £206K towards the budget of the MRAO, Cambridge for the calendar year 1978.

(iv) Meridian Astronomy

The Council approved a proposed collaboration between RGO and the University of Copenhagen to establish an advanced observing facility for meridian astronomy on La Palma at a capital cost of up to £160K.

(v) Physico-Chemical Measurements Unit (PCMU)

The Council approved expenditure of up to £180K for the support of PCMU services at Harwell in 1978/79.

(vi) Neutron Beam Programme at AEA

The Council endorsed the general scale of the SRC contribution of the order of £1280K (at 1977/78 prices) to the joint SRC/AEA neutron beam programme.

(vii) Laser Studies

The Council approved a grant of £163K over 3 years to Professor D J Bradley (Imperial College) for studies of coherent radiation and non-linear interactions at short wavelength.

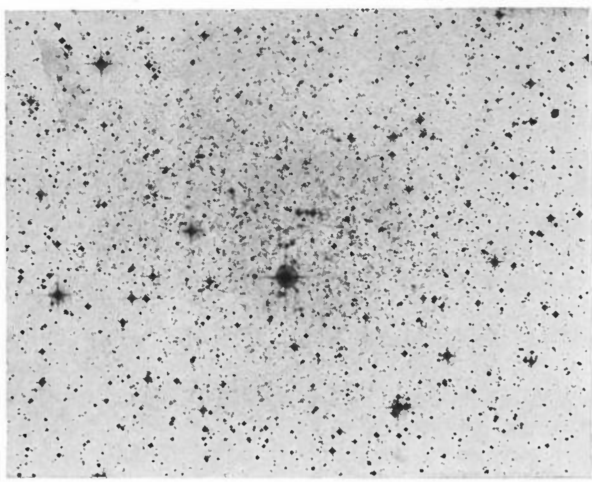
New members of the Local Group of galaxies

R D CANNON

The UK Schmidt telescope in Australia, which is operated by astronomers from the Royal Observatory, Edinburgh, is engaged on a systematic photographic survey of the southern sky. Because of recent improvements in photographic emulsions and in telescope design, this is the deepest such survey ever carried out for any part of the sky, and naturally most of the interest is in detecting the faintest and most distant objects possible. In particular, counts of faint galaxies and quasars should help us to map out the large-scale structure of the universe, and to understand conditions during the early stages of its development.

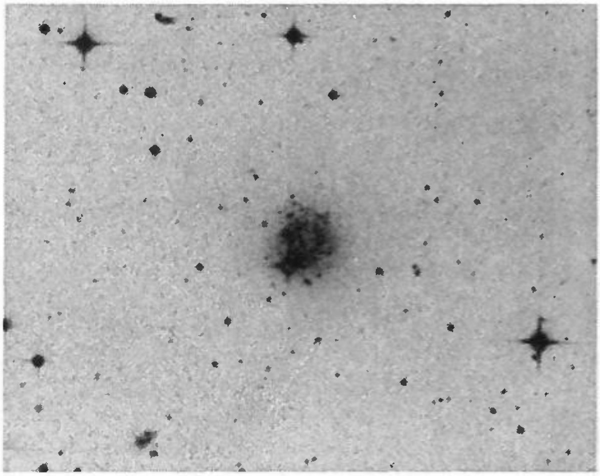
UK Schmidt telescope building at the Anglo Australian Observatory

However, not all the new objects found are extremely distant. Some are seen for the first time rather because they are intrinsically very faint. Indeed, because the volume of space within a given distance from us increases as the cube of the distance, the intrinsically faint objects are the hardest to find since we can only hope to see the few which are nearest to us. In the field of galaxies, the very faint end of the range known so far is occupied by a handful of small, tenuous conglomerations of stars known as 'dwarf spheroidal galaxies'. The brightest two were discovered in the 1930s, and four more showed up during the survey of the northern sky by the Palomar 48-inch Schmidt during the early 1950s. All are companions of our own galaxy, which forms the familiar Milky Way, and are among the nearest extragalactic objects. Although these objects are very small, they could have very great importance for the dynamical stability of groups of galaxies. The reason is that although few are known, they could in fact be widely distributed in space, but with the vast majority too faint to be detected by currently available telescopes. Indeed, they could help to determine whether the universe is going to continue its present expansion for ever, or whether it has sufficient mass that it will eventually fall back on itself under the force of gravity.



This photograph shows the mass of very faint stars which form the new Carina dwarf spheroidal galaxy

Because the sky survey by the UK Schmidt goes fainter than ever before, it was possible that many new dwarf spheroidal galaxies would be found. However, this now seems to be very unlikely. The survey is already complete for more than three quarters of the Southern sky, and usable photographs have been taken for most of the remainder. For over three years not one new dwarf spheroidal galaxy turned up. Then on 1 March 1977, a faint smudge was noticed on a photograph of part of the constellation Carina. At first this was thought to be a blemish on the plate, but microscopic inspection showed that it was composed of thousands of very faint stars, and further studies have established that it is a new dwarf spheroidal galaxy, one of our galaxy's nearest neighbours (only half a million light years away!).



The Dwarf Irregular Galaxy UKS 2323-326, known as the 'Measles Galaxy', from a 50 minute exposure on Kodak IIIaJ emulsion taken with the UK 1.2 m Schmidt telescope

Since only one new galaxy of this type has been found, it seems that these objects are *not* distributed uniformly throughout space, but are rather concentrated around our own galaxy. If this is correct, their contribution to the total mass of the universe will be negligible. However, the dwarf galaxies remain fascinating objects in their own right; they are the nearest star systems outside the galaxy, close enough for detailed study of individual stars, and the questions of their origin and history are still matters for speculation.

Moving up one step in the galaxy scale, there is a class known as 'dwarf irregular galaxies'. These are systems which begin to show some ill-defined structure, with evidence for dust and gas as well as for stars. Again, a handful of these galaxies are known to be members of our 'local group' of galaxies, of which the dominant members are our galaxy and the Andromeda spiral galaxy, Messier 31. Recently, two new probable members of this group were discovered on UK Schmidt Sky Survey plates. One of these, officially designated UKS 2323–326, is affectionately known as the 'Measles Galaxy' from its spotty appearance. Spectroscopic studies of the brightest spots, using the Anglo-Australian Telescope, suggest that these are individual stars. Neutral hydrogen gas was then looked for and found in this galaxy using the Parkes 64m radio telescope: the very low radial velocity confirms that 'Measles' is a relatively nearby galaxy.

Dr Russell Cannon is Head of the UK Schmidt Telescope Unit of the ROE.

Progress on the SRS

The Synchrotron Radiation Source (SRS) project is now well past the halfway point in its construction programme and with the installation of the linear accelerator, booster synchrotron, and the plinths for the storage ring an observer can see the new facility beginning to take shape. During February this year the various components of the booster synchrotron were brought together and the ring is now mechanically complete. During March the linear accelerator was delivered and April should see electrons being accelerated again at Daresbury – to 15 MeV during testing of the linear accelerator. First injection into the booster synchrotron is planned for May.

All of the equipment for the SRS will be computer controlled, the operators controlling the equipment through purpose built consoles which 'talk' to the specific items through a mini-computer network. The linear accelerator, which has been built by Radiation Dynamics Ltd of Swindon, has none of the usual knobs and meters, and when it was tested at the factory before shipment to Daresbury, a portable console, mini-computer and the necessary interface electronics had to be taken to the factory to carry out the tests.

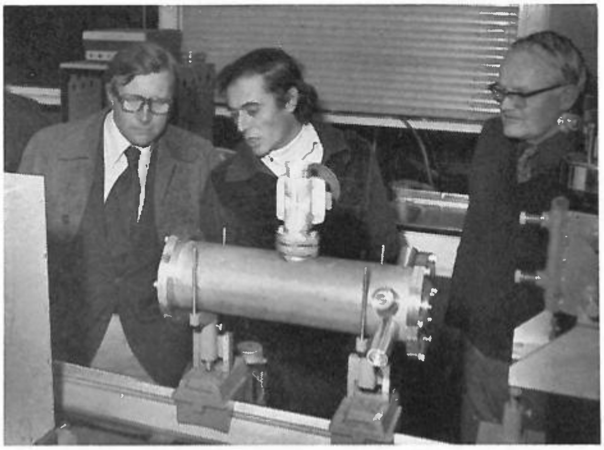
Since NINA closed down in April 1977 a lot of effort has been concentrated on clearing the equipment from the site of the storage ring in the 'Inner Hall'. This work is now complete with unwanted ducts filled and a new coat of paint over the whole area. The photograph shows the hall during October 1977 with the outline of the electron trajectories superimposed. The beam is injected from the linear accelerator at the top to the right of the booster, is accelerated to 600 MeV in the booster and then injected into the storage ring. Once the storage ring is full the electrons are accelerated to 2 GeV and will be stored there for up to eight hours. The ring of plinths for the storage ring magnets has now been put down in the Inner Hall, and the first item of storage ring equipment is already being commissioned – this is the klystron amplifier which will replace the energy radiated by the electrons.

With the booster nearing completion, design effort is now being concentrated on the components for the storage ring. The magnets and the accelerating cavities have been designed but a host of other components are still only in the schematic stage. The detailed design of the first beam lines and experiments is also being done.

Full approval for the construction of a superconducting Wiggler magnet was given in Autumn 1977 and work has started at the Rutherford Laboratory where the magnet will be designed, constructed and tested. The aptly named Wiggler magnet will increase the range of experiments that can be done with the SRS by making the electrons travel round a short detour in a very high magnetic field and thereby extending the spectrum of the synchrotron radiation which they emit further into the X-ray region.

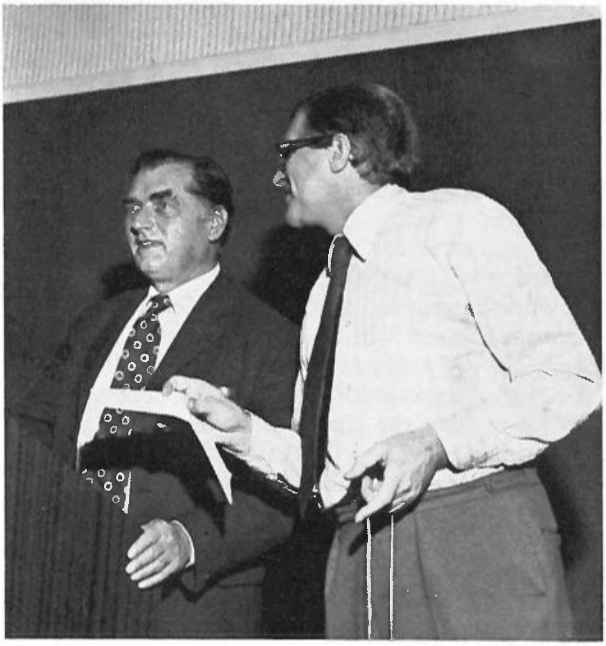
The prospective users are now meeting regularly and are planning their experiments. When they visit the Laboratory during the second half of the construction programme they will see the visible evidence of the earlier backroom design and construction work and will no doubt look forward to their first use of the synchrotron radiation beams which should be available about the end of 1979.

Getting to know us: Chairman's visits



Dr Juan Bordas, who was involved in Synchrotron Radiation Experimental work at Daresbury, explains details of the EXAFS (Extended X-ray Absorption Fine Structure) experiment to the Chairman, Professor Allen during his visit to the laboratory on 9 November. This experiment is in preparation for transfer to EMBL (European Molecular Biology Laboratory) at DESY, Hamburg. Dr P Duke looks on

Dr K F Hartley demonstrating a visual display of a spectrum recorded by the Image Photon Counting System at the Isaac Newton Telescope during a visit by Professor Allen to the Royal Greenwich Observatory on 15 November. From left to right: Dr K F Hartley; Mr D J King; Professor F Graham Smith, Director of the Observatory; Professor Allen and Mr P J Casey



Professor Allen toured the Appleton Laboratory on 13 December and is seen above, with the Laboratory Director, Dr Fred Horner (left) addressing the staff. The following month he saw some of the work being carried out by Appleton's Astrophysics Research Division at the Culham Laboratory

Gordon Walker (left), Head of the Physics Apparatus Group at the Rutherford Laboratory, explains the construction of the single-gap cylindrical multi-wire proportional chamber (one of several constructed for the European Muon Collaboration) to the Chairman during his visit on 14 November. The chamber is a prototype of a 4-gap chamber, now being built for the TASSO collaboration experiment on PETRA at DESY, Hamburg

Chairman has also met staff and seen the work being carried out at the Royal Observatory Edinburgh and at the Advance Office Swindon.

Computational science at Daresbury

A new Division, the Theory and Computational Science Division, came into being at Daresbury Laboratory on 1 October 1977, with Professor P G Burke on a joint appointment with Queen's University, Belfast, as its Head. The Division consists of the existing Theory Group and a new Computational Science Group.

It was in 1976 that the Council decided that support for computing in quantum chemistry, crystallography and atomic and molecular physics would be transferred from the Rutherford to the Daresbury Laboratory, all these being fields connected with experimental work to be carried out with radiation from the Synchrotron Radiation Source (SRS) now under construction at Daresbury. Four members of staff have now made the 'quantum jump' between Rutherford and Daresbury to form the nucleus of the Computational Science Group, the Group being augmented by transfers from within Daresbury and by external recruitment.

The Group is presently involved in four projects: (i) the calculation of precise wavefunctions and energies for bound state molecules, (ii) photoionisation and electron scattering from atoms and molecules, (iii) the SRC Microdensitometer Service to X-ray crystallographers, with associated computational support for X-ray diffraction data analysis, and (iv) the crystal structure search and retrieval program, which provides on-line facilities for the interrogation of all known structural data of organic crystals on the SRC Interactive Computing Facility DEC-10 computer in Edinburgh. In all the above the aim is to provide computational backup to research workers in the universities, and wherever possible to organise the projects in collaboration with university groups. To obtain the right degree of interaction with the academic community, it is anticipated that the Group will organise a number of one-day and weekend meetings covering relevant sectors of physics and chemistry. Indeed one such study weekend has already been organised, held at Daresbury on 10-11 December 1977, on the subject of 'Correlated Wavefunctions', and two one day meetings, one on the subject of 'Lattice and Lattice Defect Energy in Solid State Physics' on 12 January 1978, and another on 'Photoionization of Atoms and Molecules' on 16 February 1978. The primary aim of all these meetings was the discussion of the possibility of collaboration with University Departments in the future development of these fields.

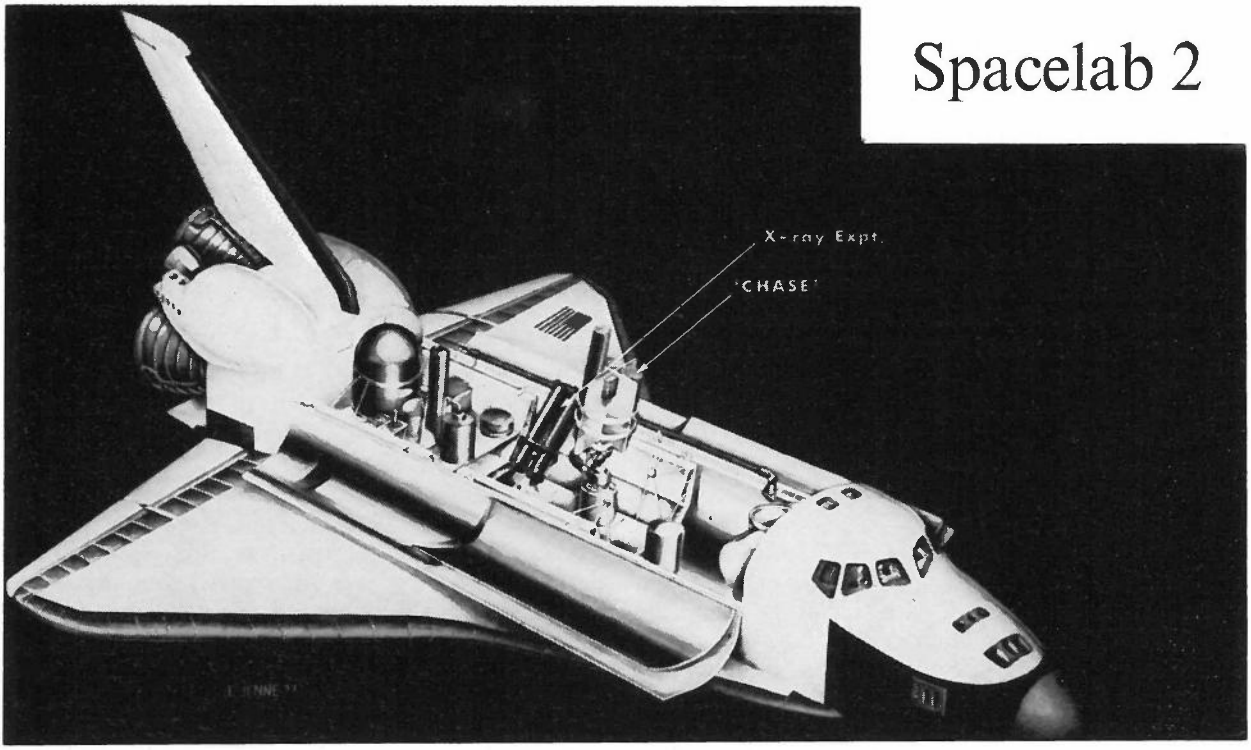
Energy recovery from waste heat

Industrial use accounts for about 40% of the UK's primary energy consumption and much of this energy is eventually dissipated as waste heat. One method of reducing such losses in industrial plant and cutting overall costs is to convert the waste heat into electrical energy to augment the plant electricity supply. Council recently awarded a £27,000 grant to Dr D O'Kelly (Bradford University), Mr G Musgrave and Professor J Sherlock (Brunel University), Dr I K Smith (City University) and Mr S S Wilson (Oxford University) for a two-year project of research into this method of energy recovery.

Ariel-V's fourth year of operation

The extremely successful X-ray astronomy satellite Ariel-V is to be kept in operation for another year. Launched in October 1974, Ariel-V is the fifth scientific satellite in the UK/US collaborative space research programme but the first in this series to be devoted to cosmic X-ray astronomy. This year Ariel-V's programme will include extended observations of selected sources, both galactic and extragalactic, to study time variations more systematically and also to exploit the data in Leicester University's high-latitude catalogue.

Spacelab 2



A model of the proposed Spacelab 2 mission showing CHASE and the Birmingham experiment

A team from the Appleton Laboratory's Astrophysics Research Division at Culham has been successful in obtaining payload space for a major solar experiment to be flown on the second flight of Spacelab in 1981. This experiment was proposed jointly with Dr J L Culhane of University College London, and was one of several hundred bids for the twelve experiments to be flown on this payload.

The Space Shuttle is a new re-usable vehicle developed by NASA as the main space facility for the 1980s. It is launched like a rocket into orbit around the earth, where it remains for periods of seven to fourteen days, carrying out experiments or putting smaller satellites into orbit. On re-entry it behaves like an unpowered aircraft and glides to land on a concrete runway. The European Space Agency (ESA) has developed a modular structure, Spacelab, which can be integrated with a set of experiments and then loaded intact into the Shuttle payload bay for launch. The first flight of Spacelab, planned for 1980, is jointly managed by ESA and NASA and has attracted much publicity over the past year. The second flight is a NASA managed mission, dedicated primarily to astronomy, for which they have offered payload space to international scientific competition.

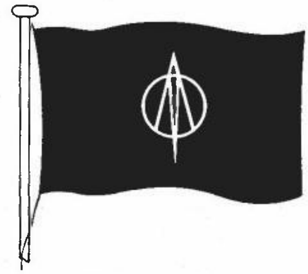
Of the twelve experiments selected, ten are from the USA and two from Britain – an embarrassing degree of UK success! In addition to the Appleton Laboratory/University College London experiment, Professor A P Willmore of the University of Birmingham will be flying a telescope to study images in hard X-rays of galactic and extra-galactic sources. The remaining payload is made up of three further solar experiments, a cosmic ray experiment, infra-red and ionospheric studies and two biological experiments.

The Appleton Laboratory/University College London solar measurement is called a 'Coronal Helium Abundance Spacelab Experiment' (CHASE). Its prime purpose is to measure the abundance of helium, important not only for understanding the physics of the sun, but having far-reaching implications in cosmology, since this helium is believed to have been produced originally during the 'Big Bang'. CHASE, which will also measure other solar properties, is one of three solar experiments to be mounted on a new fine pointing platform being developed by ESA.

The twelve experiments will be operated in orbit by two Payload Specialists, scientists drawn from among the experiment teams involved. Selection of these is now underway, and there are three Britons in the current short-list of ten.

Dr A H Gabriel, the author of this article, is Head of the Astrophysics Research Division of the Appleton Laboratory at Culham and joint principal investigator for CHASE.

SR at C



SRC racing flag

This title first appeared in 'Quest' after the SRC had competed in the first inter-departmental offshore race, organised by the Civil Service Sailing Association in 1971. We have entered each year since. In this article Martin Hall gives an account of the 1977 race.

This year we had our best ever boat. 'Festina' is a 32 ft Contessa class. She is well equipped for racing, and we were very pleased with her as soon as we stepped aboard late on the afternoon of Thursday, 29 October at Lymington. This year SRC was represented by Paul Dickinson (AL), John McGraw (RL), Phil Moore (DL), Ken Pavitt (AL), Geoff Stapleton (RL), and myself as skipper.

Even on the first evening it was clear that we were in for a bit of a blow as we ran up to Cowes at speed. We soon began to appreciate the potential of the boat, and changed sails two or three times to get the feel of working as a team. After a comfortable night in Cowes we carried on to the start line off Portsmouth, again with a following wind. Gales had been forecast by the Met Office at 0630 that morning and the wind was certainly fresh. With a favourable tide and time to spare, we practised more sail changes, and we were glad to find we could carry the spinnaker with wind well round on the beam despite the wind strength. We would need that later.

At the start line we were disappointed, but not surprised, to find the Cherbourg course replaced by a series of three alternative courses in the Solent. The start is one of the exciting parts of a race as the boats each turn and manoeuvre at some speed for best position in a confined space. Accidents can happen very fast and can be very expensive! There were 18 boats entered, all about 30 ft in length. When the start gun went at 1300 we were not best placed, but out of the main crush and with a free wind.

The first course was only eight miles, though one had to sail considerably further to beat against the wind and find the best tide. After 1 hr 47min 40sec we were across the finishing line, and soon after we were comfortably secured at the main Cowes marina. Later we retired to the Island Sailing Club bar and heard how some competitors would have done so much better but for this or that bad luck which they felt sure would not recur. But in sailing and especially racing there are so many unexpected things to go wrong, and many of them do! We were quite pleased at this stage to be fourth out of the 15 to finish, and looked forward to the next race. With the now strong winds, we felt glad of the decision not to go to Cherbourg!

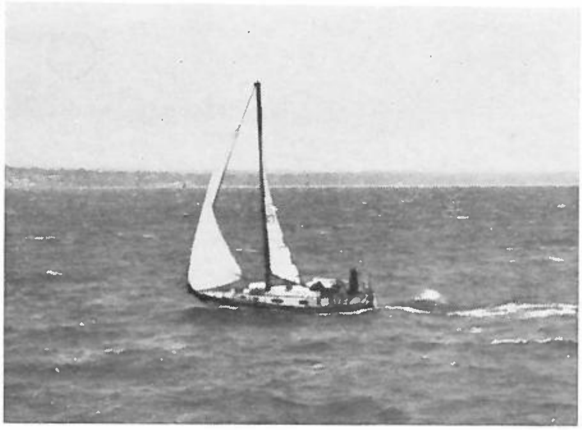
At 0630 on the Saturday there were gales forecast in nearly all sea areas, but we still kept on our biggest sails. The first short leg was a run, and our policy was to use the large headsail rather than a spinnaker, and then reef this headsail as necessary for the subsequent beats. Since the bad weather courses that we were sailing were somewhat impromptu, the arrangement was for us on 'Festina' to give the start signals by foghorn to a given time sequence. It is little comfort to know

From left to right: Paul Dickinson, Appleton; Ken Pavitt, Appleton; Geoff Stapleton, Rutherford; Martin Hall, Appleton (holding the flag); Phillip Moore, Daresbury and John McGraw, Rutherford

that few other boats heard our standard commercial 'foghorn' but certainly we got a good start, being first across the line a few seconds after 0900! Soon we were being slowly overtaken by those chancing a spinnaker, but they had the problems of sail change after a short run and we did not regret our plans. There was then a long beat against tide and each crew made their choice as to where to find the least waves, best wind and least tide without running aground. Towards the end of this tedious and tiring beating we had had to change down our headsail and reef the main as the wind rose. We then saw several big boats running under spinnaker in the opposite direction to ours, and saw others on our course being blown almost flat onto the water by the heavy squalls. In the worst of these we recorded a wind speed of 50 knots (Force 9/10) and saw the spinnakers in various states of disarray. In one case the mast had given way before the sail did! After rounding the windward mark we decided not to carry a spinnaker, and having split our No 1 (biggest) headsail we attempted to goose-wing our No 2 headsail in the unsteady wind and seas. We romped home, trying not to gybe with so little sea room between us and the land. At the end of 5hr 28min 33sec sailing, we were disappointed to be ninth out of the 13 to finish this 17 mile course, and tried to think how to do better next day. After lengthy sail repairs, there was again much chat over beer at the Island Sailing Club.

On Sunday, remembering the previous day's 'foghorn' fiasco, our competitors seemed to use 'Festina' as part of the start line and kept close until we sounded the start, again at 0900. The course was much the same as for the previous day, but having a slightly longer run after the start we used the spinnaker with advantage. This year we hoisted the spinnaker stopped up in rubber bands to avoid the upsets and irritations of the sail opening its own not-so-good way. The rubber bands broke in turn as the sail opened to the wind and we were pleased with the technique. Although the wind was slightly less than on the previous two days, we were content to stay with our No 2 headsail whilst beating to the windward mark. At that stage we took a risk! The wind had picked up somewhat, but we flew the spinnaker again and pulled an impressive bow wave through the water alongside us. This sort of sailing is most exhilarating and although the tiller had too much force to control at times and we 'broached' right round off course with the sails pulling down onto the water, we made up a lot of time and after 3hr 31min 35sec, came fifth in this race of the 13 to finish.

Overall in the series of three races we came fifth of the 17 boats entered from 11 departments. Naturally we should have liked SRC to have come first. Since we were so pleased with 'Festina', we have already booked her (slightly better) sister ship for a full week next year so as to get more practice as a crew. It may seem pedantic to quote race times to seconds, but even after many hours racing it is often a few seconds that count.



Festina in splendid isolation before the race

So far 25 people have represented SRC in these races. If we can enter two boats in the 1978 race I for one shall be delighted. I am sorry that we always have to disappoint some of those who apply to come. Really this year we had only one regret – that there was no means of flying the SRC burgee at the masthead!

Martin Hall is a leader of the Chilbolton radar group at the Appleton Laboratory. Anyone interested in sailing for the SRC is invited to contact him at the Lab (ext 328). The 1978 race will start on Friday 29 September.

Newsfront

New Year Honours

Our congratulations to Professor W E J Farvis, Professor R Wilson FRS and Dr W F Watson who were awarded the CBE and Mr R Rivers who was awarded an MBE.

Professor W E J Farvis is a Council member and a member of the Engineering Board and of the Polytechnics Committee.

Professor R Wilson FRS is IUE Project Director, a former member of the Astronomy, Space and Radio Board and former Head of the SRC Astrophysics Research Unit, Culham.

Dr W F Watson is a former member of the Materials Science and Technology Committee and of the Polymer Engineering Management Committee.

Mr R Rivers is a Higher Executive Officer at London Office.

Arthur Pickett

At the unusual (for him) end of a camera just before Christmas was Principal Photographer of Daresbury Laboratory, Arthur Pickett. Arthur, who is well known to many in the Council from his days in the Atomic Energy Authority at Culcheth, Dounreay and Winfrith as well as since 1965 when he joined Daresbury, was being snapped at a farewell presentation before taking up voluntary premature retirement. During his time at Daresbury, Arthur has created a very valuable photographic history of the work of the Laboratory and has provided an excellent service to both Laboratory Staff and University Users. A presentation of a clock and a bumper card of snapshots was made by the Director, Professor A Ashmore.

Pictured right Mr Mike Reordan who was awarded the MBE in the Birthday Honours List. With him at Buckingham Palace are his wife and daughter Glenys. Mr Reordan worked at London Office until his untimely death in March
Photo: Feature Press

Mr John Smith, Appleton Laboratory, who was awarded the OBE in the Birthday Honours List is pictured after his investiture at Buckingham Palace in December, with his wife Joan and sons Graham and Adrian
Photo: Feature Press

From left, Professor Ashmore, Arthur Pickett and Bill Jones (Head of Engineering Services)

Ken Tarry
Someone else from Daresbury who has retired and was well known elsewhere in the Council, particularly at the Rutherford Laboratory, was Ken Tarry. Ken served in a number of public service organisations—the GPO, TRE Malvern, AERE Harwell—before joining what was to become the Rutherford Laboratory to work first on the PLA and then on Nimrod. Whilst still at Rutherford he joined the team which designed the radio-frequency acceleration system for NINA and has worked at Daresbury throughout the Laboratory's existence. Once NINA was successfully operational, Ken assumed responsibility for the operation and development of the linear accelerator. In recent years he has directed a section designing and commissioning the rf equipment which forms a major part of the SRS project.

£ £ £ £ £ £ £ £ £ £ £ £ £ £ £

Winning Suggestions
The following awards were made by the London Office Awards Committee at its last meeting: £50 to Miss J M Duncan for a new file tracer card; £5 to Mr D H Brooks for a suggestion to include imprint numbers on forms; £5 to Mr P D N Tomsen who suggested combining an individual's advanced course and research studentship files thus avoiding duplication of personal information.

RGO has awarded £25 to Mr M F Spooner, who suggested a way of rectifying a fault on the stand-by alternator which both saved money and protected the Time Service by keeping the plant in service; £5 to Mr M Dermody for a suggestion to include the 6-inch Cooke telescope in the Public Exhibition; and £5 to Dr R J Bingham and colleagues who suggested alternative night heating in emergency in the Physics Building.

Among the other awards made: £100 to Mr John Spencer, Rutherford for a suggestion in connection with the fibre glass strips for the muon drift-chamber; £175 to Mr M J Athawes, Rutherford again for a suggestion concerned with the muon chambers; and £250 to Mr John Carr, formerly of Rutherford's Electronics Section.

Ken Tarry in a characteristic pose at a farewell presentation before Christmas

Dr G H Stafford, Director, Rutherford Lab (far right) presents a cheque for £600 (the highest award made since the introduction of the scheme in 1971), to Mr Dave Price (left) and Mr Terry Wickens. This award was for their suggestion to improve trimming of the printed circuits used in the construction of the 12 large drift chambers which are part of the UK's contribution to the European Muon Collaboration Project at CERN

Mr Eddie Towndrow (left), a craftsman in Rutherford's Technology Division, receives a cheque for £190 for his suggestion for a suitable container to hold the material to be used with the Deuteron Target

FR 80 makes a film of the book

Members of the Atlas Computing Division of the Rutherford Laboratory successfully carried out a feasibility study last Spring to determine whether the FR80 could be used for high quality printing of scientific data.

They did this using bibliographic entries (including chemical formulae) from the data base of molecular structures maintained by the Cambridge Crystallographic Data Centre. The Centre accumulates references to organic crystal structures—mainly from periodicals—and each year publishes a book of the entries for that year.

To be of use to the research community, the book has to be printed quickly which means that conventional printing methods cannot be used because of the difficulty of proof reading thousands of very similar complex chemical names and formulae.

Computers are used to produce five different types of index (main bibliography, author, formula, permuted formula and compound name) from the one set of data and do the typesetting.

The magnetic tapes carrying the information for 1976 which were sent to the Rutherford staff early last year contained 2762 references and 1313 cross references, listed in five different formats. The printers added 20 introductory pages to the 817 produced at Rutherford from these references and the book was published last Summer.

Encouraged by the success of the first book made using the FR80, the Centre began work on a larger cumulative volume (15,993 citations in six types of index) containing all the references published in the previous eight volumes. This second book was processed at Rutherford in the Summer and published in December 1977.

Rutherford staff are now busy with the 1977 volume.

33.26 **Piperidine hydrochloride**
$C_5H_{12}N^+$ Cl^-
J K Dattagupta N N Saha J Cryst Mol Struct, 5, 177 1975

33.27 **bis(Isonicotinato) magnesium tetrahydrate**
$2C_6H_4NO_2^-$ Mg^{2+} $4H_2O$
M B Cingi A C Villa C Guastini D Viterbo
Gazz Chim Ital, 104, 1087 1974

33.28 **4 – Cyano – pyridine – N – oxide**
$C_6H_4N_2O$
K I Hardcastle M J Laing T J McCauley C F Lehner
J Cryst Mol Struct, 4, 305, 1974

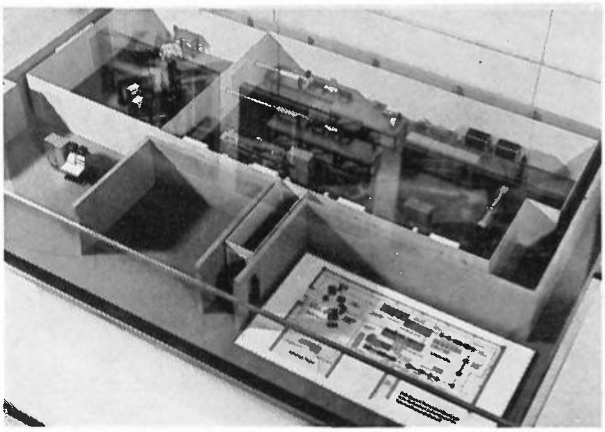
33.29 **Isonicotinic acid**
$C_6H_5NO_2$
F Takusagawa A Shimada
Acta Crystallogr Sect B, 32, 1925, 1976

33.30 **Piperidino – thiosemicarbazide**
$C_6H_{13}N_3S$
C H Koo H S Kim C H Chang
J Korean Chem Soc (Daehan Hwahak Hwoejee 19, 85 1975
Also classified in 8

An extract from the first book to be made using the Rutherford Lab's FR80, a precision microfilm recorder

Laser Exhibition

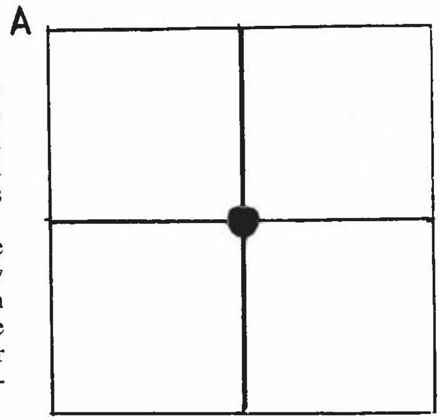
A special Laser Exhibition was held at the Science Museum, London from 1 November until 31 January to show the many applications of lasers in the fields of science, commerce, defence, communications and even entertainment. Rutherford's contribution was a model of the Central Laser Facility – the highest power laser (in an unclassified laboratory) in Western Europe. The model, shown right, is a scale 1/15 replica of the installation, and shows the laser source, the target area and control room.

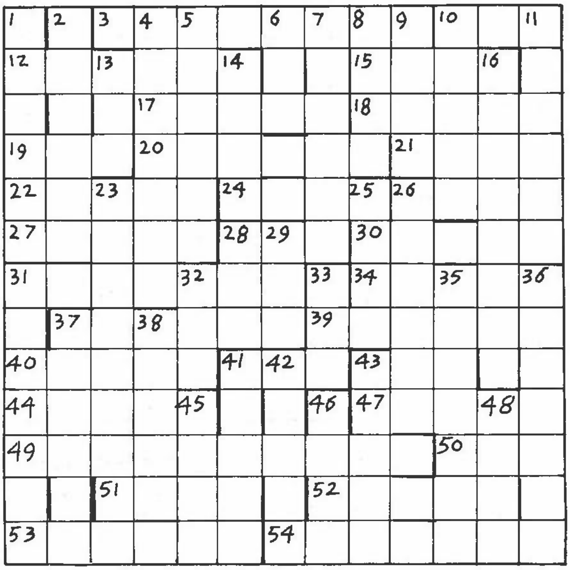


NUTCRACKER 26

A drunkard has found his way to the top of a half-finished building, where there is a network of concrete beams. Before a last swig reduced him to a state of utter confusion, he had reached the junction marked at A (see diagram right). From A he now walks along the beams, at each intersection (including his starting point) choosing his direction (left, right, forwards or back) at random. If he chooses a direction where there is no beam, he will fall to his death, but if he manages to reach the centre of the network he will find a safe platform and a ladder down (which even in his befuddled state he will certainly take). What are his chances of reaching safety?

The prize will be awarded to the first correct entry drawn on 1 May Entries to the Editor, 'Quest', Room 1532, State House. Please state whether you would prefer a book or record token. The solution will appear in the next issue.





MAXIM 16

MAXIM 16

Eight farm animals have been removed from the asterisked positions and placed in the pens at the centre of the diagram.

Clues

ACROSS

3. Fiiend replaced – what's wrongly implied (8)
*10. How to get up road's slope, including leftwards (7)
12. He's surrounding observatory with brave types (6)
15. F got by dropping C from vapour (4)
17. Western beers are consumed here! (5)
18. Drilled – and how one feels after too much drill (5)
19. Tidal movement reverses in Caribbean (3)
*20. List in the wrong order, have a go at a clue (9)
*21. Very powerful service I have (7)
*22. Out of tune, ill, be in very good spirits (9)
24. *Pen*
26. Turn around and around – what helps the wheels go round (4)
27. Alexander's and yours initially (5)
28. *Pen*
*30. Shy about protegé, left, avoiding danger to self (8)
31. Buddy of 44, left with small houses (7)
*34. Follow arts man with a twitch – that's highly orthodox (8)
37. What Henry wanted stiffened if French came to all points (6)
39. Bent tube, so thick (6)
40. Wine a chap drinks in company (5)
41. *Pen*
43. Presumably collected by Japanese numismatists (3)
44. Hellish hot, as he was one of a trio (5)
47. Taking an article from 19th century battlefield is against the law (5)
49. Haggle with Iris and somehow she'll give you a cup of tea, etc (6, 4)
50. In the south-east, one of these is China (3)
51. Tidy way of drinking, with no splash (4)
52. Speech of Hannibal at Interlaken? (5)
53. Capture the attention of English given time (6)
54. Ceremonial dress that's worn unceremonially about work (3, 4)

DOWN

1. Set her off in groups they say are crowded (6)
2. Rabies raging in part of Yugoslavia now (6)
* 4. Occasionally the present is present with the past (3, 3, 4)
5. See a rarer metal replaced by iron in old-fashioned loyalty (6)
6. Source of whisky in Sussex (3)
7. What happened in the end? The lustre was lost (6)
8. Something that flows in Heidelberg and further north (4)
9. When temper's raised, a fatal end's produced (4)
10. Strange! – American leaves something in an antique shop (5)
11. Roughly and cruelly ruled over capital of Yemen (6)
13. What burglar's out to do, and Bobby (3)
14. Type who's likely to throw something at Stetchford end (4)
16. Vile dish served – really bad (8)
23. It's somehow nicer to be on best part of pivot – very satisfying! (9)
25. *Pen*
26. Boxer in a hole (6)
28. *Pen*
29. *Pen*
31. British champers? It's enough to make a man go in for exercise! (7)
32. *Pen*
33. *Pen*
35. Where men dress in a djellabah, or in a suit (7)
36. Foods harvested several times, by the sound of it (7)
37. Clothes a teenager has are probably not made from this old-fashioned stuff (6)
38. A circle that's associated with nose, and with neck (5)
41. Rider won't win this by finishing jump behind time (5)
42. Product of melting other metals (5)
43. Throw away in gently rising trajectories (5)
45. Tobacco provided by 49 (4)
46. Think I love using metric unit shopping? (4)
*48. Colour of US agents in coal mine (7)

The prize will be awarded to the first correct entry drawn on 1 May .... Please send your entry to the Editor, 'Quest', Room 1532 at State House and state whether you would prefer a book or record token. The solution will appear in the next issue.

The Brain of SRC?

Twenty teams from the Swindon Advance Office took part in a quiz competition organised by the Sports and Social Club for the title 'The Brain of SRC'. Competition was tough and it says much for the skill of questionmaster Wally Bray that his decisions were accepted without too much mayhem.

Some of the team names chosen by the participants demonstrated an admirable grasp of the finer points of job description and included Contracts Indians who soon knocked out Contract Chiefs only—inevitably to be brought to book by the Financial Wizards. The Training Idiots were eliminated by Manpower Academicals who in their turn were crushed by Secretariat Allstars. Salary Allsorts went down to Superannuation which met Engine Hearing in the final.

Chairman Geoff Allen presented the Hilda McIntosh Trophy to the winning Engineering team. Some in the audience thought they detected some satisfaction on his part. Could the fact that he had been Chairman of the Engineering Board have had anything to do with it?

Hilda McIntosh who worked in the London Office of the Council for seven years until her untimely death in 1977 had asked that any money donated for flowers should instead be given to the Imperial Cancer Fund. It was decided that a little money should be spent on a permanent memorial. The Shield has been presented to the Sports and Social Club to put up as a prize for this annual competition.

We understand that certain colleagues in the London Office think they could give Engineers a run for their money anytime.

From left: Wally Bray (Chairman), John Cima (one of the contest organisers), Liz Foley, George Rankin (Chairman of the Sports & Social Club), and Janet Orme

Photo above shows a young visitor to the Public Exhibition at the Royal Greenwich Observatory. Over 45,000 visitors saw the exhibition in 1977

Solution to Maxim 15

The winner was Dr D R S Boyd (Rutherford Laboratory) who wins a £2 book token.

C	A	P	F	U	L	F	I	L	T	E	R	S
D	R	E	A	R	A	L	N	E	S	T	L	E
E	M	B	L	A	Z	O	N	N	H	A	I	R
R	E	A	L	L	Y	P	E	T	R	A	V	V
R	E	F	U	S	E	P	R	H	I	N	E	E
A	L	F	N	A	P	E	S	O	M	T	O	R
B	A	L	D	B	I	D	E	O	P	I	U	M
E	L	I	U	L	C	R	A	T	E	H	S	I
I	I	N	L	E	T	E	T	U	R	E	E	N
T	D	G	A	L	A	S	S	N	A	R	E	D
R	O	O	T	A	S	E	M	I	N	O	L	E
O	L	D	E	S	T	L	U	O	T	H	E	R
S	N	E	S	S	E	L	G	N	I	S	I	R

Solution to Nutcracker 24

The solution is Distig the 15th of February. The winner was L Naylor (Daresbury Laboratory) who wins a £2 book token.

Misprint of the year?

17th Premature Retirement Working Party Meeting

The briefing, which will begin at 10.30 a.m., will now be held in toom 52 here at the Swindon Office.

Telex message sent in by Sid Mullineux, RGO.

Stop press

Our congratulations to Dr Alan Gibson, Head of the Laser Facility at Rutherford and Professor Phil Burke, Head of Theory and Computational Science Group at Daresbury, who have been elected Fellows of the Royal Society.