QUEST

August '74

Europe's high flux reactor

Sports day

Home control for our latest satellite

QUEST

House Journal of the Science Research Council

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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.

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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.

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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.

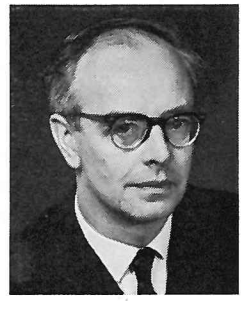
Two's company, Three's a crowd

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.

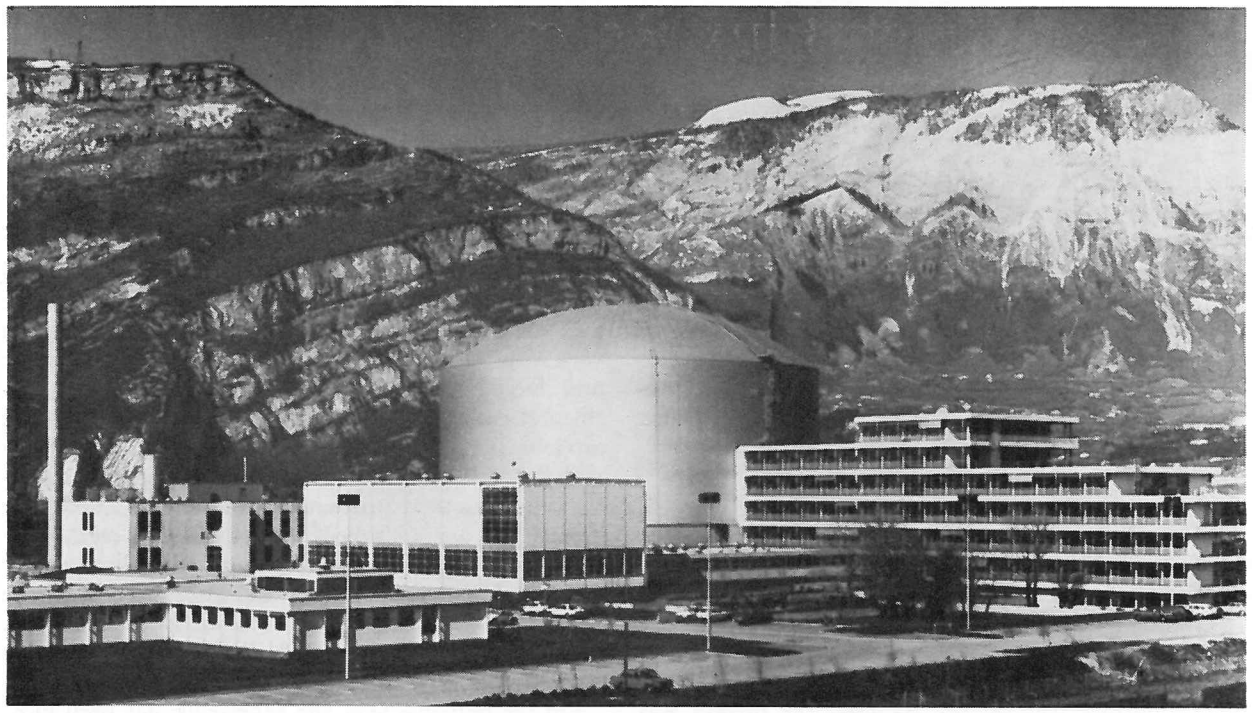
On the personal side, the experience has been most enjoyable. From my first day here, 2 May 1973 (I had forgotten that no one on the Continent works on 1 May and so lost (gained?) a day as a result), all administrative and most technical discussion has been in French and all scientific discussion in 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.

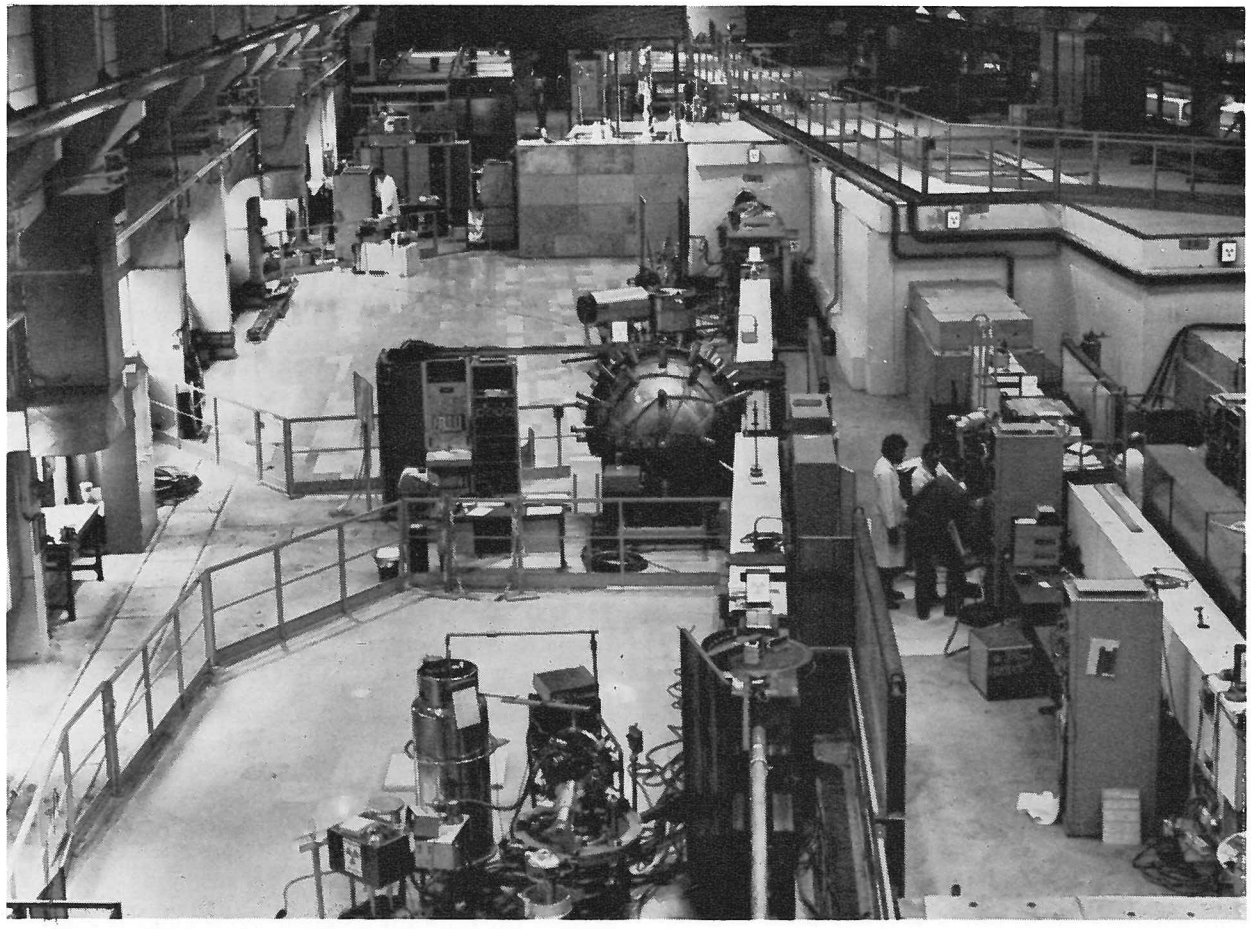
No special licence required

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

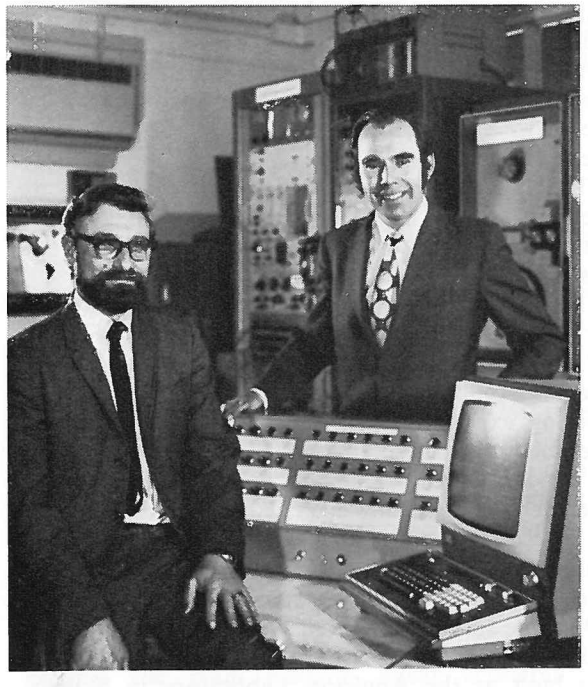
These large computers are used to process the data and to calculate the current pointing direction, drift rate and orbit positions, to check the experimenters' data, and then to transmit all this information over data links back to the control centre, where it is recorded on magnetic tape. In the control 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



Picture shows Peter Barker, Head of Satellites Division (left) and Barry Martin, Head of Computing and Systems Analysis Division

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

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:

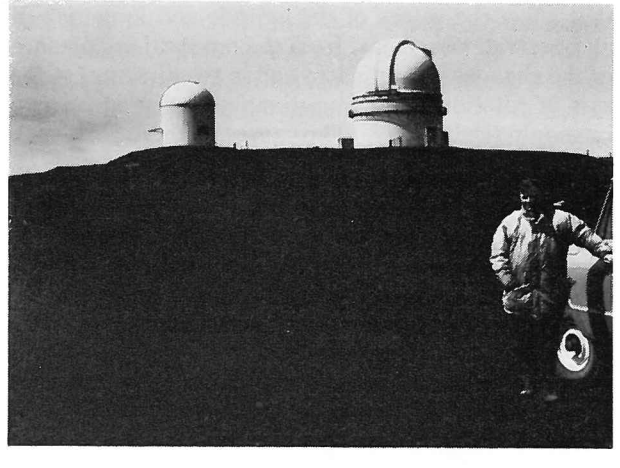
- Review SRC-supported energy research projects in a national context and advise on a suitable balance of support between different aspects;
- identify important areas of research and training requiring more detailed study with the intention of giving priority encouragement;
- consider future trends 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

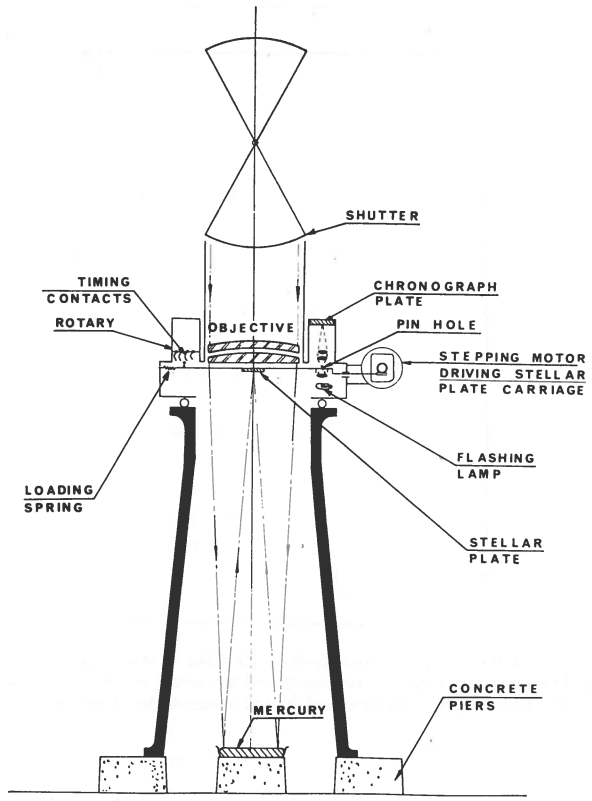


Fig 1. Schematic diagram of the Herstmonceux Photographic Zenith Tube. The objective lens is 10 inches in diameter and the focal length is 136 inches. The rotary rests on a ball race supported by the tapering main tube. The physical, mechanical and optical advantages of this general design have remained unsurpassed for 120 years

of $\pm 0{\cdot}0015$ 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 $1\frac{1}{2}$ 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-

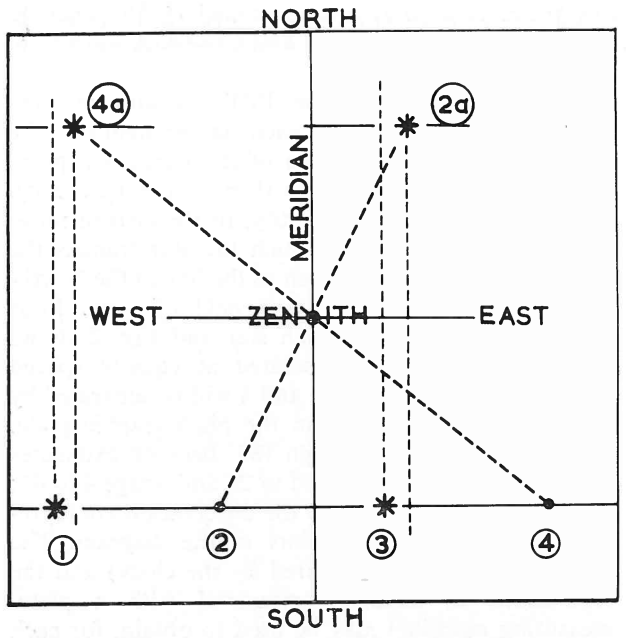


Fig. 2. Illustration of an observation of a star transit. The displacement of images from 2 to 2a and 4 to 4a resulting from 180 rotations are shown by the diagonal lines intersecting in the zenith. The observations are restricted to stars within 15 arc minutes of the zenith

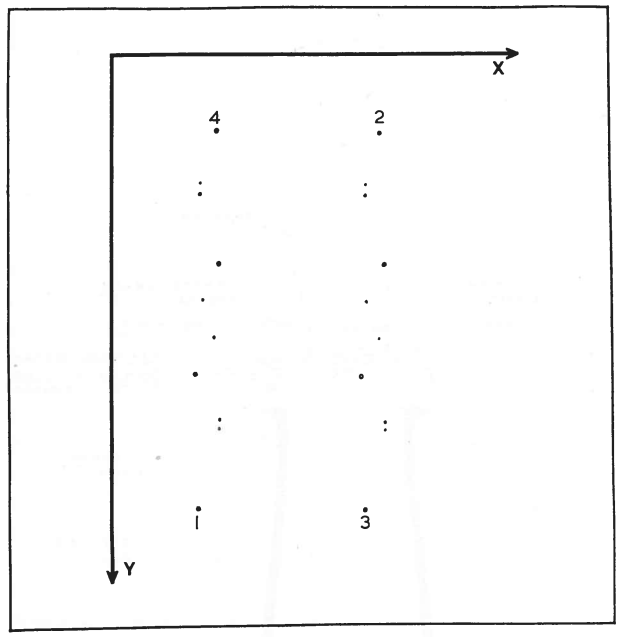


Fig. 3. Copy of plate enlargement showing 5 stars (20 images); published plate results are based on the mean of all stars on the plate. Image size is determined by the magnitude of the star

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.

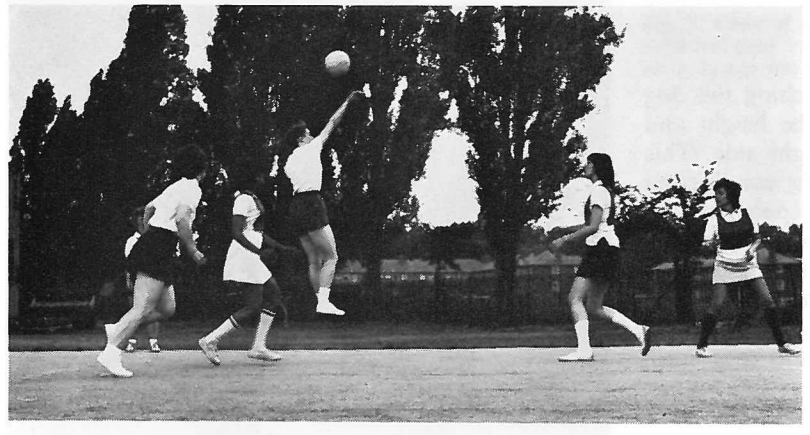
Contrary to most people's romantic notions, a guide dog does not stand at the edge of the pavement looking both ways waiting for a favourable time to cross! In fact it will set off across a busy road even while traffic is approaching and will stop only when immediate danger threatens—having been trained 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.

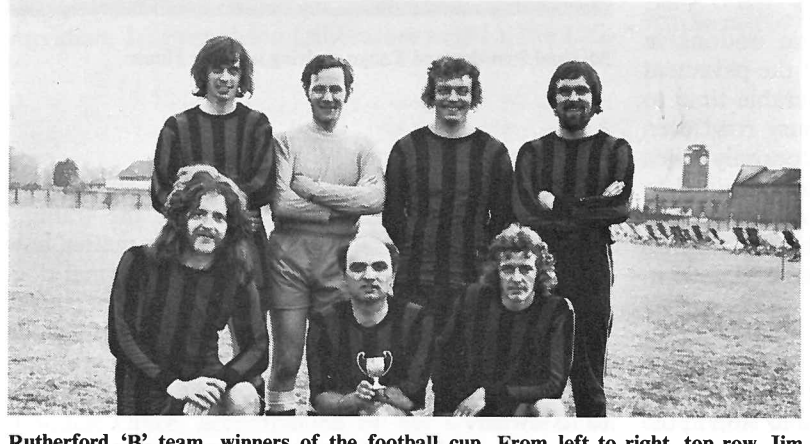
Michael Reordan and Tanya arriving at State House

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!



Atlas compete against Appleton for the netball cup



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

Council Capers 1974

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
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

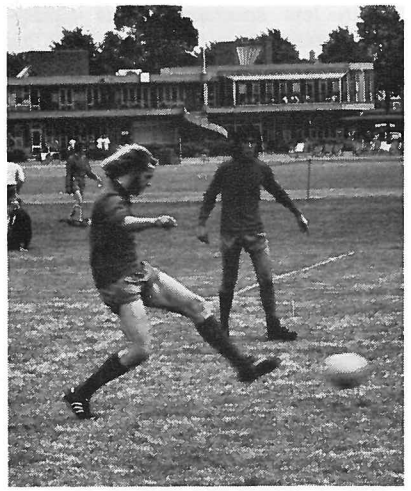
Mrs Edwards also presented the Flowers Trophy to Daresbury Laboratory. This trophy was donated by Sir Brian Flowers, former Chairman of Council and Past President of the Sports Association, for an annual golf competition (see page 16).

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).

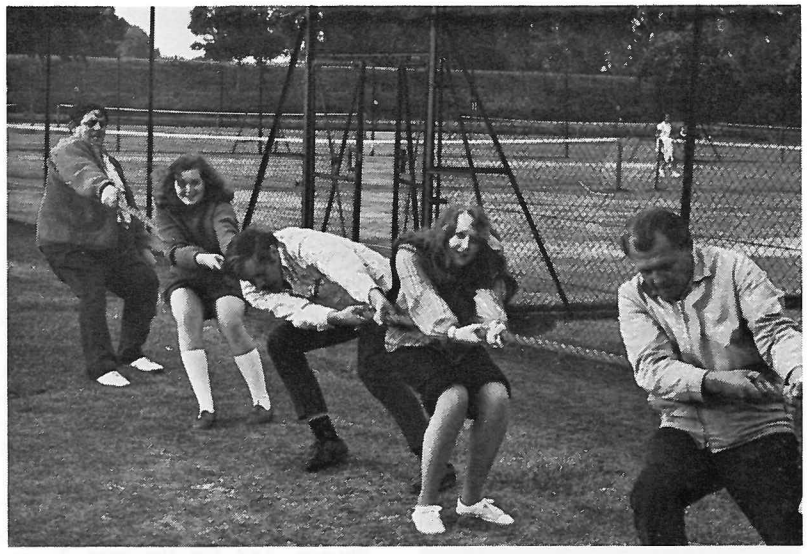
Familiar faces mingled with newcomers at the social evening with music provided by Appleton Laboratory's disc jockey. Sports Day again lived up to its tradition of providing the one occasion of the year when members of staff from all SRC's establishments can get together both in friendly rivalry and socially.

Photos: Peter Hicks, Appleton Laboratory

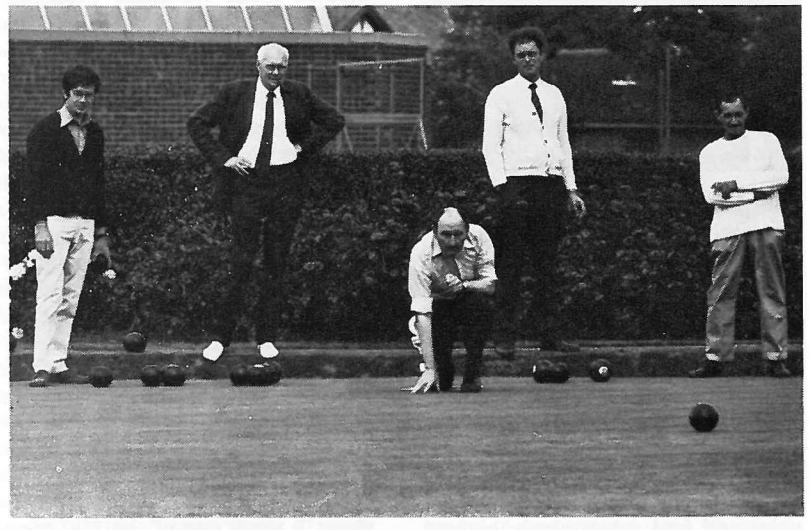
Dr George Wilkins and Mrs Irene Malin, winners of the Mixed Doubles, Dr Fred Horner and Mrs Edwards



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*)



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.

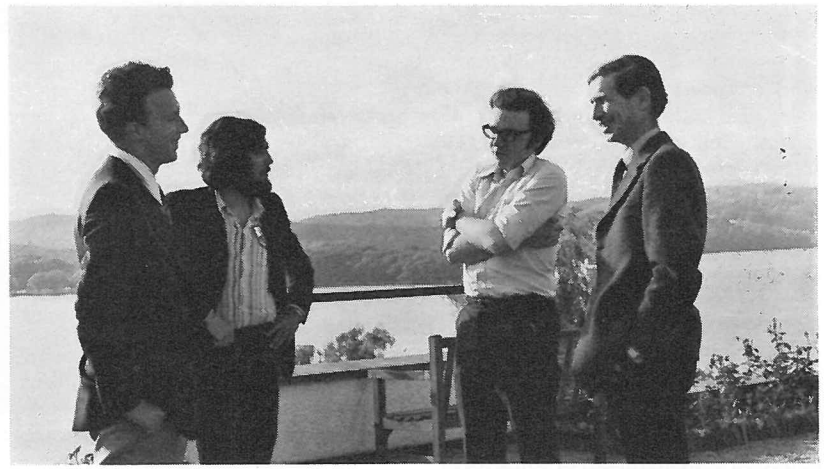
Dr V C Reddish (ROE) to Deputy Chief Scientific Officer. Before joining the staff of the ROE in 1962, Dr Reddish spent five years as Lecturer in Astronomy at Edinburgh University and three years as Lecturer in Radio Astronomy at Manchester University. Dr Reddish has been in charge of one of SRC's major 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.



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)

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.

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.

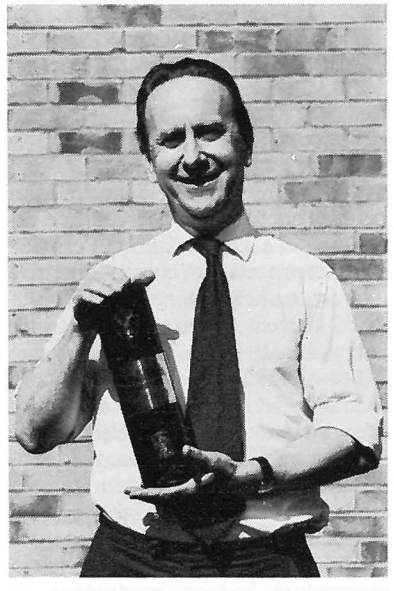
Don Perkins gave a comprehensive survey of neutrino physics and demonstrated how further understanding of nucleon structure in terms of partons could be extracted from such data.

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.



Quest writer of the year,* Frank Bale (Appleton Lab) with his prize bottle of whisky (*see Quest, no 1 1973 p. 18)

Prize Posters

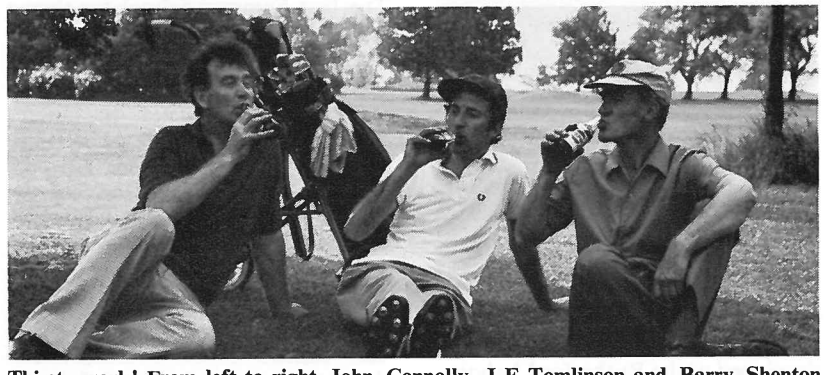
A competition was recently organised by the SRC Suggestions Scheme through its local committees to design new posters for the scheme. Prizes were awarded to the following members of staff:

Mr J H W Andrews, London Office (£20);
Mr R Halton, Appleton Laboratory (£15); and
Miss W Maltby, London Office (£10).

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.



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.

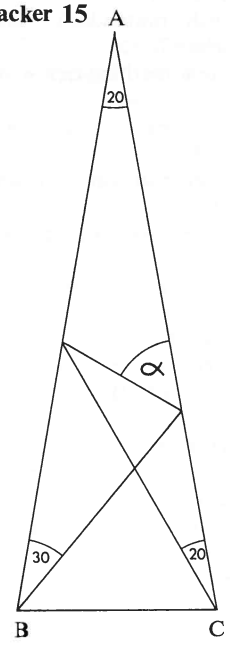
In 1975 the Tercentenary of the founding of the Royal Greenwich Observatory will be celebrated with possible Royal Visits both to Greenwich itself and to Herstmonceux to mark the occasion. There will be an exhibition dealing with the historical aspects in the Queen's House at Greenwich, while at Herstmonceux 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



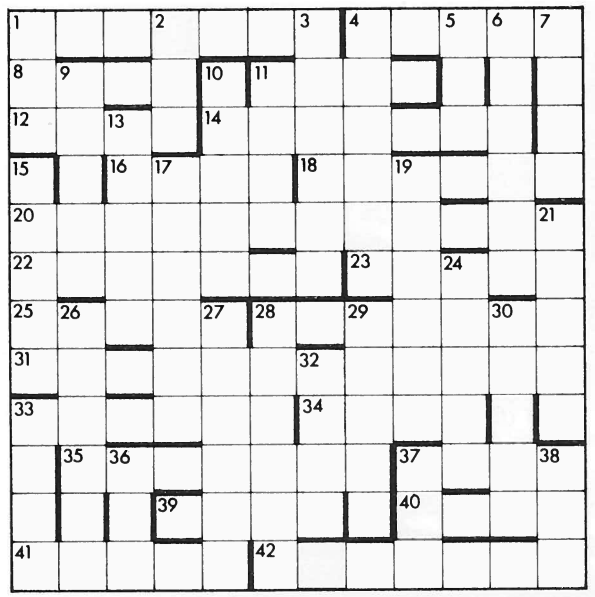
Triangle ABC is isosceles with a vertex angle of 20°. Other angles are as shown. The problem is to determine angle α by *pure geometry only*. At least two completely different routes exist. There will be a prize of a £2 book or record token for the most elegant solution sumbitted to the Editor. Please 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	

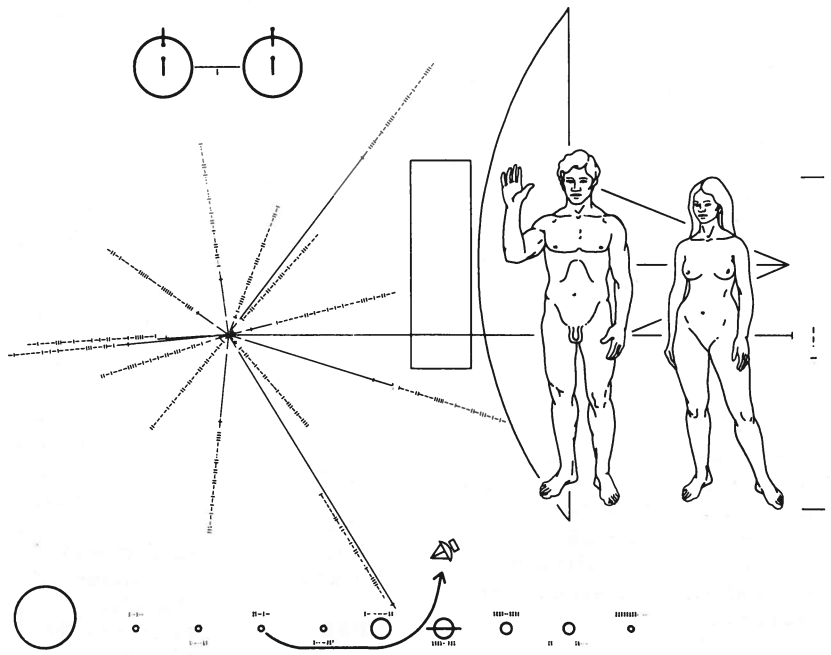
The winner of the £1 book token was P A Machin, Atlas Computer Laboratory.

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).

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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.