

QUEST

Vol. 7 No. 3

House of the future

Prince of Wales inaugurates AAT

Ariel-V explores the Universe



QUEST

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Cover

Picture shows a general view of a prototype model of the "autonomous house". The opaque panels are solar collectors to provide heating. The sloping walls are designed to provide suitable alignment for these panels and to improve the flow of wind to the roof-mounted aerogenerator.

Quest has been 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

This issue of *Quest* is balanced to represent several of the Council's interests at the present time.

The Autonomous House feature is an example of a grant for work which may have major social and economic implications in the field of housing; Ariel-V now successfully launched will we hope advance knowledge in the exciting new field of X-ray astronomy; the Anglo Australian Telescope now inaugurated will open up astronomy in the Southern Hemisphere to a greater extent than ever before.

The articles on scatter radar and Triumf report on other aspects of the Council's support for the physical sciences. Our feature on Turkey shows a reader in an enquiring, observational frame of mind even when off duty and will we hope have popular appeal.

Quest is now receiving a significant amount of copy from its readers which is particularly welcome as active reader participation is the basic support of any house journal. We hope this kind of support will continue to grow.

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The house of the future ?

Staff at London Office were among the first to see a prototype model of an "autonomous house" which was on display at the Annual Report Press Conference in October.

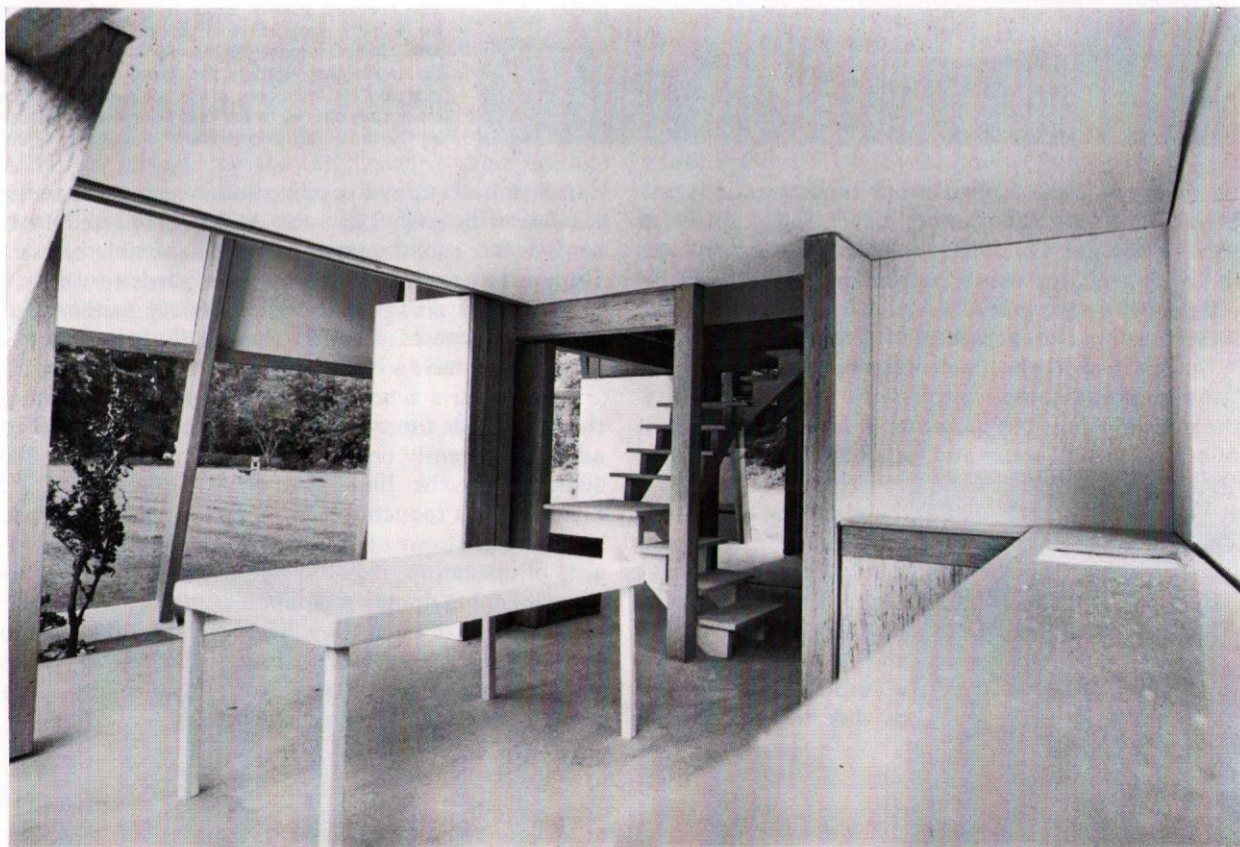
The "autonomous house" project which is sponsored by an SRC grant of £30 000 and a Department of the Environment grant of £6000 is being undertaken by Alexander Pike and his team at the Department of Architecture, University of Cambridge. The concept of an "autonomous house", freed completely from connections to centralised services, seeks to contribute solutions to some of the problems facing us today—depletion of energy, materials, food and water resources, pollution and urban growth.

Our consumption of resources is increasing at a very rapid rate, particularly in terms of energy, both directly for domestic use and indirectly in the production of consumer goods. Yet the more easily won

sources of energy are fast disappearing as each newly-found supply of fossil fuel is voraciously consumed by the demands of the affluent society. As resources become scarce so prices rise and it has been estimated that the price of oil, gas and electricity may rise by about 15 per cent per annum over the next ten years, quadrupling present rates.

In this climate of shortages, the costs and losses in distributing services such as electricity, gas, water and sewage disposal are receiving much greater attention. The economic viability of services networks has become questionable and their serious influence on the pattern of city growth has also to be considered. Cities throughout the world are expanding at an alarming rate and it has been estimated that by the year 1984 more than half the world's population will

View from the kitchen/dining area, with insulating screens open, overlooking the enclosed and outdoor garden areas





The enclosed garden space which can be used for a large proportion of the year as a leisure area, for children's play or for vegetable cultivation. In fine weather the living areas on the ground floor open onto a terrace and the hinged insulating screens to the first floor bedrooms can be raised so that they overlook the garden area

be living in cities—aggravating transportation problems, pollution, land values, crime rates and other social disorders. The impending levelling of standards of living will, for many people mean an intolerably different life-style unless we plan for measures which increase self-sufficiency and self-determination.

Sufficient work has now been undertaken on the "autonomous house" project to show that it is theoretically possible to create a house independent of central power, water and food services and the next stage will be to construct a prototype.

The house will exploit the abundant and ubiquitous sources of energy: solar and wind power. Space heating will be provided by using collectors for solar radiation, storing the heat obtained during the summer for use throughout the winter, boosted by the periods of winter sun. Wind power will be utilised for generating electricity with the surplus energy above the capacity of the generator diverted to provide

domestic hot water. Recycling will be employed to the maximum extent. Rainwater will be collected from roof surfaces for use and, whenever possible re-used. Human waste and kitchen and green garden waste will be fed into a sewage digester to produce methane for cooking purposes. The innocuous sludge from the digester will have a high value as fertiliser.

The objective is not to create a house which satisfies the bare needs for survival but to provide the level of amenity currently enjoyed by most householders. To achieve this the limited level of supply must be matched by a reduction in demand. This will be done not by restrictions on a way of life but by high standards of insulation, reduction of ventilation losses and by redesigning domestic equipment to avoid wastage.

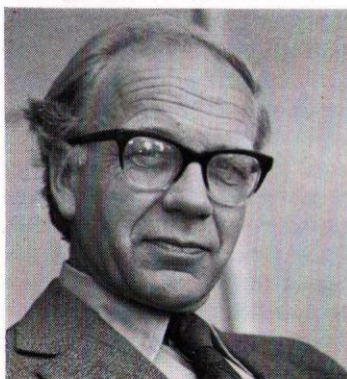
The results of the work will be applicable not only to autonomously serviced houses but also for the entire stock of housing, in which very significant savings could be made in energy consumption.

New Directors for RGO and ROE

Professor F Graham Smith, already well known to members of the Council's staff as Professor of Radio Astronomy at the University of Manchester, is to be the new Director of the Royal Greenwich Observatory in succession to Dr Alan Hunter who retires at the end of 1975 after thirty-eight years at RGO. In the meantime Professor Smith is taking up appointment at Deputy Director level.

Professor F Graham Smith PhD FRS was born in 1923 and educated at Epsom College, Rossall School and Downing College, Cambridge where he obtained his Doctorate in 1952. He spent three years (1943-46) at the Telecommunications Research Establishment, Malvern before returning to Cambridge in 1947 to join Professor (now Sir Martin) Ryle's Cavendish team. In 1964 he was appointed Professor of Radio Astronomy at the University of Manchester. From January to October 1969 he was Deputy Director of the SRC Radio and Space Research Station (now the Appleton Laboratory) on a part-time basis to help specifically with a review of the Station's research policy, after which he resumed his full-time appointment at the University of Manchester. Among his particular scientific interests are radio astronomy from satellites, cosmic ray showers, galactic radio sources and the pulsating radio stars (pulsars). He has helped to develop radio telescopes and their instrumentation from the earliest postwar designs to the large interferometers and parabolic reflectors in use today.

Professor Smith, who was Secretary of the Royal Astronomical Society from 1964-71, was elected to Fellowship of the Royal Society in 1970. He is married and has a family of three sons and a daughter. His principal recreations are walking and sailing.



Congratulations to our colleague **Dr Vincent Reddish** on his appointment as Astronomer Royal for Scotland and Regius Professor of Astronomy in the University of Edinburgh in succession to Professor Hermann Brück CBE who retires at the end of September 1975. Dr Reddish also succeeds Professor Brück as Director of the Council's Royal Observatory Edinburgh.

Dr Reddish is 48 years of age. In 1952 he qualified for the London University external degree of BSc in Honours Physics and two years later was awarded the degree of PhD in Astrophysics from University College, London. He then lectured in Astronomy at Edinburgh University and in Radio Astronomy at the University of Manchester before joining the staff of the Royal Observatory, Edinburgh in 1962. His researches into the properties of interstellar matter and the formation and evolution of stars earned him individual merit promotion to Senior Principal Scientific Officer in 1966 and the award of a degree of Doctor of Science by London University in 1967. He was appointed in 1970 to the post of Project Officer for the construction and operation of one of the World's largest astronomical cameras, the UK 48-inch Schmidt telescope in Australia which was commissioned in 1973 and is at present being used to map the southern skies. At the Observatory he also leads the team which has developed high speed machines for automatic measurement of astronomical survey photographs. Dr Reddish is one of the three UK members of the Anglo-Australian Telescope Board. He was appointed OBE in the last Birthday Honours.

Dr Reddish is married with two sons and lives in Edinburgh.



Council Commentary

July to November 1974

Membership

At the July meeting, the Chairman thanked the retiring members, Dr Chilver, Sir Eric Eastwood (Chairman of the Astronomy Space and Radio Board), Professor Matthews (Chairman of the Nuclear Physics Board), Professor Mitchell and Professor Richards for their outstanding services to Council over many years. In October, the Chairman welcomed Professor Burcham (Birmingham University) as the new Chairman of the NP Board and Dr Horlock (Salford University), Dr Kennedy (British Non-Ferrous Metals Technology Centre) and Sir Norman Lindop (Hatfield Polytechnic) as new members of Council. He also welcomed Professor Elliott in his new role as Chairman of the ASR Board.

Visit to Loughborough

The fifth in a series of weekend meetings of Council members, Board representatives and senior staff was held in September at Loughborough University of Technology to discuss subjects of current interest in more detail than is possible at usual Council meetings. Two main topics were considered—the Council's policy for support of postgraduate training and the development of new methods for the support of research in engineering and science. Proposals arising out of the meeting will be considered for action at later Council meetings, for example see the section on postgraduate awards below.

Finance

(i) *Outturn 1973/74*

A paper presented to Council in July explained the exceptional £3.3M underspent on the Supplementary Estimates figure of £76.161M for 1973/74. The main causes identified were (i) fluctuations in exchange rates applied to international subscriptions, (ii) the energy crisis which had a widespread effect and reduced the scope for switching resources and (iii) over-compensation in seeking the supplementary estimate to deal with the unprecedented inflation. In discussion the importance of individual authorising officers notifying Finance Division promptly of any likely underspend, so as to allow appropriate corrective action, was emphasised.

(ii) *Estimates 1975/76*

In October the Council agreed guidelines for the preparation of the 1975/76 Estimates on the basis of a likely allocation of £94.09M which, in real terms is a little less than the 1974/75 allocation. The proposed expenditure on research grants by Engineering and

Science Boards was reduced compared with the Forward Look to take account of current trends but provision was included for both the Synchrotron Radiation Source (SRS) and the proposed High Powered Laser Facility (see below).

(iii) *Guidelines for the Forward Look 1976/77–1980/81* Council considered at its November meeting, the financial guidelines to be used by the four Boards in preparing the 1976/77–1980/81 Forward Look. Council's Forward Look will be submitted to the Department of Education and Science, for consideration by the Advisory Board for the Research Councils, at the end of April 1975. Council noted the DES guidance that the main Forward Look should be derived from the 1975/76 Estimates with a presumed growth rate of 0.7% pa. By contrast, the main programme in the 1974 Forward Look had been produced on a 2.5% pa growth rate. Council approved appropriate guidelines for each Board. In addition, Boards were asked to show marginal changes to be made in their programme for both a higher and lower growth rate so that Council would have a choice of projects and programmes before it, when it formulated its overall Forward Look.

High Powered Laser Facility

In July, Council agreed in principle to the establishment of a central facility for high powered lasers for use by university research groups, subject to the availability of funds. The principal objectives would be (1) to create in the laboratory superdense high-temperature plasmas; (2) to study non-linear interactions of very intense optical and infra-red radiation with matter; and (3) to provide facilities for other new basic investigations in physics and other subjects using high-powered laser beams at a variety of wavelengths. In parallel, because of the long term possibility of developing controlled thermo-nuclear fusion, the UK Atomic Energy Authority (UKAEA) has been considering the establishment of a high-powered laser facility for compression studies. Council agreed that the possibilities of a joint SRC/UKAEA collaborative research programme should be further considered. Council agreed that a preliminary appraisal of the resources required for the proposed facility be carried out at Rutherford, in consultation with appropriate university scientists and the UKAEA.

Postgraduate Awards

The take-up of studentship awards in 1974 is expected to be about 3550 compared with the 3950 available. In view of this short-fall, Council, following its Loughborough discussion, decided in October that in 1975 the number of awards to be offered should be 3600 in line with the 1974 take-up. In addition special encouragement is to be given to the CASE scheme

where a collaborative research project is agreed between an employer and a university and where the student, having both an industrial and academic supervisor, is expected to spend a period of at least three months in the firm. Provisionally 240 awards have been allocated to this scheme and extra awards will be made available if needed. Council in November agreed the allocations of studentships to special schemes and the allocation of studentship quotas to Boards.

Science

(i) *Synchrotron Radiation Source*

In October, Council approved the construction of a dedicated Synchrotron Radiation Source (SRS) at Daresbury at a capital cost not exceeding £3M and annual operating expenses of about £1.5M including a research and development programme and overheads. This will be a unique facility in Europe providing radiation from 0.4Å⁰ wavelength to the ultra-violet and a wide range of experiments will be possible. Of particular interest is the facility's potential for time resolve measurement primarily in biological applications. The construction of the SRS will take about four years and it will replace the existing parasitic use of NINA for synchrotron radiation when that facility is closed down. Council deferred a decision on the proposal to accelerate the construction of the SRS so that the consequences of the proposal can be looked at in more detail.

(ii) *Microfilm Recorder Atlas Laboratory*

In July, Council approved expenditure of up to £220,000 for the purchase of a new FR-80 microfilm recorder for the Atlas Laboratory.

(iii) *Research Grants*

In July, Council approved two grants totalling £109,100 to Professor B S Hartley, Imperial College, London, for the development and application of new amino-acid sequencing techniques and study of the evolution of enzymes.

Engineering

In July, Council approved a supplementary grant of up to £97,000 to Professor B Randell, Newcastle University, for the design of highly reliable computing systems. Council was informed that NRDC were interested in patenting a hardware mechanism developed by the Newcastle team for providing automatic checkpoint restart facilities. At the same meeting Council approved a supplementary grant of up to £240,500 to Professor E A Ash, Professor A L Cullan and Professor D F N Davies, University College, London, for continued support of the Microwave Research Unit and approved the award of a grant up to £131,300 to Dr S K Bhallacharyya, Birmingham

University, for a major programme on grinding processes, involving high strength and semi-permanent wheels.

Astronomy Space and Radio

(i) *Northern Hemisphere Observatory (NHO)*

Council in November approved the general concept of a Northern Hemisphere Observatory comprising a 4.5m, a 2.5m and a 1m telescope at an estimated capital cost of £13m and a likely operational cost of about £1M pa. Final approval will be sought in 1975. The main aim of the Observatory will be to carry out optical studies of extra-galactic sources, some of which would complement the outstanding work of British radio astronomers. It is proposed that the Isaac Newton Telescope be moved from RGO to the NHO to provide an operational 2.5m telescope by 1978. Council approved a design study for the 4.5m telescope and continuation of discussions with prospective hosts and overseas collaborators. Council noted that the Director of RGO would be responsible for the project and for establishing the necessary NHO project team. Professor Graham Smith is the project officer.

Council in October had approved the purchase of a replacement mirror blank for INT at a cost not exceeding £80 k and in November, as part of the NHO discussion, approved the necessary expenditure to figure the blank.

(ii) *UK-6 Satellite*

The project development phase for the UK-6 Satellite having been completed, Council in October approved the full development phase at a cost not exceeding £5.62M which, when research grants for payload and support costs for the Appleton Laboratory are included would bring the overall cost to about £7M. The satellite will contain three experiments from four universities with equipment for studying the ultra-heavy component of cosmic rays, low-energy X-ray astronomy and variable cosmic X-ray sources. The prime contract for the spacecraft will be let to Marconi Space and Defence Systems with BAC Ltd as sub-contractor. The project will be managed by the Appleton Laboratory and the launching is proposed for June 1977.

(iii) *Research Grants*

In October Council approved the award of a grant to Professor Sir Bernard Lovell, Manchester University, to allow development of a multi-telescope radio-linked interferometer at Jodrell Bank at a capital cost of £1.695M and an operating cost of £80-£120K per annum. This grant will provide a 25m E-Systems dish to be sited in Mid-Wales, using the site originally earmarked for the Mark VA radio telescope and will be used in conjunction with the existing Mark IA

Cosmos

A Machine to explore the Universe



A high speed automatic machine, COSMOS (shown left) was unveiled in November at the Royal Observatory Edinburgh in the presence of the Chairman of the Council, Professor S F Edwards, the Astronomer Royal for Scotland Professor H A Brück, representatives of Heriot-Watt and Edinburgh Universities and members of the press.

COSMOS has been developed to detect and to measure the vast numbers of faint distant galaxies recorded on photographs taken with the U.K. 48-inch Schmidt telescope which was commissioned in Australia last year. It has been built for the Observatory by Computer Applications Services of Heriot-Watt University and was designed jointly by scientists from both institutions.

COSMOS finds and measures the Co-Ordinates, Sizes Magnitudes, Orientations and Shapes of images of stars and galaxies on the photographs at rates of up to a thousand per second.

and Mark II dishes at Jodrell Bank and the 82' dish of the Royal Radar Establishment at Defford. The interferometer will be used to study maser emission sources in regions where star formation is believed to be taking place and to study extra-galactic continuum sources such as novae and pulsars. The interferometer will be capable of making observations down to a wavelength of 6cm.

Nuclear Physics

(i) EPIC

Council in November discussed the proposal to build an electron-positron storage ring complex (EPIC) at the Rutherford Laboratory at a capital cost of £25.7M. Council agreed there was a strong scientific case for EPIC but deferred a decision on the project until it was clear whether the cost could be accommodated within the resources to be provided for the NP Board in the Council's 1975 Forward Look. Council was concerned about the effects on support for science generally if it were committed to so large a project in a period of almost zero growth of its budget. The Office and NP Board were therefore asked to pursue the possibility of an international financial contribution to the project. Since EPIC requires advanced technology, Council invited the Engineering Board to consider whether it would wish to finance university participation in any part of the EPIC programme.

Council invited the NP Board to put forward a programme for continuing preliminary expenditure in 1975 to enable negotiations with potential partners to be pursued effectively.

(ii) Research Grants

Council approved in November consolidated grants for the five major Film Analysis Centres (namely Birmingham, Glasgow, Liverpool and Oxford Universities and Imperial College, London) totalling £1.09M for the year ending 31 January 1976. The grants to Imperial College and Oxford made provision for upgrading of their computing installations.

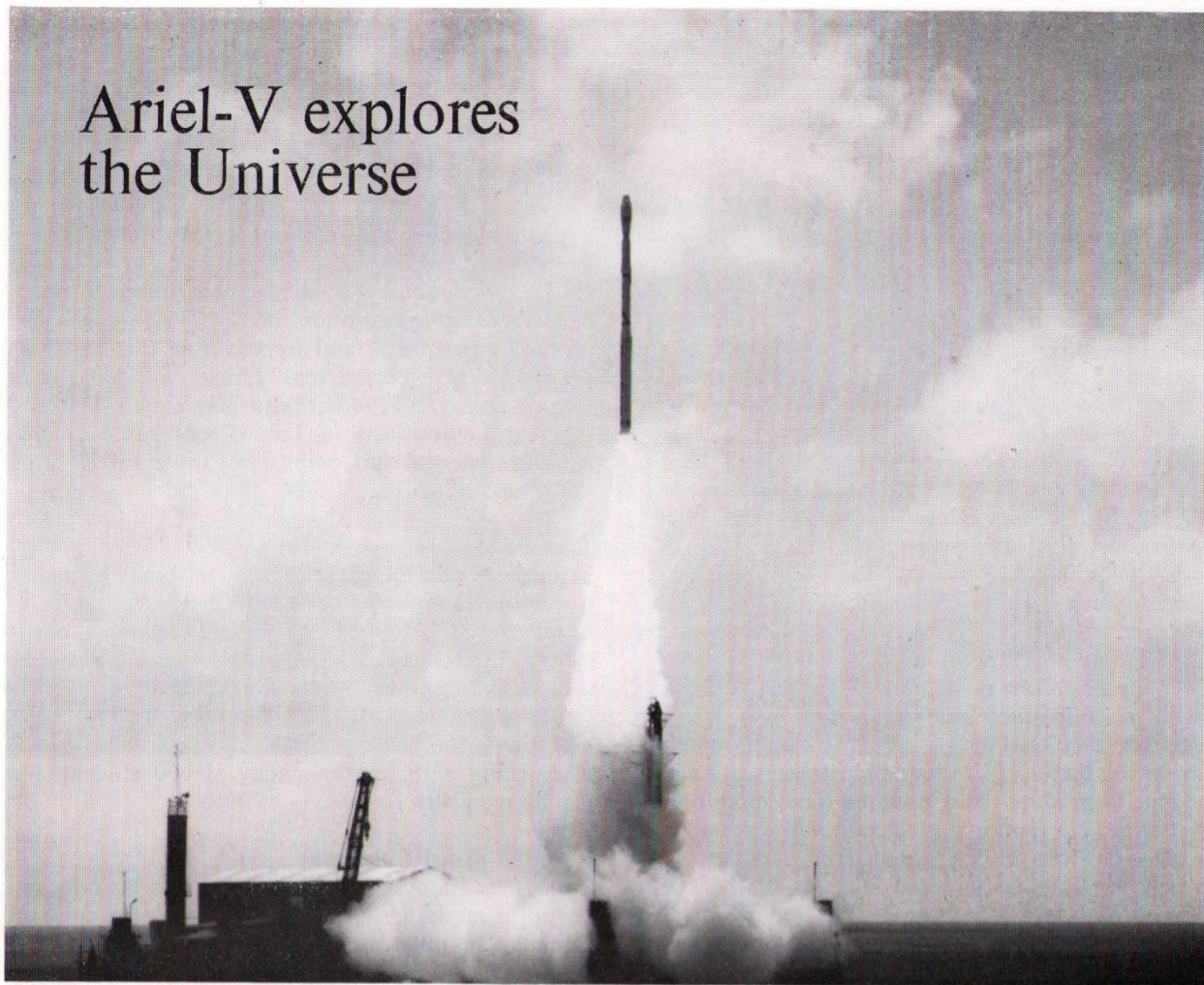
Energy Research

The Council in October noted a recent document entitled "SRC and Energy Research: the present state and some possible future options". It also agreed that as energy spanned science and technology that the existing Energy Round Table and Energy Proposals Panel should be formally constituted as Panels of Council.

Improvements to Cosener's House

In October, Council approved the expenditure of up to £73,500 to provide a better conference room and better bedroom accommodation at The Cosener's House, Abingdon.

Ariel-V explores the Universe



Ariel-V (originally UK-5—see *Quest*, vol 7 no 2) the Council's latest satellite, which was renamed after its successful launch, is now orbiting the Earth every 95 minutes at a height of over 300 miles at 17 000 miles per hour. Unfortunately our readers will not be able to see the satellite as it will not in fact at any time pass over the UK. Latest news from the Ariel-V Control Centre at the Council's Appleton Laboratory is that all the experiments on Britain's first X-ray astronomy satellite are working satisfactorily.

Ariel-V was launched successfully into an equatorial orbit at 0847 BST on Tuesday, October 15, by a Scout rocket contributed under a collaborative agreement with the US National Aeronautics and Space Administration (NASA), from the Italian San Marco launch facility in the Indian Ocean off the coast of

Kenya with the cooperation of the Kenyan Government. The six scientific experiments designed for cosmic X-ray studies by University College London, the University of Leicester, Imperial College London and the US Goddard Space Flight Center have been switched on by signals initiated from the Appleton Laboratory's Ariel-V Control Centre. Many of the X-ray sources which the experiments will measure emit one hundred thousand times the energy of the sun. Many have lifetimes of only a few months; and some may be 'black holes'.

All experimental data in the UK is now being transmitted to the university groups from the Control Centre by Post Office Datel data links. We will keep readers informed of the scientific results of this most valuable research.

TRIUMF — the Meson factory

R WIMBLETT

"It is proposed that you be seconded to the Triumf accelerator at Vancouver for 13 months. Do you accept the secondment?" Well that's how it all started 18 months or so ago. Now that I have returned to the 'old country', let me tell you a little of this fascinating part of the world. First of all a little about Triumf to keep you informed about scientific developments.

Triumf, a nuclear and medical research facility, was initially conceived as a three University meson facility (hence the name 'Triumf'). The nuclear particle accelerator is presently in the final stages of commissioning. The participating Universities are now Alberta, British Columbia, Simon Fraser and Victoria. Each has been involved with a major aspect of design and construction.

The accelerator at Triumf is a sector focused, negative ion cyclotron giving a final energy of 500 MeV. It is the first accelerator in Canada capable of producing mesons (a sub-atomic particle) and should be able to produce many hundred times more mesons than other conventional accelerators in the world. As in all cyclotrons, electrically charged particles of low energy are injected into the machine at the centre, between the poles of a large double Dee magnet. The magnet guides the particles into a circular path. Resonator gaps, boost the energy of the particles, each boost making them spiral outwards in larger circles until they achieve their highest energy at the outer circumference of the machine. A stripping foil is used and positioned at a suitable distance from the centre of the machine for beam extraction at the required energy level. The beam is guided to strike targets of different materials to produce beams of specific types. The two techniques, first combined and exploited in the Triumf cyclotron are:

- the use of a specially shaped magnet to accelerate a constant stream of particles
- the acceleration of negatively charged H (Hydrogen) ions to achieve efficient extraction of the constant stream.

In addition to the high energy nuclear physics research, Triumf particle beams will be used for radio chemistry experiments, radiobiology and therapy for cancer treatment.

An SRC funded experiment is one of the first in which the Triumf cyclotron is used to carry out nuclear physics research. This experiment has the participation of several British Universities with the

University of British Columbia. My own modest involvement was with design and construction of liquid hydrogen bombardment targets which operate at a temperature of -253°C , in nuclear physics experiments and by the time this article is printed, it is expected that Triumf will have been commissioned and the first beam accelerated. The hard work and enthusiasm of Triumf staff has overcome all obstacles and this enthusiasm must surely bring them success.

The Site

Triumf is sited on the edge of the University of British Columbia campus, some 9 miles from the centre of Vancouver. The University is situated in a partly cleared forest area of about four square miles. The campus is beautifully gardened and affords wonderful views of the coastal mountain range to the north and the Pacific Ocean to the east. It is a thriving seat of learning with approximately 10 000 student and faculty members.

Beautiful British Columbia

Vancouver (population 1.1 million) is a bustling but beautiful modern city on the extreme west coast of Canada, 35 miles or so north of the Washington border of the USA. The city lies in the Fraser Valley and with its closeness to the snow peaked coastal range, Pacific Ocean and the Fraser River is probably the most beautiful city I have ever seen. A look at the history of Vancouver shows that the area was first charted by George Vancouver, Captain of a British Naval frigate in 1792. At that time a small number of Red Indian settlements existed and within 50 years a few pioneers, mainly British, settled in what they then called Gas Town. Gas Town was named after a leading citizen who told so many yarns he was nicknamed 'Gassy Jack'. A monument stands to his memory in the original Gas Town area of Vancouver. The Canadian Pacific Railway forged a pathway through the Rockies to reach Gas Town in the late 1850's. This brought a new lease of life to the small community and Gas Town was renamed Vancouver.

Vancouver has grown at a staggering rate since then to become a major sea port with attractive theatres, museums, art galleries and now universities pushing to the forefront of nuclear and medical research. Average summer and winter temperatures in Vancouver are 80°F and 40°F respectively. Winter



Ski time at Mount Seymour near Vancouver

snow always brings excitement to the children, for it doesn't appear every winter. Skiing on the Grouse, Seymour and Whistler mountains is an inexpensive popular pastime between the months of November and May. The city has many large indoor ice rinks, so skating, ice hockey and curling are also popular winter sports. Incidentally my wife Mary and I became members of the Triumph curling club. Mary is immensely proud of the champion curling trophy won by her team and does not readily allow me to forget it.

Summer pursuits, most of which we enjoyed to the full, are salmon fishing in the Pacific, swimming, weekend barbeque trips and touring. We didn't hunt bear or caribou but this certainly is popular with game hunters. The Canadian Rockies are only 450 miles away and the summer vistas of the Rockies, glaciers and bright blue mountain lakes are really magnificent.

Vancouver winters are extremely rainy with only a few dry spells between October and February. The Vancouverite explains "Waall! it's the winter rains that make our city gardens so green and gives us our lovely pine forests. Besides when we have rain the rest of Canada has snow". It is noticeable however, that the normally friendly, good-natured citizen grows a little morose during the winter rains emerging again in the spring with his warm smile.

Much of the wealth in Vancouver is in logging and

salmon fisheries. A little engineering industry has grown to support wood pulp processing, building and fish canneries. The cost of living is slightly higher than in Britain but salaries compensate. Fresh fruit and salads are plentiful and inexpensive all year round, other food stuffs are at average world prices.

Vancouver has a multi-racial population, all living in harmony, often with special areas populated by individual nationalities. Chinatown, a quaint oriental area with colourful shops and restaurants, is a good example of this. Similarly, Greek, German and Italian areas exist, retaining some of their customs and providing international cuisine of a high order.

I must also praise the friendly and efficient Royal Canadian Mounted Police. The 'Mounties', who now only use horses on ceremonial occasions, are a much respected, fair and tolerant force and must rank as one of the world's best police forces.

Earlier I made mention of the friendliness of the people. My wife, son and I made many good friends in Canada, many of whom held dear their British connections. If a chance comes for you to visit Vancouver, take it! I bet you will want to make a return visit.

The following telex, dated 15 December 74 was received from the Director of Triumph 'Full energy extracted, Triumph beam achieved today. . . .'

Ron Wimblett is an Engineer in the Nimrod Division of the Rutherford Laboratory.

The day the Prince came to Coonabarabran

On the day, the event was as meaningful for the little country town of Coonabarabran in New South Wales, some 400 miles north west of Sydney, as for the world's astronomical community, many of whose members had either arrived in the town already or were staying at the Observatory at Siding Spring, 18 miles away, home of the 150-inch (3.9m) Anglo-Australian Telescope.

The event was the Anglo-Australian Telescope inauguration by HRH, The Prince of Wales. The date was October 16.

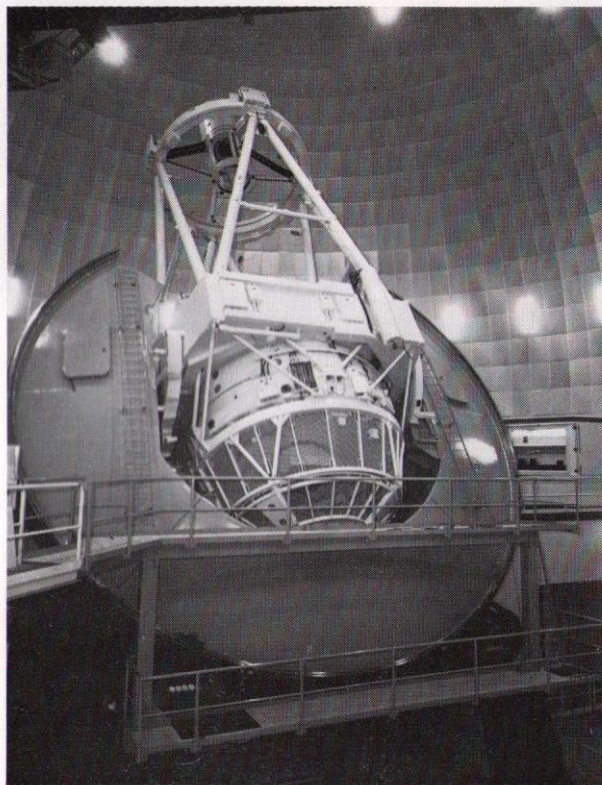
Two days earlier Coonabarabran had held its annual races. Already it was in celebratory mood before the Prince's car passed through on its way from the tiny local airstrip to the Telescope.

There he was greeted by Sir Fred Hoyle, present Chairman of the Anglo-Australian Telescope Board and introduced to the Board members, who include Mr M O Robins, Director of the Council's ASR Division, and Dr V C Reddish of the Royal Observatory, Edinburgh, Officer-in-Charge of the Council's 48-inch Schmidt Telescope which is alongside the AAT.

In his inaugural address the Prince of Wales said "This whole development here at Siding Spring is a splendid example of the best of British and Australian expertise in the realm of astronomical observation and, with an American Director of such noteworthy scientific repute, its future as a centre of international study must indeed be assured. . . . In appreciation of the importance of this telescope in the Southern Hemisphere it is particularly exciting for me to be able to declare this aperture open."

The Prime Minister of Australia, Mr Gough Whitlam, said that "More than two centuries after Cook's voyage British and Australian astronomers can now pursue their observations of the Southern skies with this new Anglo-Australian telescope—this brilliant example of advanced technology and precision engineering."

Among the 400 guests and about 60 press representatives at the function, was a small contingent of British representatives headed by the High Commissioner, Sir Morrice James. It included the Chairman of the SRC, Professor S F Edwards, the President of the Royal Society, Sir Alan Hodgkin, the British Board members mentioned earlier, Professors J Ring, H Elliot, D W H Stibbs (all members of the Astro-

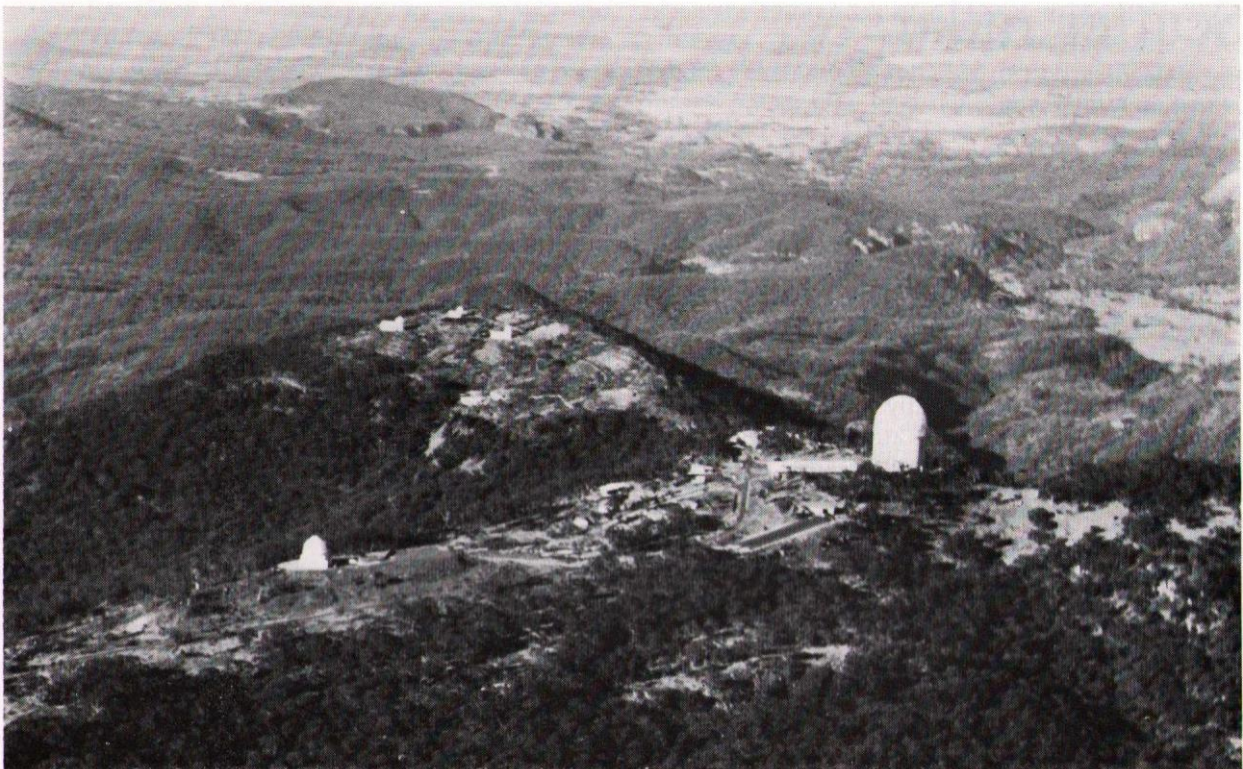


A general view of the telescope

nomy, Space and Radio Board), Professor D E Blackwell, Professor of the Royal Astronomical Society, Dr Alan Hunter, Director of the Royal Greenwich Observatory, Professor Graham Smith, Director Designate RGO, Mr J F Hosie, a former member of the AAT Board when Director of the Council's ASR Division, and a young astronomer chosen by the Royal Astronomical Society.

After a buffet lunch at which the Prince of Wales mingled informally with the other guests he departed to inspect the new local High School.

The British contingent stayed on to inspect the telescope and its potential in greater detail, while Coonabarabran returned to normal—if its life can ever be quite so normal again—and await the arrival of the tourist trade which surely must now grow rapidly as visitors to the Observatory increase, after all the national and international publicity the Telescope has received.



An aerial view of the Observatory showing on the left the Council's 48-inch Schmidt telescope



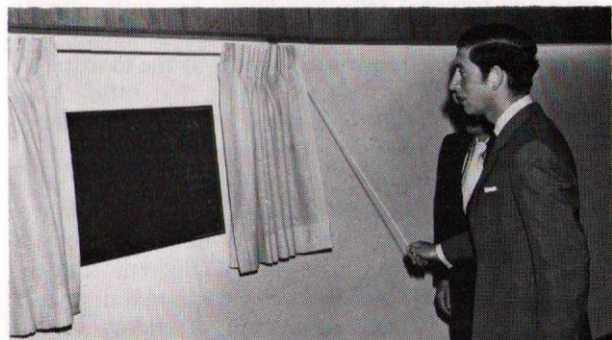
The Prince of Wales addresses the inaugural gathering. On his left in order are Sir Fred Hoyle, the Prime Minister of Australia, Mr Gough Whitlam and the British High Commissioner, Sir Morrice James



A dramatic shot of the interior of the prime focus cage



Dr V C Reddish of the Royal Observatory, Edinburgh, a British member of the Anglo-Australian Telescope Board is introduced to the Prince of Wales



The Prince of Wales unveils a plaque commemorating the inauguration

Scatter radar

P H McPHERSON

For approximately fifty years, experiments have been conducted with the aim of increasing our knowledge of the physics and chemistry of the ionosphere. This region of the earth's atmosphere exists above a height of 50 km, where the incoming radiation from the sun and other sources is sufficiently energetic to ionise a small fraction of the neutral atmosphere, producing electrons and a variety of positive ions. Early work established that there are several layers, usually below a height of 400 km, which are responsible for reflecting radio waves back to earth. Until the advent of rockets and satellites, the only way to investigate the ionosphere was to observe its effects on these reflected radio waves.

The most frequently used method has been the pulsed sounder or "ionosonde" technique, whereby a pulsed radio frequency signal is beamed upwards and the time taken for the signal to be reflected back from the ionosphere is measured. The depth to which the signal penetrates into the ionosphere depends on the frequency in use and the radio wave will be reflected at the point where $N = f^2/80.6$. Here, N is the electron density in m^{-3} and f is the frequency in Hz. By progressively changing the frequency (usually between about 1 and 20 MHz), a vertical profile of the ionospheric electron density can be obtained. This method and variations of it have provided vast amounts of data over the years but suffer from two main drawbacks. Firstly, as the frequency is increased, the point of reflection will jump from the maximum electron density of one layer to some point in the next highest layer (or away into space if there are no more layers) and so no information is obtained about the "valleys" between layers or about the ionosphere above the topmost reflecting layer. Secondly, during radio blackouts following solar disturbances, the absorption of the transmitted energy by the ionosphere becomes very high, with the result that little or no reflected signal reaches the receiver at a time when interesting phenomena are occurring.

Scientists have for many years been aware of a mechanism for obtaining signals from the ionosphere which is different to the mirror-like reflection of shortwave frequencies. In this "incoherent scatter" method, much higher frequencies are used (i.e. greater than 40 MHz) where absorption of energy by the ionosphere is low and where the normal mirror-like reflection does not occur. For these reasons the

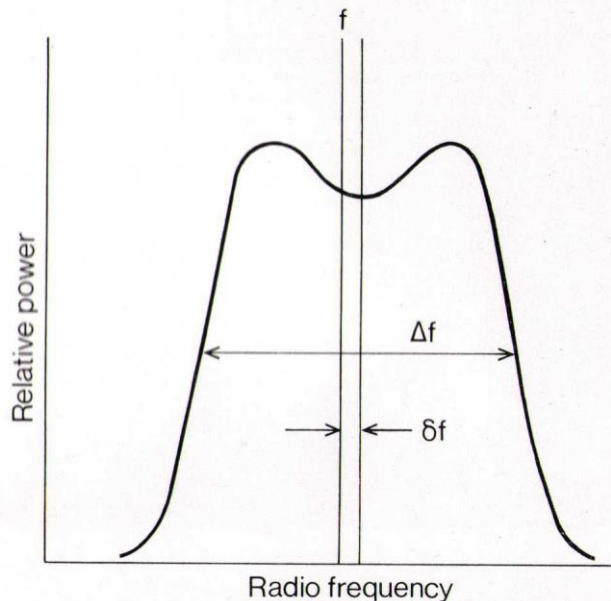


Fig 1

method does not suffer from radio blackouts and can yield information about any region of the ionosphere from near the bottom to as far out as several thousand kilometres, depending on equipment sensitivity.

The method depends on the fact that electrons can behave like small radar targets with a radar cross-section similar to the Thomson electron cross-section of 10^{-28} m^2 . It is necessary to use high transmitter powers and large aerials together with very sensitive receivers to detect the very weak signal which is produced. As a result of the random motion of the electrons in the transmitter beam, the signal scattered by each particle has a small doppler shift, the overall effect being to produce a broad spectrum at the receiver which is more or less symmetrical about the transmitter frequency. A typical spectrum is shown in Fig. 1. Because the signal/noise ratio is so small, typically 0.05, these spectra are buried in noise and require integration techniques for their recovery.

From the shape of the spectrum we can obtain the temperatures of the electrons and positive ions in the region under investigation (temperature here being related to kinetic velocity). Perhaps the most important measurement is that of the shift of the spectrum as a whole from its symmetrical position about the transmitter frequency (δf in Fig 1). This is a doppler shift due to bulk movement of the ionosphere through the neutral atmosphere and is a direct measurement of the ionic drift velocity.

There are two main methods by which the experiment can be performed. The first involves the use of a pulsed radio frequency signal, similar to the short-wave ionosonde but in this case it is only necessary to transmit on one frequency. The transmitting aerial beams the signal upwards and between each transmitted pulse, sufficient time is allowed for the same aerial to be used in the receiving mode. This so-called "monostatic" system can also include a multi-channel data store, each channel being gated with the appropriate time delay to record data from different heights. In this way, vertical profiles of electron density can be easily obtained, being simply related to signal/noise ratio. Over a period of a few minutes and with a suitable system of gating, spectra (as shown in Fig. 1) can be built up. But the pulsed method is not ideal for measuring ionospheric drift velocities.

The second experimental method involves much more hardware than the pulsed method. In this case, the transmission is once again beamed upwards but is a continuous wave signal. One or more receiving stations with large steerable aerials, situated some way away from the transmitter are then used to obtain simultaneous data. Fig. 2 shows the situation with one receiving station looking at the transmitter beam. Any region of interest can be investigated by changing the elevation angle of the receiving aerial. By using three receiving sites in a "multistatic" C.W. configuration, three velocity components can be measured along the mirror direction (Fig. 2) from which the total speed and direction can be calculated.

Soon after the first attempt to see incoherently scattered signals in 1958, a monostatic pulsed radar was built at Jicamarca near Lima, Peru, and began observations in 1961. This was followed by other pulsed systems at Arecibo in Puerto Rico, Stanford, California and Millstone Hill, Massachusetts. Both Canada and the USSR had a station and in France the first C.W. radar was constructed, with a transmitter at St. Santin and a single receiving site at Nançay. In Great Britain, incoherent scatter experiments began in 1966 when a pulsed incoherent scatter system (or PUSCAT) was built at the Royal Radar Establishment, Malvern. This consists of a 150' diameter parabolic dish aerial pointing vertically upwards and a transmitter operating at 400.5 MHz with pulse lengths of 33, 67 or 200 μ s (corresponding

to height resolutions of 5, 10 or 30 km) at a peak power of up to 7 MW. This ran successfully for several years and is still used occasionally, but was superseded in 1971 by a multistatic continuous-wave experiment (or MISCAT) run jointly by personnel from R.R.E., the University College of Wales, Aberystwyth, and the Appleton Laboratory. In this system, the transmitting aerial is the same as for PUSCAT and the transmitter normally provides 40 kW of C.W. power. There are three receiving sites (see Fig. 3) at Aberystwyth, Wardle (the Mark III radio telescope of Jodrell Bank), and the Science Research Council's radio telescope at Chilbolton, Hants.

Because of the size and cost of incoherent scatter systems, there are still only a handful of them in operation in the world, as compared to the 100 or more short-wave ionosondes. However, the contribution made by incoherent scatter to our knowledge of the ionosphere is enormous because of the wide range of

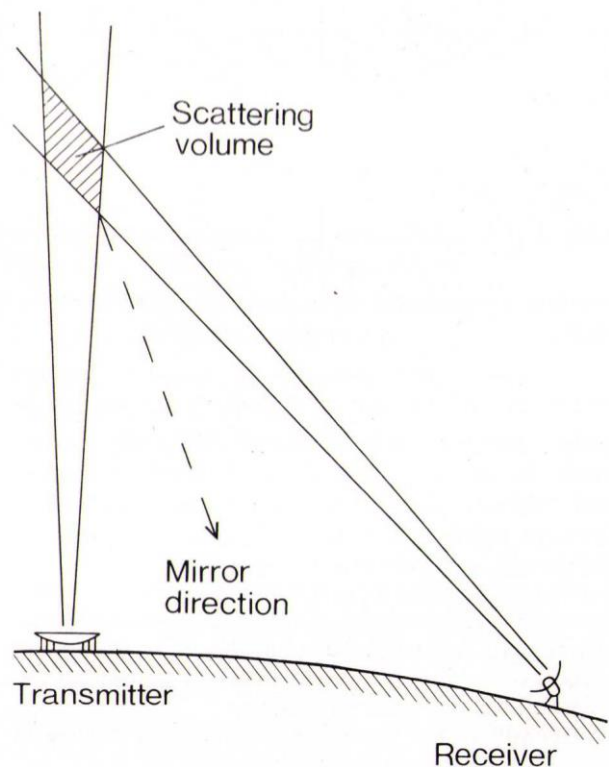


Fig 2

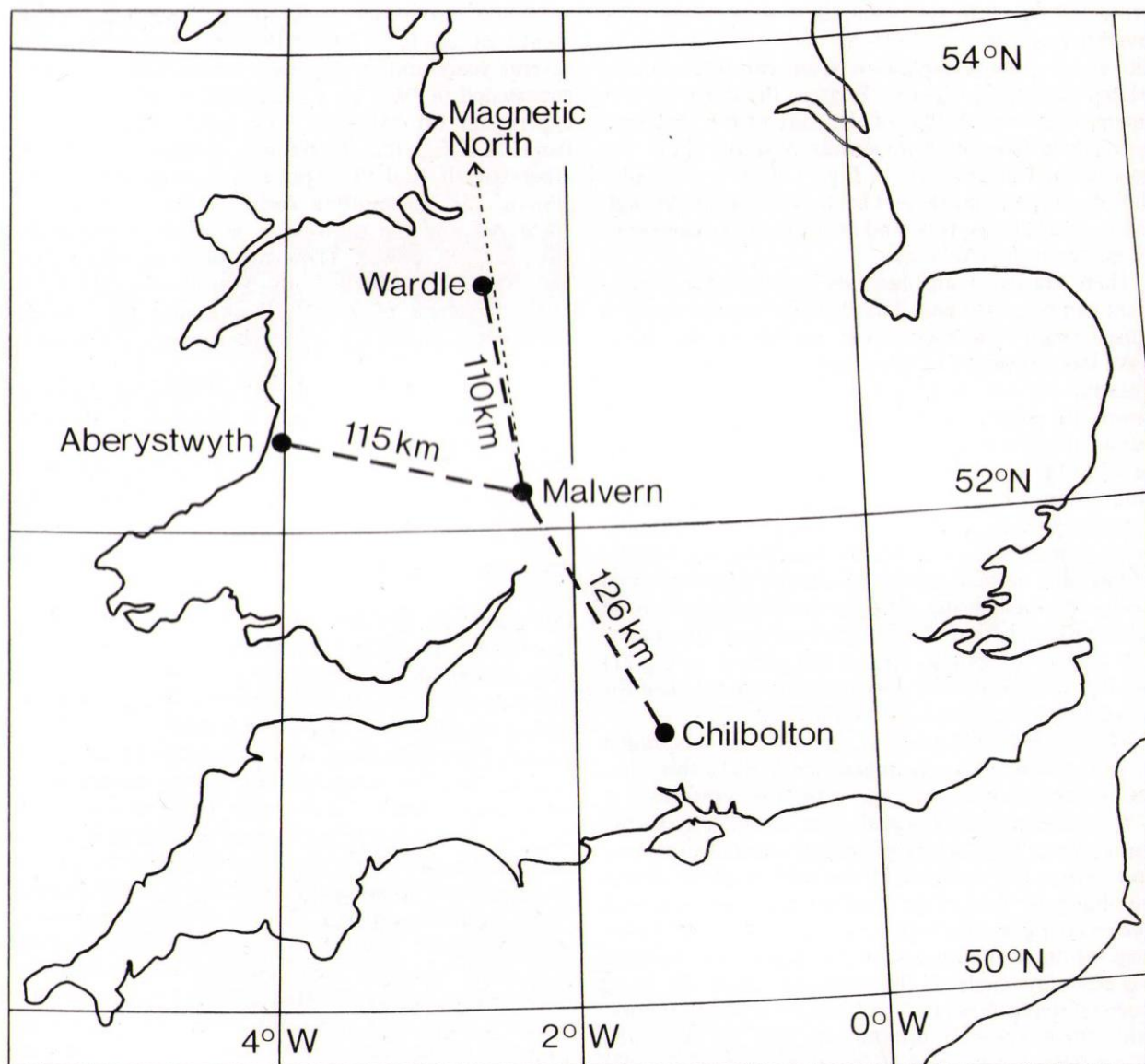


Fig 3

parameters that can be measured. Above the 100 km mark, the understanding of such processes as heating and cooling, winds and tides is becoming clearer from the incoherent scatter radar measurements and deductions can be made from these data about neutral atmosphere temperatures and winds. Calibration and cross-checking of rocket and satellite-borne experiments is also possible and better mathematical models of the ionosphere have been produced for use by scientists and radio engineers.

Recently it has been proposed that a European

incoherent scatter facility (or EISCAT) should be set up in northern Scandinavia. At present there is only one station in operation in the auroral zone (Chatanika, Alaska) and there is a need for more data in this region of the ionosphere and the overlying magnetosphere, where the phenomena are complex and hard to interpret. If it materialises, EISCAT should help to meet this need.

Peter McPherson is a Higher Scientific Officer in the Incoherent Scatter Group at the Appleton Laboratory.

Tercentenary of the Royal Greenwich Observatory

As our readers are aware (*Quest* vol 7 no 2) the Tercentenary of the founding of the Royal Greenwich Observatory is being celebrated in 1975. We are pleased to give details of the "Tercentenary Diary for 1975" which has just been published.

March Anniversary of King Charles II's Warrant appointing the Reverend Dr John Flamsteed first Astronomer Royal.

March 26 Opening of "300 Years of Astronomy" Exhibition in the Queen's House. This exhibition opens to the public on March 27 and remains open daily 10 am to 6 pm (Sundays 2.30 to 6 pm) until late 1975. Opening hours in November and December 10 am to 5 pm Mondays to Fridays, 10 am to 6 pm Saturdays, 2.30 to 6 pm Sundays. Admission free. Catalogue produced by *The Times* and edited by Colin Ronan.

April Issue of commemorative stamp by the Post Office.

Issue of commemorative medal by the Royal Mint. The Royal Mint is collaborating with the National Maritime Museum in the production of a special set of three 2½ inch medals using a common obverse and three different reverse designs. Limited gold and silver editions and an unlimited bronze edition are planned. The designer will be William Andrewes.

Issue of special film for European Architectural Heritage Year, made for the Department of the Environment by Graphic Films, and including the Old Royal Observatory.

May Inauguration of the new onion dome and 28-inch refractory telescope at the Old Royal Observatory.

June 22 Anniversary of King Charles II's Warrant establishing the Royal Observatory at Greenwich.

June 23-27 Special visits by invitation to the Royal Greenwich Observatory, Herstmonceux, for scientists and others with allied interests.



The Octagon Room, Flamsteed House, Old Royal Observatory, Greenwich

July 14-18 Special symposium "The Origins, Achievements and Influence of the Royal Observatory, Greenwich, 1675-1975" at the National Maritime Museum.

July 17 Reception given by the Royal Astronomical Society and the Royal Society.

Symposium at the Royal Greenwich Observatory, Herstmonceux.

Garden party at Herstmonceux Castle for delegates to symposia.

July-September Special programmes "300 Years of the Observatory" in the Planetarium, Old Royal Observatory, and also every Saturday.

Aug. 2-17 Open fortnight at Royal Greenwich Observatory, Herstmonceux. Certain domes and departments will be open to the public, including the Isaac Newton telescope, and there will be recorded commentaries on the work carried out with certain telescopes.

August 10 Anniversary of laying of foundation stone of Observatory (now Flamsteed House) by John Flamsteed in 1675.

Turkish delight

J C GILLING

For the past few years, Dennis Fogerty, a colleague of mine in the London Office, has taken a party overland to Turkey for a camping holiday. This summer the plan was to establish a base camp in Istanbul, and cruise in the Aegean and Mediterranean and I—who had never camped before let alone ever contemplated a five-day journey to Asia—decided to join the party together with my husband.

When we reached Istanbul, we set up our tents and basked in the sunshine while waiting to join our cruise liner. Here we had our first experience of Turkish hospitality when we visited a garage owner in an Istanbul suburb. Like the English, the Turks stop for tea at the slightest excuse, but the Turkish custom is rather different and tea is taken in a small glass without milk. A familiar sight throughout Turkey are the tea boys, who supply shops and offices, running to and fro with trays of small glasses of tea.

The following day we boarded the SS *Iskenderun* a Turkish maritime cruise liner. The *Iskenderun* was not just a cruise liner but also a ferry carrying cargo and passengers between the various ports of call—many of them difficult to reach by road. This constant changing of transit passengers made the voyage more enjoyable to the long-term cruisers as we were able to meet many interesting and friendly Turks.

Our first stop was Izmir. Although it is a large, modern port the town still retains all the old trappings of Smyrna (its ancient name). Here we took a horse-drawn carriage along the seafront to the bazaar and the mosque and then on past the ruins of the ancient Roman Agora towards Mount Pagos, topped by the Velvet Castle, and ancient fortress.

Fethiye, a delightful place with small houses huddled by the sea and the ancient Lycian Tombs set into the hillside, was our first port of call in the

Sultanahmet Camii, the Blue Mosque, Istanbul





A fisherman at the Galata Bridge, Istanbul selling freshly cooked fish sandwiches

Mediterranean. As we anchored small boys scrambled up the ropes of the ship and dived into the sea from the quayside.

It was at our next port, Antalya, one of the finest settings in the Mediterranean, sheltered by the Lycian Mountains in the West, that five of us decided to see something of the interior of Turkey. A day excursion was organised to Perge, the site of the ancient Pamphylian City now in ruins. After we had spent some time there reliving ancient times and absorbing the atmosphere, the coach took us on to Aspendos, the finest preserved Roman theatre in the world, which was fantastic. It is still used each June for special productions during the Antalya Festival. It was here, away from the coast, where the sun was reflected off the bleached white stone of this ancient theatre, that the temperature soared to well over 100 degrees Fahrenheit. Then on to Side, another old ruined city by the sea. On our journey inland we passed by fields of sunflowers, sweetcorn and cotton.

From Antalya we cruised steadily to Mersin—very steadily in fact—so much so that we wondered why we were sailing so slowly. Because we could not understand the Turkish news broadcasts we did not know that the Turkish troops had landed once more in Cyprus. The troop ships were leaving from Mersin and so our arrival there obviously had to be delayed.

Mersin is one of Turkey's largest ports and modern cities and yet it can trace its origin back 12 civilisations and so it still does not lose any of its Turkish atmosphere or traditions. There are some splendid gardens

bordering the seawall named after one of the famous Turks, Mustafa Kemal Attaturk. Together with some of our party and some Turkish students, we spent the evening at a very modern hotel dancing under the stars to international music as well as exciting Turkish rhythms.

The next morning the ship sailed on to Iskenderun which was our furthest port and very close to the Syrian border. It was here that the whale was said to have coughed up Jonah. The scenery here was magnificent. The port was surrounded by the Taurus Mountains, the sea was a gorgeous turquoise. The palm-tree-lined streets looked so quiet and horsedrawn taxis moved so slowly along them in the heat of the day. Everything looked peaceful and sleepy, even the traders in the colourful market went about their work steadily.

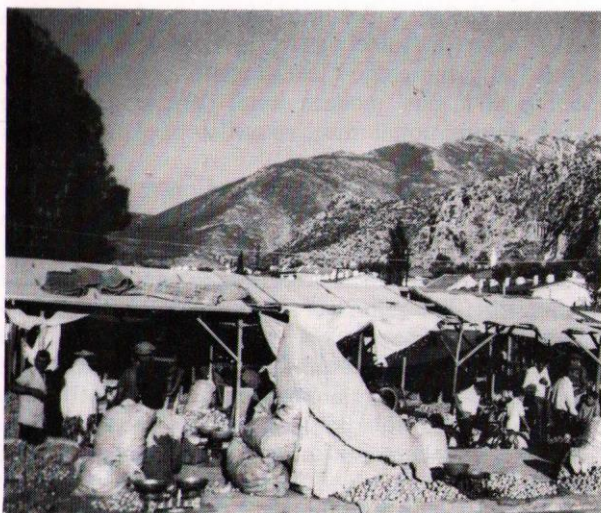
Alanya was our first return port and we spent some time exploring the ancient fortress, the castle and the Damlatas cave said to be famous for curing asthma.

However, our return to Antalya was very disappointing because we were told that we were not to leave the ship as we would be sailing at a moment's notice. But as it happened we did see quite a lot of the coastline and the quayside because we were just outside the harbour for the next 36 hours. After this delay, the captain was ordered to take his ship back to Istanbul as quickly as possible which meant that we could not stop at Marmaris, Bodrum and Kusadasi.

During the voyage into the Bosphorus from the Aegean Sea, we passed quite close to many Greek Islands and through binoculars the coastline and hotels could easily be seen on the Island of Rhodes. We cruised slowly through the Dardanelles so that we were able to see the monuments to the soldiers who took part in the landings in Gallipoli. Across the water from Gallipoli the ruins of the ancient city of Troy could easily be seen.

Back once again in Istanbul or Byzantium, or Constantinople—not only does this city have the distinction of having three names but it also links Europe to Asia and was formerly the capital of the Ottoman Empire. Although it is no longer the capital of Turkey it is a large, important port and the gateway into Asia and the East. The different cults, people, architecture and food give this city a fascinating atmosphere. It was interesting to see the bazaars, the dockside markets, the bustling ferryboats crossing the Golden Horn and the Bosphorus and the men selling their delicious, freshly-cooked fish and bread from their boats at the Galata Bridge.

A stay in Istanbul would not be complete without seeing Gulhane Park, Topkapi Palace and its gardens. Formerly, it was the home of the Ottoman Sultans, their harems and the famous jewels. Nearby is a more famous land mark—St Irene Museum and



A market area at Fethiye, Turkey

St Sophia, one of the world's most famous churches. St Sophia was originally built as a Christian church but in the fifteenth century it was converted into a mosque and in 1935 Attaturk, the founder of the Turkish republic, removed its religious character by transforming it into a museum. Across

the square is the avenue leading to the precincts of the magnificent Blue Mosque. In contrast to the massive bulk of St Sophia the Blue Mosque looks elegant and graceful with its six minarets and beautifully curved domes. This mosque of Sultan Ahmet was built during the years 1609–1619 and is known as the Blue Mosque because of the blue haze of mosaic tiles and the coloured windows.

Our last stop before the Turkish border was Edirne, the ancient Roman city of Hadrianopolis. This city was also an Ottoman capital for almost a century until Constantinople was captured. It used to be the centre of the country's traditional sport of wrestling. It was in Edirne that we came across our first Turkish bath. It is still in use to-day and in fact was being used the day we found it—much to the embarrassment of the local men who clutched their towels to them as three English ladies toured the establishment!

On this hot note our time in Turkey came to an end. Although we spent only 17 days there, we saw a lot of the country, met many wonderful people and ate and drank many delicious things. A return in the future is inevitable as there are so many more things to discover in this magnificent country.

Julia Gilling works in the Finance Division at London Office.

Newsfront

MASTER

John Birmingham, Peter Kent and Alex Bell.

MASTER stands for Minimax Algorithm teSTER. Designed and written jointly by Harwell and SRC Chilton, it incidentally plays a fair game of chess and recently competed in the first World Computer Chess Championship at Stockholm.

Most chess championships take place in an atmosphere of quiet tension but when computers compete it's more like a circus. The majority of the thirteen machines were linked through a variety of visual displays, teletypes and voice telephones (see photograph) which inevitably causes noise and confusion on top of which the audience, at either end of the links, can (and do) comment aloud, criticise and occasionally applaud.

There is, nevertheless, tension of a kind, particularly for the authors of the programs who must watch



From left Alex Bell, Geoff Lambert, Peter Kent, John Birmingham and John Waldron plotting their next move at the MASTER console

their creations make a sequence of good moves mixed with the occasional horrendous blunder.

The four round tournament was eventually won by the Russian program KAISSE. It won all its games,

beating two of the top American programs in the process and then drew in a friendly against another: CHESS 4.0—the previous champion. Mikhail Donskoy, KAISSE'S author, accepted the first prize on behalf of the program, a £500 gold medal donated by Robert Maxwell.

MASTER came fifth out of the thirteen which was encouraging because, at the time, it had played only five hours of chess and had never before played to tournament rules. According to these rules a dedicated program (like KAISSE) can spend up to six minutes on average for each of its first forty moves. In the tournament MASTER, which was sharing the IBM 360/195 at Chilton with other jobs, was averaging just over 30 seconds per move.

However, MASTER lost two games not because of fast play but because it still had bugs. The worst bug was that it rated a knight as worth only two pawns. It therefore played them well but neglected to protect them from pawn attack and, on one occasion in a game it actually won, scorned to capture one of its opponent's knights.

MASTER is essentially a test bed program to investigate techniques for searching large decision trees very quickly. It plays chess only because it is plugged into a legal move generator for that game. It then grows, searches and prunes a chess tree six moves into the future selecting a move on the basis of an evaluation function which is also plugged in. This evaluation function gives it "chess knowledge" eg a knight is really worth three pawns. In MASTER'S case the evaluation function is deliberately minimal, in fact its chess knowledge could be written on the back of an envelope. This is deliberate because the program must then derive its power mainly from the fast tree searching techniques, precisely the techniques that we are trying to investigate. Hopefully if these techniques prove successful then MASTER can be easily adapted to study other problems by plugging in other move generators and equally simple evaluation functions.

Without doubt the best way to test and improve such techniques is to take part in chess tournaments; to

put your program where your mouth is. Having found the knight bug the evaluation function was altered and MASTER then gave a demonstration at the Westfield Physics Exhibition. Reproduced below is the game MASTER played against a member of the Hampstead Chess Club, Mr T I Casswell, rated 153.

Because the program does not learn Casswell already knew how to beat it but, he wrote later, "it was my deliberate policy to adopt a critical and dangerous defence as I thought this would be more entertaining both for the spectators and myself although clearly, if one is out for a win against a computer, it is wiser to adopt a careful positional line and wait for the computer to make a weak move as it seems inclined to do at the later stages of a game".

The WILKES-BARRE line in the two knights defence is indeed one of the more violent variations in which black (Casswell) sacrifices a succession of pieces to obtain a quick mating attack. What really pleased us, however, was MASTER'S mating sequence; unusually elegant for a computer program. Nevertheless the program should have lost at move 10, Casswell overlooked a mate in four.

MASTER has about 300 book openings partly to avoid traps like the one set out on the right (the Wilkes-Barre trap is now in the book) and also to save time in the openings. The program is currently being rewritten to make it even faster, more robust, to have more book openings and, by necessity because it has thrown away a number of won games, more knowledge for end games.

Despite all these improvements it is very much the case of running hard to stay in the same place. The American reaction to the Russian win (and the subsequent crowing in the Soviet press) has been similar to the events following the launching of Sputnik in 1957. National prestige is now involved and American programs, which currently play at county level, are confidently expected to be approaching human master level by 1977 when the next World Championship takes place.

1 p-k4	p-k4	
2 n-kb3	n-qb3	
3 b-b4	n-b3	
4 n-n5	b-b4	
5 n*bp	b*p+	
6 k*b	n*p+	
7 k-k3	q-k2	
8 n*r	q-n4+	
9 k*n	p-q4+	
10 k*p?	p-k5+	black overlooks mate in 4
11 k*p	b-b4+	
12 k-b3	b-n5+	
13 k-b2	b*q	
14 b-kb7+	k-b1	
15 r*b	n-k4	
16 b-n3	n-n5+	
17 k-n1	p-kn3	and MASTER has weathered the storm
18 p-q4	q-r5	now to develop
19 r-b1+	k-n2	
20 p-r3	n-b3	
21 b-b4	r*n	
22 b-k5!	r-b1	black no longer decides how he loses
23 n-b3	p-b3	
24 r-b4	q-n4	
25 n-k4	q-r4	
26 n*n	q-k7	
27 n-k4+	k-r3	
28 r-r4+	q-r4	
29 r*q+	k*r	
30 r-kb1	r*r	
31 k*r	k-r3	
32 p-b3	k-r4	
33 b-b4	p-kr3	
34 n-b6+	k-r5	
35 p-n3+	k*p	
36 b-k6+	k-r7	and MASTER claims a win
37 n-n4+	k-r6/r8	
38 n-b2+	k-r7	
39 p-n4++		

It will be interesting to see if MASTER can earn its name also—maybe even become GRAND MASTER.

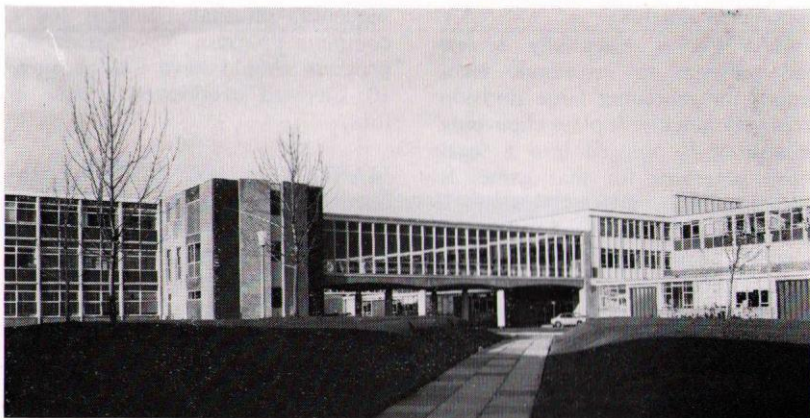
Rutherford's new library

Rutherford Laboratory has a new library which was officially opened on Tuesday 26 November by Dr T G Pickavance CBE the first Director of the Laboratory. Members of the Nuclear Physics Board who were holding a meeting at the Laboratory on that day were present at the short ceremony together with the present Director of the Laboratory, Dr G H Stafford, members of the management and invited guests. Prof W E Burcham, Chairman of the NP Board opened the ceremony. Having remarked that the opening of the Library was an added bonus, Prof Burcham spoke of Rutherford Laboratory and its first Director saying that the present size and shape of the Laboratory was due more to Dr Pickavance than any one man. He had been in at the birth of the Lab and, of course, Nimrod itself and had played a large part in building up the Laboratory. Later in the role of Director of Nuclear Research, Dr Pickavance had been the prime mover in UK participation in the CERN SPS project; he had "a profound influence on this". Prof Burcham concluded by saying "Gerry (Dr Pickavance) has always seen more clearly than most how things were developing... the Library was a necessity and Gerry had seen the need". The unveiling of a commemorative plaque was carried out by Dr Pickavance saying "I declare the Library open". Prof Burcham presented Dr Pickavance with a tray as a memento of the occasion and Mrs Pickavance with a bouquet of flowers.

The new library, designed as a 30 metre span bridge connecting Buildings R1 and R25, forms an attractive and yet functional focal point to its central location. The east facing wall of the bridge is formed of gold tinted double glazed solar control glazing units which together with low brightness light fittings and with natural colour rendering, used in the main library hall provides glare free lighting, helping considerably in creating the right kind of atmosphere.



Dr Gerry Pickavance declares the library open



The new library which is designed as a span bridge connecting buildings R1 and R25

In addition to the main library hall and connecting corridor from Buildings R1 to R25 the new three storey block anchoring the south end contains, on the ground floor storage room for library material and on the first floor the extension to the main hall containing reception desk, Librarian's office, general office and Xerox room. Accommodation is also provided on this floor for an area devoted to Micro Fiche and Micro Card Reader and five small study

rooms. The second floor of the block accommodates the ventilation plant room and when completed a fully equipped multi purpose conference room.

The library itself contains a vast amount of material including some 10 000 or so books, 40-50 000 reports, journals, all British Standards data manuals, general reference books, and many excellent services provided by the Librarian, Elizabeth Marsh and her staff.

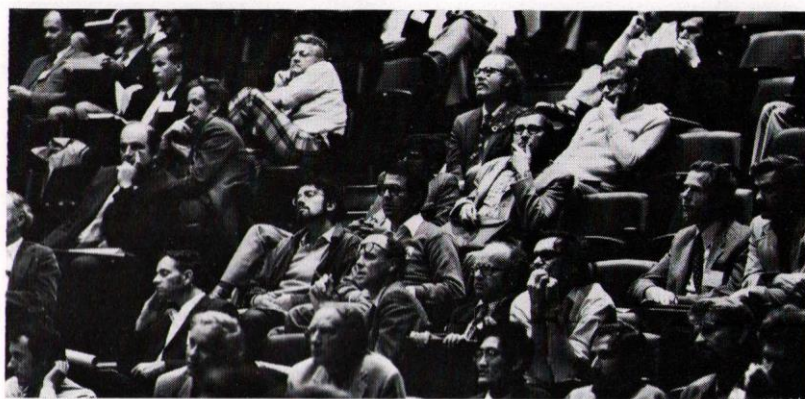
XVII International Conference on High Energy Physics

The XVII International Conference on High Energy Physics was held at the Imperial College of Science and Technology, London from 1–10 July 1974. The series originated at the University of Rochester, New York as an annual event but quickly changed to a biennial event held in Europe, Russia or the USA. This year for the first time the UK was the host country and the conference, sponsored by the International Union of Pure and Applied Physics and the Science Research Council was organised by the SRC's Rutherford Laboratory. Anyone interested in tracing the history of this conference series (to quote from the CERN Courier—"known affectionately as the Rochester Conference") will find a very enjoyable account entitled "The Rise of International Co-operation in High Energy Physics" by their founder, R E Marshak in the June 1970 issue of "Science and Public Affairs", the Bulletin of the Atomic Scientists.

Recent venues have been at Vienna 1968, Kiev 1970 and Chicago in 1972. In the 1960s these conferences were exciting events as, with the advent of higher energy accelerators fresh information became available on the behaviour of particles. For the next decade high energy physics had to get to grips with the abundance of new information which had become available with the many new theories produced. With the opening of new experimental facilities the Chicago Conference in 1972 produced a feeling of excitement and anticipation of new discoveries. Although the ideas that have been upset in the intervening two years were largely unforeseen the discoveries certainly justified the anticipation.

So it was with considerable interest that about 800 participants from over 40 countries, arrived in London last summer. Many were accompanied by their wives and families adding about 160 to the total to be accommodated in London at the height of the holiday season and providing a number of problems for the organisers, both of the Conference programme and of the social activities.

The columns of *Quest* are not the



A study in concentration—delegates at the Rochester Conference

place to discuss in detail the many and varied subjects discussed especially as the Conference Report, all 800 pages or so, is to be published shortly. Something like 1000 papers were submitted of which about 10% were finally accepted.

The main interest centred on the recent surprising results from the ISR (Intersecting Storage Rings) at CERN which revealed that the total proton-proton cross-section rises with energy; evidence that weak neutral currents exist, soon confirmed by counter experiments at FNAL (Fermi National Accelerator Laboratory) and the results of experiments at the Stanford electron-positron storage ring SPEAR which upset some deeply held beliefs on the $e^+e^- \rightarrow \text{hadrons}$ reaction.

On the social side, eighteen excursions including visits to Windsor Castle, Kew Gardens, a famous brewery and an Elizabethan Evening were organised ending with a private viewing of the Royal Academy's Summer Exhibition. This event marked the end of the 1974 Conference leaving some delegates, no doubt, wondering what surprises the next two years held in store and what the major talking point would be when they met again in Russia in 1976 for the XVIII Rochester Conference.

The CERN Courier ended its report on the Conference with the following prediction "There will either be excitement among physicists at a discovery of great importance or a number of professionally

despondent but inebriated physicists" and that seems as good a way as any to end this brief report.

Nutcracker 15

Angle $\alpha = 50^\circ$; J Clemmow, London Office wins a £2 book token.

Nutcracker 16

The East Swindon Women's Institute is a remarkably well-informed body, at least about its own members. On a recent visit, I was able to learn 10 facts about them in as many minutes:

1. All those who embroider also make jam.
2. All the Committee are over 50.
3. Only women with black hair are beekeepers.
4. Only those who are graduates were not born in Wiltshire.
5. No left-handed member makes jam.
6. Only embroiderers have blue eyes.
7. All the members with black hair are divorced.
8. All those born in Wiltshire are beekeepers.
9. Only members with blue eyes are graduates.
10. All members over 50 are left-handed.

What can you deduce about the marital status of committee members?

For answer turn to page 24.

A rewarding suggestion

We are always being told that one way to beat inflation is to improve efficiency. Mr B (Brian) J Smith did just that and was rewarded on Election Day, 11 October, with a cheque for £75. The award, approved by the Rutherford and Atlas Laboratories Local Suggestions Awards Committee, was presented to Brian, a skilled craftsman in the Nimrod Engineering Department by Ron Russell, the Department's Deputy Head.

Brian's suggestion was for a flip-up scintillator. The prototype has successfully completed its trials and is now in use on the X3 beam line. Scintillators are used to locate the position of the proton beam from the accelerator in relation to the target and also to check the tuning of the beam by looking at the size of the spot shown on the scintillator. As the scintillator is directly in front of the target and constantly in the path of the beam, it deteriorates with time making further beam detection difficult; overcoming this problem involves moving the mounting table and disturbing the set-up. The alternative of changing the scintillator requires the beam being shut down and entry into a region at high radiation level causing further problems.

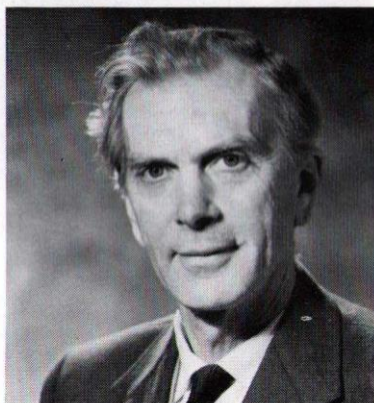
The flip-up scintillator, remotely controlled from Nimrod's Main Control Room, is only in the beam path when required for lining up, thereby prolonging its life, reducing the radiation exposure to personnel, and saving money estimated at £300 in the first year. It is easily replaceable being located by a spring clip, when old targets are renewed, the removal of these old targets greatly reducing the radiation levels.

Like all the best ideas, it is simple. Alec Goode, the Chairman of the Awards Committee in congratulating Brian on his achievement, spoke of the value of such large awards in encouraging other people in their efforts.

Mr M O Robins

Mr Robins, Director of ASR and Science Divisions has been appointed a Visiting Professor in the Department of Physics and Astronomy at University College, London.

Nobel prize winners



Nobel Prize Winner—Professor Sir Martin Ryle

All members of the Council's staff will wish to congratulate the Astronomer Royal, Professor Sir Martin Ryle and his colleague from Cambridge University's distinguished radio astronomy group Professor Antony Hewish, on being awarded the 1974 Nobel Prize in Physics for their pioneering research in radio physics. Sir Martin receives his share

of the award for his observations and inventions in particular of the aperture synthesis technique and Professor Hewish for his decisive role in the discovery of pulsars. Sir Martin is currently Chairman of the RGO Committee and a member of the Astronomy Space and Radio Board and Professor Hewish is a member of the ROE Committee.



Ron Russell (left) presenting cheque to Brian Smith

Long-boat fails in attempt to fall 50 ft into the River Weaver

George Holland

We started half an hour late in totally alien weather as the sun was shining brilliantly! By noon it was raining. This time on the placid waters of the "Bridgewater," and "Trent and Mersey" canals from industrial Runcorn through the pastoral countryside of Cheshire to salt-soaked Northwich in the sixty-year old 70 feet long narrow boat "Lapwing".

"Lapwing" was commanded by Peter Shrubshall, who was also guide, barman, deckhand and entertainer all in one. The helmsman, Charlie, was a 70-year-old born to the canals and who could neither read nor write. Our journey took us through the Dutton tunnel, 1300 yards long, to the new Preston Brook Marina for refuelling. During this pause we took the opportunity to see the collection of old vehicles being reconditioned by our host's company.

On once more through the rain to Saltersford tunnel which, because of its s-bends meant one had to take a chance on meeting anyone coming the other way. Peter explained to us the canal code; Engine gives way to horse, pleasure gives way to commercial and the most import-



Lapwing enters the Saltersford tunnel



Brockhole, an exhibition centre set in beautiful gardens bordering onto Lake Windermere, was the destination of a full coach party of members of the Daresbury Laboratory Sports and Social Association

One fine September morning they toured the exhibition which describes the geology, flora and fauna of the area and afterwards had a two hour cruise on Lake Windermere

Picture shows the happy party during one of their scheduled stops

Picture: Gordon Foster



In October in keeping with the modern passion for nostalgia the Daresbury Sports and Social Association organised a trip to the Severn Valley Steam Railway at Bridgenorth. The party boarded the noon train for the thirteen mile trip to Bewdley, a journey of one hour. The steam locomotive used (for the benefit of train enthusiasts) was a 5-4-6-0 class 2 pulling Great Western Railway coaches. At Bewdley the engine was uncoupled to change ends for the return trip. Back at Bridgenorth the party roamed round the workshops and inspected the engines being renovated. A typical example was the Britannia No 7000 which was built at Crewe in 1950 and was used on the Scotland to London route. This engine may be back in service by 1976

Picture shows the party during the journey

Our thanks to Fred Farrimond for the report and Gordon Foster for the photograph

ant: smaller gives way to larger. If all these fail one relies on a superior nautical vocabulary. Our call to heaven was answered and we passed safely on into the rain and to the third and final tunnel at Barnton. Towards the exit we observed a very bright light coming towards us where upon some of the more religious element protected us with the Sailors' Hymn. The holiday-maker gentleman chickened out and reversed from the tunnel to let us pass.

We had now reached the highlight

of our journey: to descend some 50 feet vertically into the River Weaver using the 99 year old Anderton Lift. Do you believe in "Murphy's Law"? We do. The lift operators, due to go on strike on the following Monday, appeared also to have a ban on overtime. However we were not downhearted over a mere detail and whilst Arthur Pickett kindly agreed to venture into Northwich to find the coach to take us back to Runcorn, Peter completed our day by opening the bar with free drinks all round.

American Astronaut visits the Appleton Laboratory

Dr Owen Garriott, 43 year old American astronaut, recently visited the Appleton Laboratory in Ditton Park. One of the second 3-man crew to occupy Skylab in 1973, he spoke to the staff about his 59 days in space.

Dr Garriott—a native of Enid, Oklahoma—is no stranger to Ditton Park. In 1961 he spent six months at the Radio Research Station (now the Appleton Laboratory), on leave of absence from Stanford University, California. During his visit he joined in the Station's research work on the ionosphere—the layer in the upper atmosphere that reflects radio waves and makes possible long distance radio communications. He also joined in lunchtime games of cricket and made many friends at the Station.

In 1965 Dr Garriott left his post as an electrical engineering professor at Stanford University and joined NASA as a trainee astronaut. Keeping up his scientific interests, he published in 1969 a textbook on the ionosphere. This book was an Anglo-American project, its other author being Dr Henry Rishbeth, a member of the staff at Ditton Park.

After eight years of training, Dr Garriott's turn for a space mission came in 1973. He was launched from Cape Kennedy in July. After docking with the orbiting Skylab, his crew had to extend the "parasol" that had been erected by the first crew two months earlier. The "parasol" reduced the high temperatures inside Skylab, that had resulted from accidental damage sustained by the spacecraft at its original launching.

Dr Garriott's main work in space consisted of observations of the sun. With a battery of film and TV cameras, and specialized instruments, the Skylab crews made completely new discoveries about the violent "storms" which take place on the sun. The radiation produced by these "storms" influences the earth's upper atmosphere; it disturbs the ionosphere—and so upsets radio communications—and causes vivid displays of aurora or "northern lights" in high latitudes. Part of the Appleton Laboratory's research programme is concerned with these phenomena. Dr Garriott also helped



Dr John Saxton, Director of the Appleton Laboratory (right) welcomes American astronaut Dr Owen Garriott

to look after Arabella and Anita, the spiders that successfully spun webs in space and the minnows that swam round in circles when exposed to weightlessness.

Weightlessness did not worry Dr Garriott. Apart from bouts of motion sickness in the first two days in orbit, the crew were in excellent physical shape. Their good condition was attributed to their daily hour of hard exercise taken on specially-designed machines and they felt no ill effects on returning to earth. Dr Garriott made use of weightless conditions to carry out a series of demonstrations of basic scientific principles. He found it easier to demonstrate Newton's Laws of Motion (propounded in the seventeenth century) in Skylab, than on earth where gravity complicates matters. One of his films, demonstrating the basic principles of rotation, received its first-ever showing at the Appleton Laboratory.

Life aloft was so busy that Dr Garriott had little time to look out of Skylab's window. But he did want to get a good photo of Great Britain. He waited a long time for a suitable day but eventually took a superb picture showing most of England and Wales. And Skylab has been seen by thousands of Britons, thanks to the accurate predictions of its

orbit, made at Ditton Park and published in the Press.

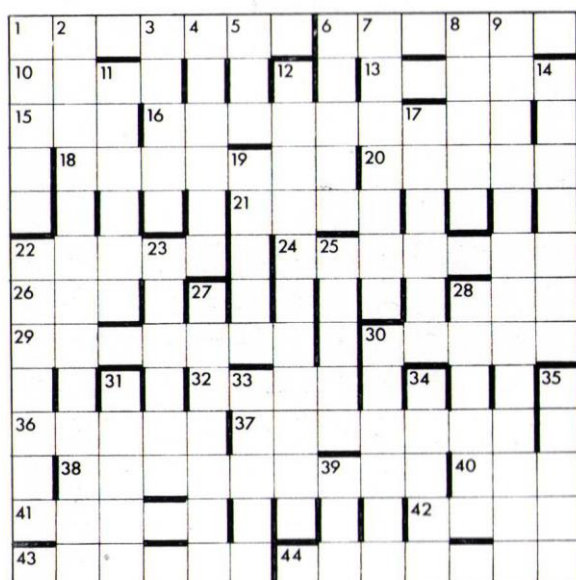
After visiting Ditton Park, Dr Garriott spent some days at the Farnborough Air Show as the representative of President Ford. The previous week he and his wife had attended a conference in a remote part of Russia. Now he is back at Houston, Texas. In his new NASA job of Acting Director, Science and Applications, he is busy with past results and future plans in the US Space Programme.

Topkapi Safari

Dennis Fogerty will be organising a three week trip to the Balkans and Turkey in August '75. It will be a tour for the adventurous—overland all the way from London, through Hungary and Rumania to Istanbul. If you can stand the sun, have a liking for the unusual and approximately one hundred pounds there may be a place for you. For further information write or ring: TOPKAPI SAFARI, East Finchley, London N.2. Telephone: 01-833 0915.

Nutcracker 16

All the Committee are divorced.



MAXIM 7

This is a 'Theme and Variations' Puzzle.

The theme word is clued at 4 down, and the 4 variations are labelled A, B, C and D.

CLUES:

ACROSS

1. Composer's note belies composition (7).
6. Sensation you'll create if you fall off mountains backwards—be quiet, now! (6).
10. Christian name found in episcopal annotations (4).
13. Feature of committee-designed horses: thus decapitated the member involved (5).
15. Licensed to hire out (3).
16. Ingredients of a neat, tidy meal provided at Ye Olde Cafe (6, 3).
18. What belongs to us locked up? Be brave! (7).
20. As the church pursues an error... (5).
21. ...decree is in process of being retracted (4).
22. Stellar, ie star-containing constellation (5).
24. and 7 down: Variation A (2 words).
26. Sounds ill after making mistake (3).
28. Boozer recalled by Miranda (3).
29. Variation B.
30. Digs for old pennies (5).
32. A lake, if lake-ish, produces corrosion (4).

36. A configuration that is heaps better (5).
37. Unfair, eg, in West Africa, holding back a developing country (7).
38. and 9 down: Variation C (4 words).
40. A quaternary qualification that's a definite plus (3).
41. Peaceful demonstration. There's something wrong about it (3-2).
42. One-nothing produces a change in colour (4).
43. Gears rough starting? Make smooth with this (6).
44. A reputedly happy sunbather, and in the south, son! (7).

DOWN

1. Who's opponent of beer in Duke's Head and King's Head? (5).
2. Applied physics Prof's job could be fatal (8, 5).
3. The flower of effortless hard work (5).
4. Council's advisers can be so drab (6).
5. Lived in Israel in Old Testament times (3).
6. Places that sound as if they go with sounds (5).
7. See 24 across.
8. Change when you start work and when you finish (5).
9. See 38 across.
11. A cat in charge denotes small-scale activities (6).
12. Variation D.

14. Middle name of poet (T S is up and is at work) (7).
17. A director in charge of the cash register? (6).
19. "Colonist 99"—there's a caper! (5).
22. Helps, like the girl over things that get crossed (7).
23. Free exercise after sending me back to former spouse (6).
25. Practising posh chant (5).
27. Cages in birds (7).
28. One upset migrant to 33 from Greece (6).
30. He asked to see a penny—a new penny that is, sir (6).
31. Used in heats what could give less speed in final (5).
33. A rhyme that's positively attractive (5).
34. Nymph who doesn't drink, taking notice (5).
35. Buddleia's centre visible in May as in March (5).
39. What a duck produces—sounds like time to change the bowler (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 Maxim 6

Across	Down
1. Ceramic	1. Cos
4. Ideas	2. Ash
8. Opts	3. Carlos
11. Hand	4. Invent
12. Sash	5. End
14. Pervade	6. Avenue
16. Tail	7. Spit
18. Learnt	9. Payee
20. Herstmonceux	10. Spite
22. Reapers	11. Helm
23. Trier	13. Strap
25. Upper	17. Aspect
28. Ammonia	15. Shrub
31. Biochemistry	19. Across
33. Slater	21. X-rays
34. Else	24. Inter
35. Fissile	26. Pilfer
37. Urns	27. Rhesus
39. Dual	28. Aerial
40. Pest	29. Miler
41. Press	30. Irons
42. Loosely	32. Mell
	33. Step
	36. Ice
	37. Ups
	38. Sty

G Kerr, Royal Observatory Edinburgh, wins a £2 record token.

