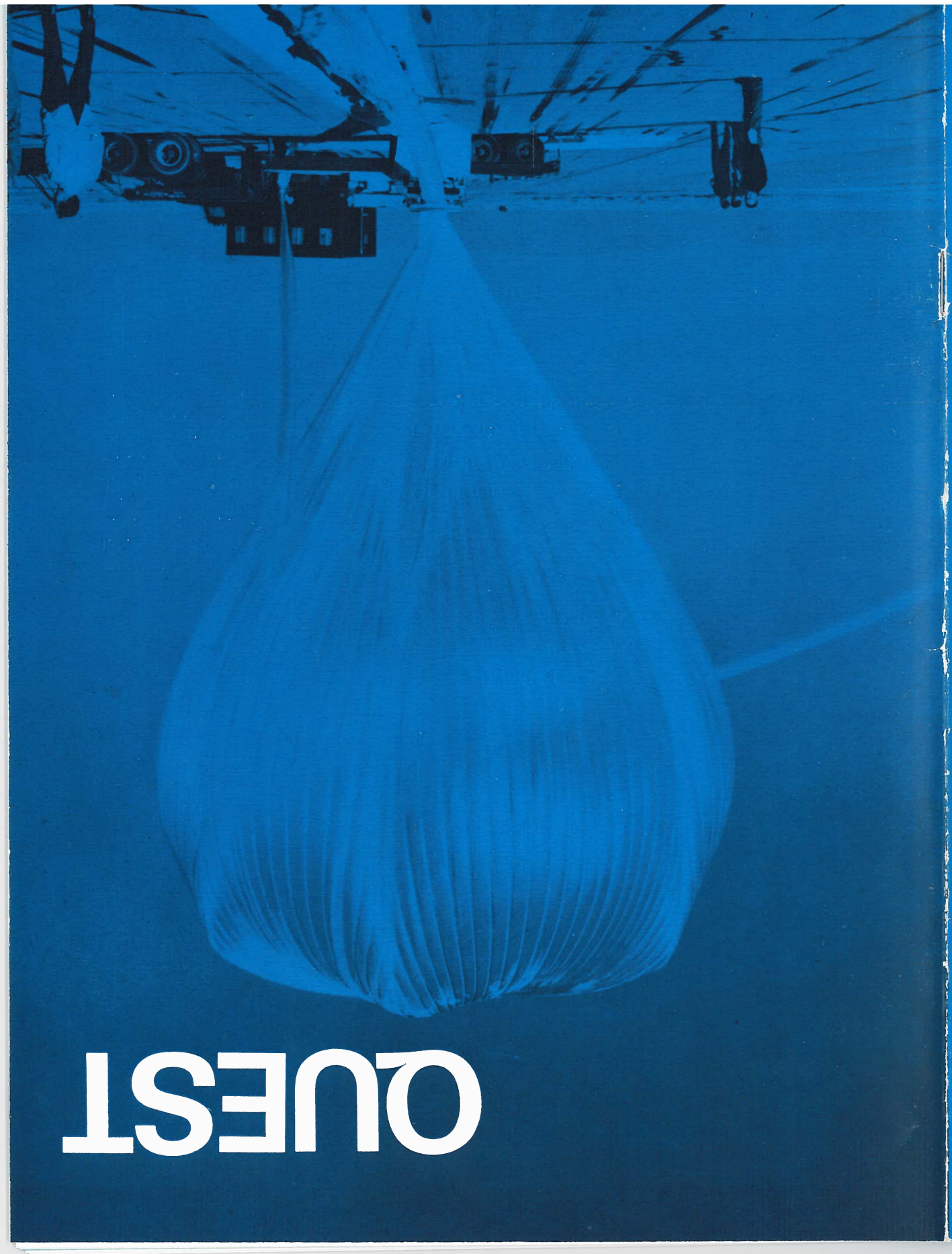

QUEST

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QUEST

House Journal of the Science Research Council

Vol. 5 No. 1
January 1972

contents

'Way up in the air in my beautiful balloon'

Cover picture: *a large helium filled balloon carrying scientific experiments which was flown in August 1971 from New Mexico. The launch is described in* **'Iter ad Astra'** *on page 7. The experiments included a solar spectrograph prepared by Queen's University, Belfast and the Astrophysics Research Unit, Culham.*

Published by the Science Research Council, State House, High Holborn, London, W.C.1. Set in Univers and printed by Wells KPL Swindon Press, Swindon, Wiltshire.

QUEST

To begin our fifth year of publication this issue of *Quest* has a supplement on Space Research carried out in the Science Research Council. As nearly every establishment is mentioned it looks as if most of us get involved in one way or another. Thanks are due to the Astrophysics Research Unit in particular who provided much of the material.

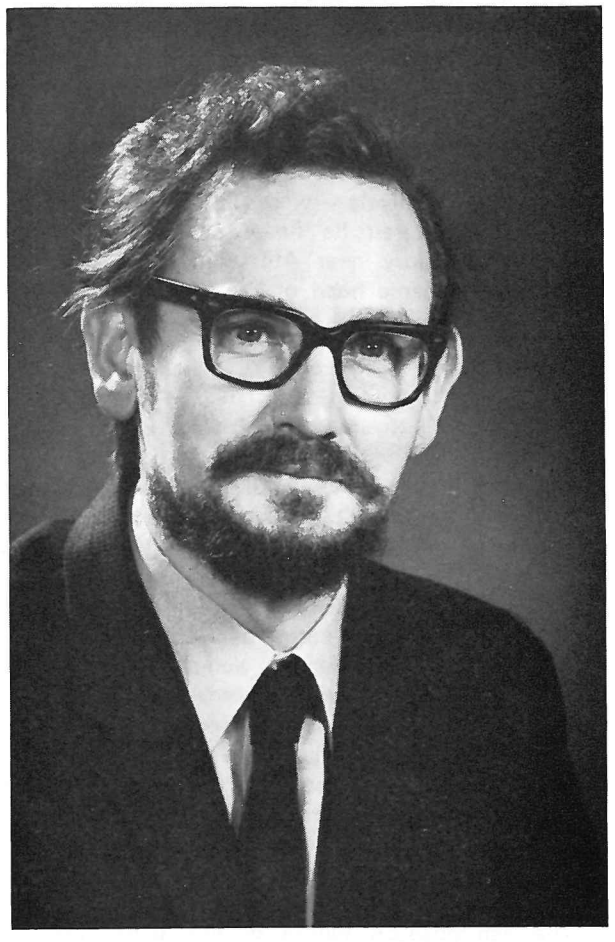
The idea behind the supplement is to bring different aspects together. For the April issue we will be collecting news and pictures of the technology that supports the research programmes and in July the subject will be SRC's present and future projects in Europe. We look forward to receiving contributions from you – in the form of articles, illustrations and suggestions – on the special topics and others.

We sign off with a wish for a prosperous year to everyone in SRC and no less to those who seek our support.

profile

Dr. Robert Wilson

Head of Astrophysics Research Unit



Since this issue of *Quest* is especially concerned with Space Science, it is appropriate to profile Dr. Wilson who heads the Astrophysics Research Unit of the Science Research Council. Although the ARU is the smallest and most recently formed of the SRC laboratories, it has already achieved an international reputation for its work in the field of space and laboratory astrophysics. Dr. Wilson's own scientific interests are directly reflected by this work which is aimed at understanding the physics of the sun and other stars and also the interstellar medium. This is done by using two complementary techniques: direct observations from space vehicles and laboratory measurements on high temperature ionised gas (plasma), which can simulate astrophysical conditions.

Coming originally from Northumberland, Bob Wilson graduated in physics at Newcastle University and then moved to Scotland to carry out post-graduate research work in astrophysics at the Royal Observatory, Edinburgh. Soon after his arrival in Edinburgh, a remarkable natural phenomenon occurred. One afternoon, the sun appeared to be coloured a deep blue and during that night a proverbial 'blue moon' was seen. Some rapid work with the ROE 36 inch Cassegrain telescope produced spectroscopic observations of the very unusual 'blue sun' phenomenon and these led to his first scientific publication. He showed that the blue colour of the sun was caused by selective scattering of the sunlight by small particles in the atmosphere; the particles had come from the smoke of forest fires burning in Canada several days before!

The research topic which occupied most of his time at the Royal Observatory concerned the nature of several diffuse absorption lines which are produced in stellar spectra by some component of the interstellar medium. This presented similar problems to the 'blue sun' investigation since both involve the theory of light scattering by small particles. While working at the ROE, he was awarded a PhD degree by the University of Edinburgh for astrophysics research and he also met his future wife, Eileen.

In 1957 he was granted leave to take a Canadian National Research Council Fellowship which gave him the chance to work at the Dominion Astrophysical Observatory in Victoria, near Vancouver in British Columbia, Canada. While at Victoria, he continued his research on the diffuse interstellar absorp-

tion features and showed that they were probably caused by the small solid particles in interstellar space – the same interstellar dust that produces a red colouration in the light from distant stars.

When Dr. Wilson returned to England in 1959, his new appointment meant a change in his scientific interests. He joined the Controlled Thermonuclear Reactions Division at the Atomic Energy Research Establishment, Harwell, and was soon put in charge of the Spectroscopy Group. This group was mainly concerned with measuring the properties of the high temperature ionised gas which was produced in experimental devices used to study the problems of controlling thermonuclear fusion reactions. Although this work was in many ways different from his earlier astrophysical research, the techniques involved – measurement of physical conditions by spectroscopic analysis – were quite similar. In 1960 the UKAEA centred its fusion programme on the Culham Laboratory near Abingdon, Berkshire, and Dr. Wilson became head of the Spectroscopy Division.

the sun seen from a skylark

Having developed several methods for the measurement of very high temperature by studying extreme ultraviolet emission from hot plasma sources, Dr. Wilson and his colleagues became interested in the possibility of using similar techniques to study the high temperature atmosphere of the sun – the solar corona. Using the sun-stabilised *Skylark* rocket as a vehicle to carry spectroscopic instruments above the absorbing layers of the earth's atmosphere, the Culham group first recorded the extreme ultraviolet spectrum of the solar corona in 1964. Since that time, many more rocket payloads have been prepared. Flown at a rate of about two a year they have provided data for an active solar physics investigation.

The astrophysical nature of this work was not directly relevant to the UKAEA fusion programme but it was closely related to the work of the SRC Astronomy, Space and Radio Board. Consequently, the astrophysics research work was transferred from the UKAEA to the SRC and by 1969 most of the staff in the Culham Spectroscopy Division had been transferred to SRC to form the new Astrophysics Research Unit at Culham. As head of this new unit, Dr. Wilson has extended the original solar physics programme and it now includes further studies in ultraviolet astronomy and laboratory astrophysics.

In addition to his work in astrophysics research and in the management of the ARU, Dr. Wilson has played an active part in more general SRC management as a member of the Space Policy and Grants Committee and of the Astrophysics Policy and Grants Committee of the ASR Board. He was also the first chairman of the SRC Panel on Instrumentation for Large Optical Telescopes (PILOT) and a member of the committee set up by SRC to review the future programme of astronomy in the southern hemisphere.

studies in ultra-violet

Since 1964 Dr. Wilson has been concerned with several proposals for observatory-type satellites designed to make astronomical observations at ultraviolet wavelengths. He was responsible for the scientific aspects of two detailed design studies – the Large Astronomical Satellite (LAS) and the Ultraviolet Astronomical Satellite (UVAS) – which were carried out for ESRO, the European Space Research Organisation. The UVAS proposal was examined by NASA in the USA, and they suggested that the proposed UVAS concept could be developed as the main experiment for a new Small Astronomical Satellite designated SAS-D. A UK project team headed by Dr. Wilson is now working on the design of an ultraviolet detector system for SAS-D which has been planned as a collaborative USA-UK satellite experiment in which ESRO will probably be involved. Th UK team working on this experiment includes staff from ARU, RSRS and University College London.

Another ultraviolet satellite experiment, which was initiated by the Royal Observatory, Edinburgh in collaboration with l'Institut d'Astrophysique, Liège, will be launched in 1972 on the ESRO satellite TD 1. This experiment (S-68) has been prepared under the guidance of a SRC project management group which is led by Dr. Wilson and includes teams based at ROE and RHEL, with additional support from the Atlas Computer Laboratory and the ARU – surely a record for collaboration between SRC laboratories.

The ARU has developed active links with several universities and Dr. Wilson holds an honorary post as a Visiting Professor at University College, London. He is a Fellow of the Institute of Physics and a Fellow of the Royal Astronomical Society. He served on the Council of the RAS from 1965 to 1967. An active member of the International Astronomical Union he was elected President, from 1967-1970, of the IAU Commission 44 which is concerned with Space Astronomy.

The many activities outlined above take up a large part of Bob Wilson's life, but whenever possible he spends his leisure at his home in Abingdon with his wife and family – two sons and a daughter – and such leisure moments are all too few.

obituary

Professor Sir Ronald Nyholm FRS

Ron, who had helped us in DSIR or SRC for many years, died in a road accident on 4 December. It seems particularly hard to realise this has happened, because Ron's outstanding feature was life. A delightful, ebullient Australian, bursting with irreverent good humour, he must have given pleasure to everyone who knew him, for one reason or another.

He was certainly a good chemist, with 250 research papers and an FRS to his credit. He set high standards for himself and everyone else. One of his chief enthusiasms in life was chemistry, and it was quite clear that to him this was a subject of unending fascination, enjoyment, and excitement. He was a real leader as head of the Chemistry Department of University College London, where his tremendous urge to see it lively and growing, maintained the international repute which the Department had under his predecessor, Ingold.

But he had energy and enthusiasm for fields much wider than his own Department or College. He was always ready to help the new universities and the ex-CATS to build up their schools of research and teaching to high standards. Only a couple of days before, I met him at the Open University where, as their first external examiner in chemistry, he was excited by the success of this new venture – and incidentally he had three new funny stories.

He was a fervent DSIR/SRC fan, largely I think because he saw how the Research Councils could strengthen the unity of science, as well as helping the outstanding individuals, especially the up and coming ones. He once proposed that SRC should create some 'DSIR Memorial Fellowships' for outstanding young chemists.

And that of course gives the clue to Ron's success. The most important thing in the world to him, more so even than chemistry, were people; his own colleagues, who, like he, had 'arrived'; youngsters, whether able or not; and perhaps most of all, people who needed help. Ron enjoyed himself most of all when helping them or sharing their thoughts and ideas, and their fun. Ron is the sort of person who will always be alive in one's memory.

C Jolliffe

biographical note

Sir Ronald Nyholm FRS, FRIC was born at Broken Hill, New South Wales, in 1917. He went to Sydney University (BSc first class honours) then London (MSc-DSc) and for the rest of his life held appointments both here and at home. In the 1950's he became President of the Royal Society of New South Wales (1954) and a Corresponding Member of the Finnish Chemical Society, a Fellow of the Royal Society and a Fellow of the Royal Australian Chemical Institute. In the 1960's he became a Member of the Science Research Council, President of the Association for Science Education and a Trustee of the British Museum.

Sir Ronald's association with the University of London culminated in his appointment as Head of the Chemistry Department of University College, a post he held since 1963.

£1M A YEAR FOR ATOMS MOLECULES AND PLASMAS ++ BEST DATA YET FROM SKYLARK SPACE FROBE IN SOLAR ULTRA-VIOLET SPECTRUM ++ SYMPOSIUM ON ELECTRON AND PHOTO INTERACT ++ £59,000 HARDWARE FOR MULTI ACCESS COMPUTER SYSTEM ++ BRITISH EXPERIMENT IN ORI ING SOLAR OBSERVATORY [illegible]-G ++ FIRST LUNAR SAMPLES FOR BRITAIN ARRIVE AT SRC ++ [illegible] FOR SRC GI FOR CONTROL ENGINEERING RESEARCH ++ ANGLO-AUSTRALIAN TELESCOPE CONSIDERABLE CONTI BUTION TOWARDS SCIENTIFIC DISCOVERY ++ RSRS PARTICIPATES IN UK4 SATELLITE TO MEA INTENSITIES OF ELECTROMAGNETIC RADIATION ++ DEVELOPMENT IN ANALYSIS OF BUBBLE CH BER PHOTOGRAPHS BY SWEEPNIK AIDED BY SRC GRANT OF £40,473 ++ SUCCESSFUL LAUNCH O

council commentary

september

As in previous years a weekend meeting was held at the end of September with representatives of the Boards and senior staff from the London Office. This year's meeting was in Edinburgh and participants stayed in Mylne's Court, a 17th century building in the Royal Mile, recently restored and now used as a hall of residence.

The Council discussed several aspects of postgraduate education and training at the Conference and in particular how support should be related to the numbers wishing to undertake postgraduate study and the likely opportunities for employment. This is important at a time when the opportunities for careers in research are decreasing, and there is a greater need for training for non-R and D type employment. As a result of the discussion, Boards have

been asked to carry out detailed reviews of the need for postgraduate training in their areas and to advise Council on how these requirements can be met.

Council also discussed whether in future more time should be devoted to keeping under review the consequences of its policies and the activities it supports, both in the scientific and social context.

october

In October the Council prepared the detailed estimates for 1972–73 for submission to the Department of Education and Science. These will be incorporated into the Estimates of Government Expenditure presented to Parliament in March 1972, and subsequently published. The Council's allocation for 1972–73 is close to that requested in the Forward Look submitted in April, but provisional allocations for the two later years are about £400k and £1.8m less than the Forward Look bid; these imply growth rates falling to 2% pa.

The expenditure approved at this meeting included £80,000 for purchase of a special magnet for the NINA electroproduction programme. The present electroproduction facility at the Daresbury Laboratory, which consists of two small solid-angle magnetic spectrometers, has enabled the Laboratory to make a significant contribution in this subject, and the new magnet will improve the data-collecting rate by almost two orders of magnitude. Amongst the grants approved for space experiments, was a supplementary award of £60,000 to University College London for preparation of three x-ray experiments to be flown in NASA satellites. Two of the experiments will be flown in the OSO–J satellite (OSO stands for Orbiting Solar Observatory) and will study point x-ray sources and the diffuse background emission, and one in HEAO–C (High Energy Astronomy Observatory) aimed at increasing angular resolution of x-ray sources.

The Council went on to discuss the staff structure in SRC and, in particular, the recent mergers of staff classes following the report of the Fulton Committee. With the agreement of the Staff Side and the appropriate staff associations, the Council has effected the same mergers as the Civil Service; the administrative executive and clerical classes have become the administration group, and the scientific officer, experimental and scientific assistant classes form the science group. The Council's policy is to continue to work towards a completely unified staff structure, but meanwhile to advance within the framework of the Civil Service arrangements.

rewarding thoughts

november

The Council agreed the financial guidelines that should be given to Boards for preparation of the 1973–78 Forward Look; Boards are required to make their submissions to Council next April so that the Council-wide Forward Look can be submitted to the Department of Education and Science at the end of April. The guidelines given to the Boards, which vary according to the present policy and priorities, are in line with the provisional allocations for the Council for 1973–74 and 1974–75, and assume a 4% pa growth rate for later years.

At the Edinburgh Conference the Council agreed to keep the number of studentships for 1972 at the 1971 level of 3850 and this decision was confirmed at the November meeting. Within the total of 3850, the Council decided on the number of awards to be made for the special schemes (such as CAPS and ASSISTS) and the quotas to Boards. The balance between research and advanced course studentships and between science and engineering was kept the same as for last year.

The Council went on to review the 'Bring-back' Fellowship scheme, which was introduced originally to counteract the 'brain drain' to North America and to benefit British industry by attracting back scientists and engineers who had gained valuable experience of advanced American industries. It is now known that the 'brain-drain' was mainly in engineers whereas the Fellowship scheme has attracted mostly scientists and very few engineers. The flow of Fellows into industry and teaching has been disappointing and the increasing level of unemployment both in the UK and the US throws into question whether the scheme should be continued. The Council decided that the scheme in its present form should be abolished, but agreed that the SRC Higher Value Fellowship scheme should be expanded to ensure that outstanding scientists and engineers could gain experience overseas and bring this experience back to the UK.

We have told how £100 was awarded under the Rutherford Laboratory Suggestions Scheme for an idea which solved a problem and resulted in a financial saving *(Quest, October 1970).*

For others keen to 'cash in' with their own original ideas, there is now a Suggestions Award Scheme for the whole of the Science Research Council *(see General Notice 58/71).* The scheme will be run by local committees who will have powers to look at ideas in the light of the benefit to their establishment and to make awards of up to £100.

A central co-ordinating committee at London Office, chaired by the Establishment Officer, with members from local committees, will determine general policy. it will also review suggestions in the light of their possible value to other establishments or to the Council as a whole.

The scheme gives a right of appeal to anyone who has reason to believe that his idea has been turned down without proper consideration of all the relevant factors. He can also re-apply for an award if an idea of his has not been taken up or rewarded and is then adopted, unchanged, within three years from the date he first put it forward.

Whenever possible the awards will be related to the anticipated savings in gross man hours and materials costs only and will be related to 50% of the estimated value of the savings in the first year. Otherwise lump sums will be assessed on criteria which apply in the particular case. Awards will be paid in multiples of £5 and the minimum award will be £5 for ideas of minor but significant value. An award can be made even if the suggestion is not actually put into practice. Putting forward ideas which have merit but are not considered worthy of an award, may gain a mention in one's personal file.

Ideas invited
are those likely to:

promote greater safety and reduce health hazards;

increase efficiency and improve morale;

encourage economy in the use of time and materials;

develop or modify devices or techniques used in SRC or lead to the invention of new ones;

improve or simplify procedures (including office procedures and forms);

lead to new designs of, or improvements to existing tools, machines or equipment; modify or improve layout and use of buildings and services;

Suggestions made will be assessed on their practical value and need not be complex or technical in content to merit the highest awards. They may be related to one's own work but should not be such that one would have been expected to put forward or implement as a normal responsibility of the job.

We hope the Suggestion Awards Scheme will give people an incentive to look at work methods with a new eye and improve ways and means – even if they fail to come up with an award winning suggestion at once.

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Send your piece to your local correspondent or to:
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London Office
(room 1521 ext 255)

SEND COPY by **February 26** for the April issue (featuring Technology) and before **May 1** for the July issue (featuring SRC in Europe)

two way match

How to match the vertical needs of the future with the horizontal activities of the present is the very difficult job of the Research Councils, the Chairman said when he addressed the press conference on the Science Research Council's sixth annual report, for 1970-71.

Mentioning the Dainton report, which was not yet published, he said that the current review of Government organisation of research and development was a matter of great importance. Science was organised in two ways – vertically and horizontally. By vertical organisation he meant the use of science to meet national or major objects such as, say, better health, transport or communications. By horizontal he meant the necessity to look at the whole range of science activity from astronomy to production engineering, from biology to meteorology in a horizontal way, subject by subject. He felt that the most difficult job was to match the horizontal to the vertical: to match academic science to the needs of the nation, bearing in mind that the prime object of academic science was to produce people with the right training and experience to meet vertical needs fifteen years later when they were at the peak of their ability.

In 1970-71, he said, the SRC had spent £51 million in support of basic research and education. About £9½ million was in the form of direct support to universities for research grants (for equipment and staff) and about £6 million was for post-graduate training awards and fellowships.

During the year SRC had accelerated its studies of the organisation of science in other European countries and its preparations for more national cooperation. This would become a major preoccupation for some years if we joined the Common Market.

Also present to address the conference and answer questions were the Chairmen of the four Boards: Professor Ford (Engineering), Dr. Eastwood (Astronomy, Space and Radio), Professor Gunn (Nuclear Physics) and Professor Kornberg (Science). Space activities were represented by Professor Sheppard, a Member of the Council, Chemistry by Professor Lewis of the Chemistry Committee and Physics by Professor Edwards, Chairman of the Physics Committee.

Why SRC is getting together with MRC was enlarged on by Professor Kornberg, taking his own subject, biochemistry, as an example. Professor Ford was asked to say more about the total technology concept. Professor Lewis talked about how one assessed the right numbers of studentships in the field of chemistry and Professor Edwards spoke about the special section of the Report on 'Research in Physics'.

more bytes

A bigger and better Computer just installed at the Rutherford Laboratory will be a great asset to the University and SRC groups who are the main users of the Laboratory's services.

The new computer, an IBM System/360 model 195, is six times as powerful as the model 75 which it replaces and cost about £3M. The Laboratory's Computer and Automation Division (under W. Walkinshaw) are particularly proud of the fact that they had it installed, accepted and working on-line in only fifteen days.

The central processor of the model 195 has a capacity of 2 megabytes, and is supported by a block multiplexor and a fast access fixed head file. Early this year the installation will be fitted with a disk store of 800 megabytes and high speed tape units. In 1973 it will be converted to a System/370 model 195.

Among the first users of the 195 will be the film analysis groups from Birmingham, Glasgow, Durham and Oxford and theoreticians from most of the university high energy physics groups. Atlas users have not yet been identified but are expected to come mostly from chemistry, plasma physics and astrophysics.

"We started in a small way with one hundred and fifty people and now we employ twenty."

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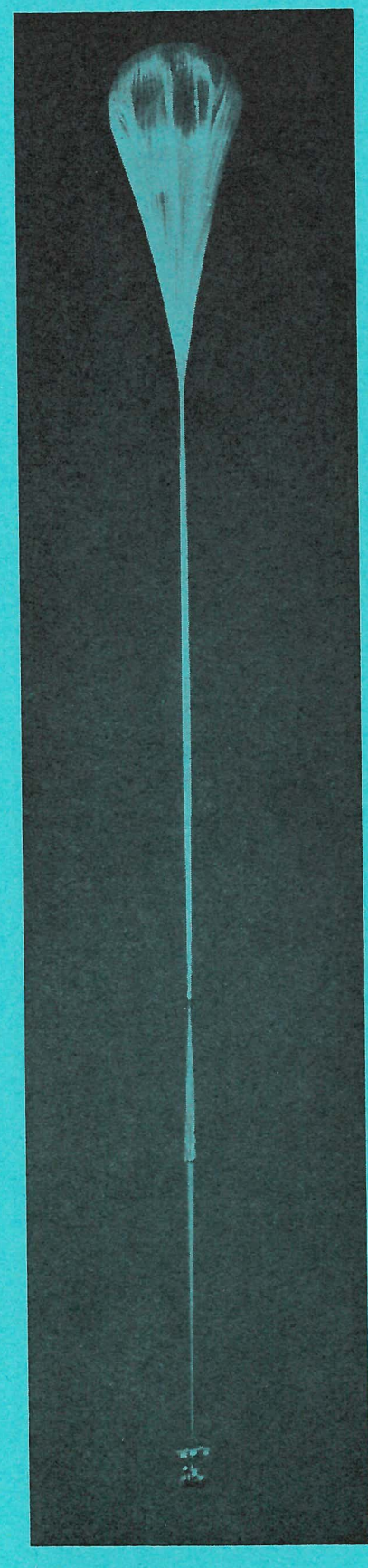


QUEST IN SPACE

Supplement on Space Research in the Science Research Council

1 iter ad astra

solar experiments launched by balloon in New Mexico

G. W. Ackland

'Iter ad astra' (Road to the Stars) is the motto emblazoned on the badge of the High Altitude Balloon Detachment of the United States Air Force stationed at the Holloman Air Force Base, located on the flat plain between the Organ and Sacramento Mountain ranges in New Mexico.

For the small group of men huddled on a dark, cold and windy runway on the aerodrome at half past four one morning early in August this year it was not thoughts of the stars that were of interest, although they were clearly visible, but rather the possibility of a long look at the Sun from nearly outside the Earth's atmosphere. For this was to be the culmination of nearly two year's co-operative effort by groups from the Physics Department of the Queen's University Belfast, from the Optical Physics Section of the United States Air Force Laboratory at Cambridge, Massachusetts, from the Meteorological Office at Bracknell and from the Astrophysics Research Unit of the Science Research Council.

It was hoped, by means of a large helium filled balloon, to carry a scientific package to a height of about twenty four miles and at the same time to point it – with great accuracy – at a particular part of the Sun's surface. By carrying the instruments above the atmospheric ozone layer it is possible to extend the observable ultra-violet solar spectrum to include the wavelength region near 2790Å. The objects of the experiments were threefold and apart from a brief statement of their scientific aims it is not intended, here, to go into any technical detail. Readers who want to know more may be interested in the full reports that will be published at a later date.

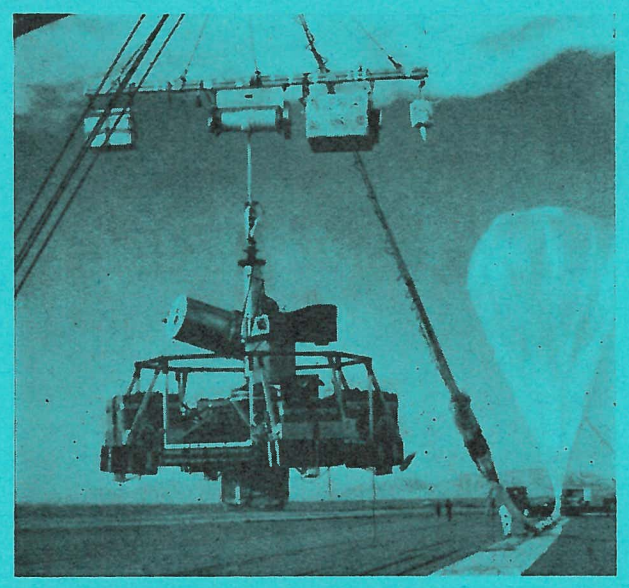
The main experiment was to record – by means of a high resolution spectrograph designed and built by the Astrophysics Research Unit and Queen's University – the profile of the Mg II doublet at 2795.5Å and 2802.7Å, with simultaneous spatial

Iter ad astra continued

resolution across the solar disk of a few seconds of arc. The second experiment, using photometers designed by Air Force Cambridge, was to measure the distribution of minute particles of matter in the atmosphere, by measuring the sky radiation near the Sun. Finally, using apparatus supplied by the Meteorological Office, the third experiment was to measure the distribution of ozone at various heights.

In addition to the scientific apparatus, a considerable amount of ancilliary equipment was to be carried in a gondola suspended below the experimental package. This included telemetry transmitters to relay information and data to the ground control station, command receivers to enable the experiments and some of the balloon functions to be controlled remotely, tape recorders to receive some of the experimental data, batteries to supply the power, and so on. The total weight was just over half a ton. To lift this to a height of more than twenty miles a balloon with a volume of 10.6 million cubic feet was required. To hold this volume of gas, imagine a sheet of plastic (actually Mylar), only .0007in. thick – about a quarter of the thickness of a human hair – but large enough to cover completely three full sized football pitches – cut, shaped and welded together to form a sphere nearly three hundred feet in diameter and itself weighing nearly half a ton.

Now imagine aiming a rifle at an old fashioned penny a mile away. This is approximately the accuracy required to point the spectrograph at the Sun. To do it there are two aiming systems, one coarse and one fine, riding piggy back on each other. The coarse system, provided by the balloon pointing equipment, can only aim at the equivalent of a six foot high man a mile away (about five minutes of arc). This accuracy is sufficient for the Meteorological Office sensor and also for the USAF photometers and they can be bolted directly to the pointer shaft. The finer pointing (about five seconds of arc), required by the spectrograph, is achieved by means of a servo controlled mirror system. These units were originally developed by the Astrophysics Research Unit for use in payloads carried on the *Skylark* sounding rockets and have been flown, with considerable success, on fifteen rocket launchings at the Woomera Range in South Australia. Only minor mechanical changes were needed to make the unit suitable for use on this balloon experiment.



the launch – by US Air Force

Preparation of the balloon and the whole of the launching operation is carried out by a skilled team of about thirty American Air Force personnel. The balloon is uncrated and laid out on a wide canvas strip down the centre of the airfield runway and the recovery parachute is attached to the bottom end of it. This is for lowering the payload gently (?) to the ground at the end of the mission when an explosive cutter will be fired, by radio command, to sever the connecting cable. The parachute shroud lines are attached to a triangular yoke locked into a quick release mechanism at the end of the jib of a twenty ton mobile crane and the payload with its gondola is suspended from this yoke about eight feet from the ground.

Checkout of all the onboard equipment starts at about half past four in the morning under the light of floodlights and continues until the Sun rises over the Sacramento Mountains (fifteen miles away) at a quarter past six. Final checks of the pointing equipment are completed and it is aimed at and 'locked on' the Sun. (Apart from a few seconds during the actual launch it remained 'locked on' for the whole of the eight hour flight.) The payload is now clear for flight.

Up to this point in time it is still possible to cancel the operation though it would not be a popular decision – imagine the problems of re-packing half a ton of balloon back into its box! However, as soon as the payload status is 'GO' and the Met men are satisfied that the weather conditions are 'GO' and the surface winds are 'GO' and everything else is 'GO' the point of no return is reached. The order to fill the balloon is given.

For safety reasons helium is the gas used rather than very much cheaper, more efficient and more dangerous hydrogen. Only just enough is used to lift the balloon and gondola, plus a carefully determined margin. This margin is influenced by a number of factors such as time of year and ground and high altitude air temperatures. While the balloon is still on the ground this amount of gas is sufficient to fill only a small part of its volume, but as it rises through the atmosphere the helium expands, in the lessening atmospheric pressure, until it fills the whole sphere.

The actual launch procedure is, in principle, very simple. The balloon is released from its trailer and as it rises the crane is driven underneath it so that at the critical moment the payload with its gondola is gently picked up from the end of the crane jib and carried smoothly into the sky. So much for theory – in practice it is more than a little hair raising, to say the least, and takes a five man team to do it with split second timing and judgement. The signal to release the balloon is given and with a roar the huge envelope rises majestically into the air. With an even bigger roar the crane moves off, accelerating rapidly in a cloud of blue smoke. The payload and gondola hanging from its jib swings and sways, buffeting violently from side to side until it seems certain that something will either fall off or batter itself to destruction against the crane jib. Suddenly everything is quiet and still and the balloon gently picks the load off the end of the crane jib and carries it smoothly into the sky. A perfect launch!

To the men of the Holloman Balloon unit it was probably just another successful operation but to the group of men now standing in the warm early morning sun (it is now half past seven) it was the start of a very successful experiment and an example of international co-operation designed to further man's knowledge of the universe and the world in which we live.

The photographs for this article and the cover were provided by the Culham Laboratory Photographic Section using the author's 35mm colour transparencies.

Far left is the payload gondola and inflated balloon ready for launch and on previous page the balloon and payload soon after launch Overall length is 420 feet.
Cover picture shows the balloon before launching.

2 x-ray astronomy

the astronomer and the space age

J B Alexander

The advent of high-altitude rockets, artificial satellites and space probes has given the astronomer new techniques of investigation. Spectacular advances in the study of the Moon and the Planets have been made possible by their close examination from space vehicles of various kinds. Although there is no hope in the foreseeable future of sending space probes outside the solar system to other stars, the space age has opened new frontiers in the study of stars and galaxies because it is now possible to observe without the restrictions imposed by the presence of the earth's atmosphere.

Most of our present knowledge of the universe has been derived from ground-based observations made at those wavelengths of the electromagnetic spectrum to which the atmosphere is relatively transparent. It is very important that observations can now be made from space in regions of the spectrum where the atmosphere is essentially opaque. Even at wavelengths where observations from the surface of the earth are feasible, the presence of air between the telescope and the astronomical object being observed is a great nuisance. The resolution of large ground-based optical telescopes is limited by temperature inhomogeneities in the earth's atmosphere, and this is one of the main reasons why such instruments are usually placed on mountain sites above some of the layers of air which cause optical turbulence. The resolution of a telescope out in space is not limited in the same way, and it should become possible to discover double stars which are not resolved with even the largest telescopes on the earth.

Observations of astronomical objects from balloons, rockets and artificial satellites have yielded considerable information about the infra-red, ultra-violet and x-ray regions which cannot be observed from the ground. Although still in their infancy, the branches of astronomy opened up by the new techniques have already made significant contributions to our knowledge of the universe. As an example, we shall consider some aspects of x-ray astronomy.

Although x-rays from the Sun were detected several years ago, it is only during the last ten years that the first extra-solar source was discovered. There are now several discrete x-ray sources known. Investigations in the x-ray region alone are of considerable interest, but much more progress can be made if the object which emits the x-rays can also be identified at optical wavelengths. Unfortunately, very few such identifications have been made yet: this is because the positions of most x-ray sources are known to an accuracy of no better than a minute of arc or so. This state of affairs will improve when more accurate positions are available.

From the few cases where the optical identification of an object in the direction of the x-ray source seems well established, it is clear that the x-ray sources are far from being a homogeneous group of

x-ray astronomy continued

objects. X-rays have been observed from both the Crab Nebula itself and from the pulsar within it. (These two objects are believed to be the remnants of a supernova, a star which exploded in 1054 AD and was recorded in ancient Chinese records). It is also claimed that x-rays have been observed from the peculiar galaxy M87 which is also a strong radio source. The mechanism by which x-rays are emitted also probably differs from object to object. In some cases, the emission is probably caused by the synchrotron process whilst in other sources bremsstrahlung emission in a hot gas appears more likely.

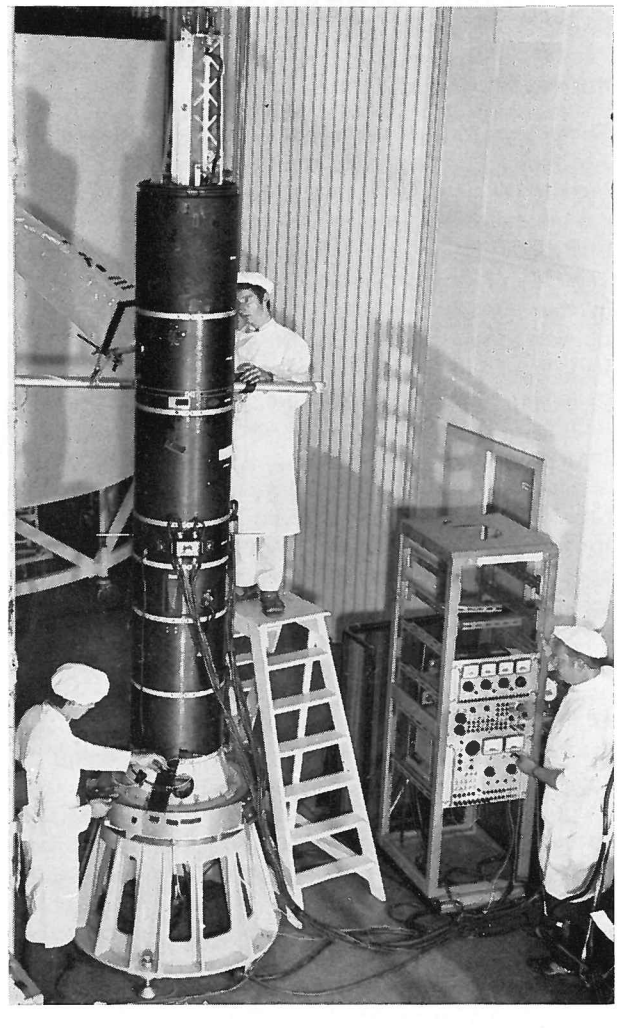
It is very desirable to obtain more accurate positions of x-ray sources so that further optical identifications can be made. A method which can be used in certain parts of the sky is that of lunar occultations. If the Moon in its monthly orbit around the Earth passes in front of a star, the radiation from that star will rapidly decrease to zero as soon as the star is in line with the limb of the Moon. (See the article 'Time, The Moon, The Stars and Man' by Leslie Morrison in *Quest* Vol. 4, No. 3.) Suppose that an x-ray source is occulted by the Moon and the time of the sudden disappearance of the x-ray emission is accurately recorded. Then it is known that at this time the x-ray source is somewhere on the limb of the Moon, and that a line from the x-ray source to the x-ray detector is tangential to the surface of the Moon. From a knowledge of the motion of the Moon, it is then possible to say that the x-ray source is situated somewhere on a curve in the sky corresponding to the profile of the limb of the Moon as viewed from the x-ray detector at the time of the occultation. If two distinct occultations of the same source are observed, it is then possible to say that the x-ray source lies at the intersection of the two curves which are derived separately for each occultation. In this way, a unique position accurate to within a second of arc or so can be obtained.

the GX3+1 experiment

A group from Leicester University led by Dr. K. A. Pounds have recently been very successful in recording an occultation by the Moon of the x-ray source known as GX3 + 1. This project was financed by the SRC. Although the idea of the experiment was first envisaged as recently as December 1970, it was possible to arrange for the detecting equipment to be launched from Woomera in a *Skylark* rocket only nine months later, on September 27, 1971. The relevant data on the Moon's position were calculated by Leslie Morrison, who works in the Nautical Almanac Office. As a result of the measurement of this occultation, it was known that the position of GX3 + 1 lay somewhere on a narrow strip of sky. A second occultation of the same source on October 24, 1971 was recorded successfully by a group from the Mullard Space Science Laboratory of University College London under Professor A. P. Willmore (also using equipment launched on a *Skylark* rocket from Woomera). From these two occultation measurements, an accurate position of the source is now available. At optical wavelengths a star likely to be associated with the x-ray source has been found in the appropriate position on photographic plates.

John Alexander is a senior scientific officer at RGO. At present he is working on problems in stellar spectroscopy and photometry especially those pertaining to the abundance of the elements. He is also RGO's local correspondent for Quest.

The picture shows the GX3+1 experiment being assembled at the British Aircraft Corporation's Filton works by a Leicester Experimenter (up the ladder) helped by BAC staff.



3 space on atlas

Barbara Stokoe

It all started in 1963. But we never realised what was going to hit us!

Those were the early days of the Atlas Laboratory. We had no machine – not even a building; but we were laying the foundations of what was to come. A small nucleus of people, temporarily housed in the Rutherford Laboratory, we had the dedicated purpose of starting up what was to become a major computing laboratory. Buildings, machines, software were our goals – and their potential users. Partly with the latter in mind, we held a one-day symposium to which many people interested in space research were invited, and many papers were given on the problems which they were then considering. Little happened for some time after that, apart from a small number of jobs which were used to try out the software on our embryo machine, now in Ferranti's factory at West Gorton, Manchester. The author looked after these jobs, with the result that all future 'space' jobs tended to come to her.

In the early days of the international collaborative programme with the United States, the satellites UK1 and UK2 were produced – to be re-christened Ariel 1 and Ariel 2 on their successful launches. None of the data processing for these satellites was performed at Atlas, and not much attention was paid to this side of the experiment – with the result that AWRE Aldermaston received an SOS to do something with all the data from Ariel 2 about two weeks *after* the launch! Which they nobly did, with many very fair comments about inadequate notice. As a result, when UK3 was planned much more note was taken of the data processing requirement, and Van Raalte of AWRE was involved at the early design stages.

There are 3 basic parts in the processing of UK3: (a) digitisation (performed at RSRS); (b) preliminary checking (performed at AWRE); and (c) separation of results (performed at Atlas). It was agreed that AWRE would do the considerable amount of programming involved in the project – with considerable help and advice from Atlas on (c).

Everything remained quiet for a while until about February 1967 when testing started on the Atlas work. Due to staff shortage, AWRE decided to use staff from their Foulness station to do the programming, and a large amount of effort was needed to keep the four programmers there happy – all married women who obviously did not want to come and spend any time at Chilton. They also did not have any experience of Atlas or its very powerful operating system or facilities. But with good-will on all sides progress was made, and shortly after launch in May 1967, we were able to give the experimenters some results. Then there was a short breathing space of a few months while modifications were made to the digitiser at RSRS.

In November, we were in business again at full production; starting at about three hours a week, and increasing over the years to a peak of ten hours. In addition to this, the experimenters themselves particularly Sheffield University, carried out much of their subsequent work at Atlas. They were willing to use our facilities to maximum advantage, including our brand new microfilm plotter, which enabled them to make sophisticated use of their results. Taken over-all, this has been a highly successful project, and is now just about completed.

Future work in store in this field includes UK4 (which we hope will be successfully launched by the time this appears) and the S68 experiment on the ESRO TD1A satellite.

For UK4, RSRS have replaced the role which AWRE filled in UK3; and much of the programming itself has been done at Atlas. Production is planned on our brand new ICL 1906A computer, now in the final stages of commissioning. This has of course created problems, since much of the testing has had to be done on other machines. Things are further complicated by having aboard a US experiment, from the University of Iowa, with the consequent difficulty of communications. We expect to use at least ten hours of 1906A time per week on this project.

We have taken over the processing for S68 from Edinburgh Regional Computing Centre. TD1A is planned for launch in February 1972. We plan to do the production work on the neighbouring RHEL 360/195, on which the Atlas Laboratory are entitled to 20% of the time for use on non-nuclear-physics work. Two members of staff are now working full-time on the programming of this project and we expect to take up a large amount of our 195 share with S68 – an hour a week may be the end result.

And so from small beginnings . . .

4 SAS-D

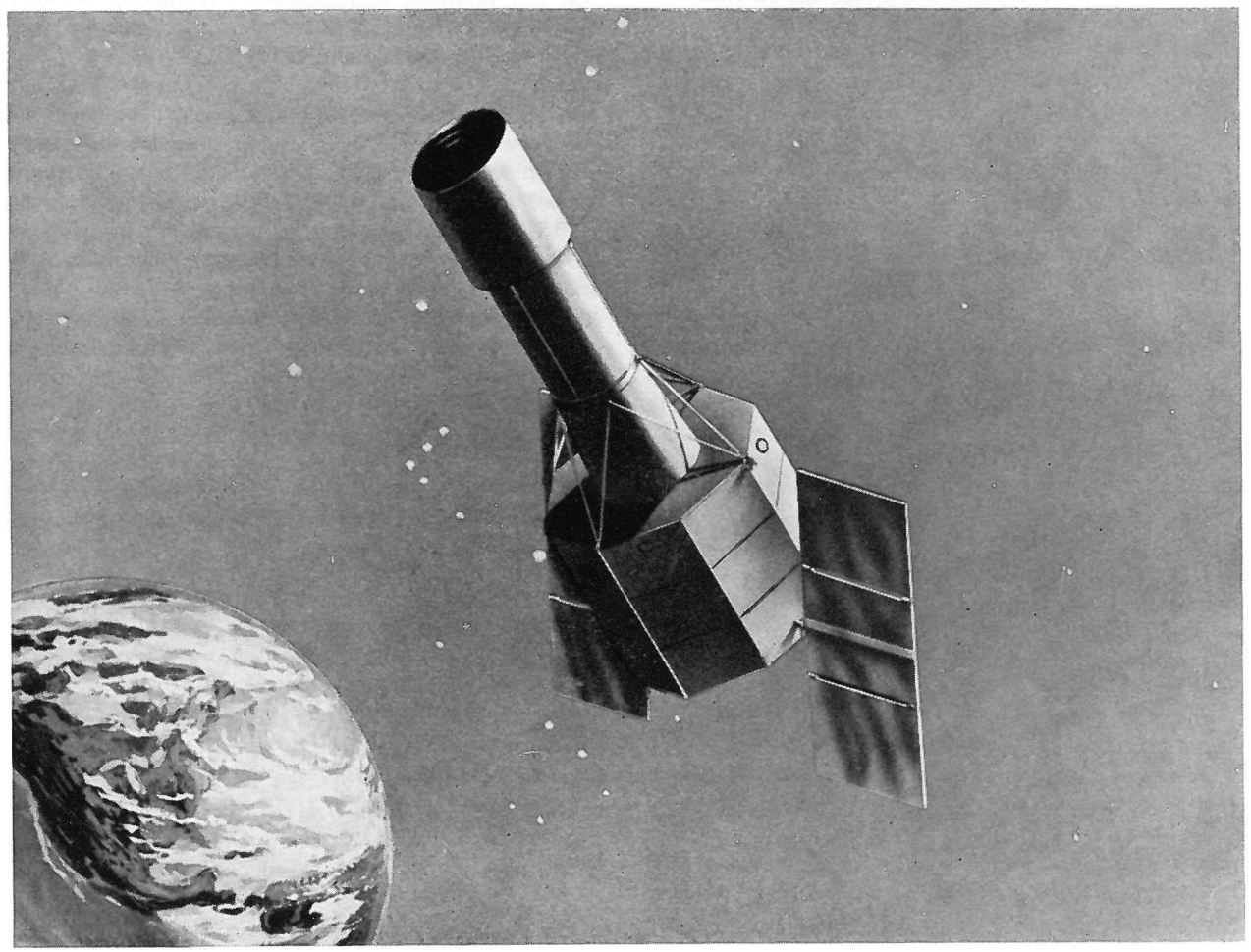
A team drawn from the Astrophysics Research Unit, the Radio and Space Research Station and University College, London is collaborating with NASA's Goddard Space Flight Center on a satellite project coded 'SAS–D' in the NASA 'Small Astronomical Satellite' series. This project is a derivative of an earlier study sponsored by ESRO and undertaken by a UK team for an 'Ultraviolet Astronomical Satellite' (UVAS). Some participation by ESRO in the SAS–D project is expected.

Briefly, the scientific package for SAS–D will consist of a 45 cm aperture Cassegrain telescope followed by an echelle spectrograph which has an image tube TV system as the detector. The satellite will be placed above the Atlantic Ocean in a geosynchronous orbit where it can be controlled from ground stations located on either side of the Atlantic.

A feature of the SAS–D system will be an observatory type of ground station in which the observing astronomer will be able to take direct control of the satellite, which should be capable of acquiring any star brighter than 12th magnitude and pointing towards it with an accuracy of one arc-second. The scientific mission covers studies of a wide range of astronomical objects, including planets, stars, the interstellar medium, galactic nebulae and external galaxies, by observations of their ultraviolet spectra in the range 1150–3200Å.

The UK is jointly responsible with GSFC for the scientific mission, and will provide the detector system, while GSFC will provide the optics and structure in addition to the spacecraft. The UK will also be contributing to the design of the telescope baffle system and of the echelle optics.

The current timetable for SAS–D provides for a launch in 1976. Both the UK group and GSFC have initiated design studies and long-lead tests which will continue until 1973. During this period a plan for completion of the project will be presented to NASA and the SRC for their consideration.



5 the sun as seen from space

A H Gabriel

On 10 October 1946, Dr. Richard Tousey of the US Naval Research Laboratory launched a spectrograph in a captured German V2 rocket, and recorded the ultraviolet spectrum of the sun from above the earth's atmosphere. This, the first space astronomy experiment, marked the start of a period in which increasingly sophisticated observations have been carried out, first on the sun, and more recently on other astronomical objects. At an altitude of several hundred Km, well above the earth's atmosphere, it is possible to extend the observable spectral range below the atmospheric transmission limit at 3000Å, down through the ultraviolet and soft x-ray regions. The outer layer of the sun's atmosphere – the corona – at a temperature of over a million degrees Kelvin, emits most of its radiation at these short wavelengths. In fact only a very few spectral lines are emitted by the corona in the visible region. It is for this reason that the ultraviolet and x-ray wavelength regions are of such great importance in understanding the physics of the solar atmosphere.

Shortly after the V2 experiments, the development of smaller sounding rockets, such as the UK *Skylark* and the US *Aerobee*, provided the vehicles for numerous solar experiments. More recently, advanced pointing controls have enabled these vehicles to be used for detailed studies of specific regions of the sun's disk. In 1962, the US National Aeronautical and Space Administration (NASA) launched the first Orbiting Solar Observatory (OSO) satellite. Seven of these have now been launched and a further three are being planned. In 1973, the first 'Apollo Telescope Mount' (ATM–A) will be launched into earth orbit. This mission, known as SKYLAB will be devoted to solar observations. It will be serviced by visiting astronauts, and will involve the periodic recovery of photographically recorded data. The primary objective, however, is to investigate the manner in which scientists/astronauts can carry out work schedules in such an environment.

There are a number of good reasons for concentrating initial measurements on the sun. It is our nearest star, and the only one in which one can foresee the possibility of spatially resolved observations, since other stars can be seen only as point sources. It is also the only star for which the entire spectral range is accessible because absorption by neutral hydrogen renders the interstellar medium opaque between 100Å and 912Å for even the next nearest star. Measurements aimed at determining the structure and behaviour of the solar atmosphere must have as their ultimate aim the understanding of the origin and heating mechanism of the outer layers, the chromosphere and corona. These layers are heated to well above the temperature of the visible disk of the sun or photosphere. It is now widely accepted that the source of this heating is mechanical energy waves, propagated upwards from the turbulent convection in the photosphere. A quantitative understanding of this heating mechanism will be of great value in predicting the behaviour of other stars with convective layers.

An important aspect of solar spectroscopic studies involves the exploitation of the unique properties of the solar plasma which are not available in laboratory plasmas. Thus, the low density enhances the intensity of the so-called 'forbidden' lines. A number of these, observed during the 1970 eclipse, have contributed important advances in our understanding of the atomic structure of the ions responsible. Observations of solar soft x-ray spectra have led to the discovery at the ARU of a new forbidden line from helium-like ions, which has subsequently been used to measure the densities in solar-active regions. Plasma effects, such as wave propagation and thermal conduction can also be studied in the solar corona.

The Science Research Council is contributing to solar space research in various ways. Its Space Research Management Unit is responsible for providing the UK National programme of Skylark rockets, launched from Woomera in Australia. The SRC also supports experimental programmes in University groups, which provide scientific payloads for Skylark rockets and also for other rockets and satellites.

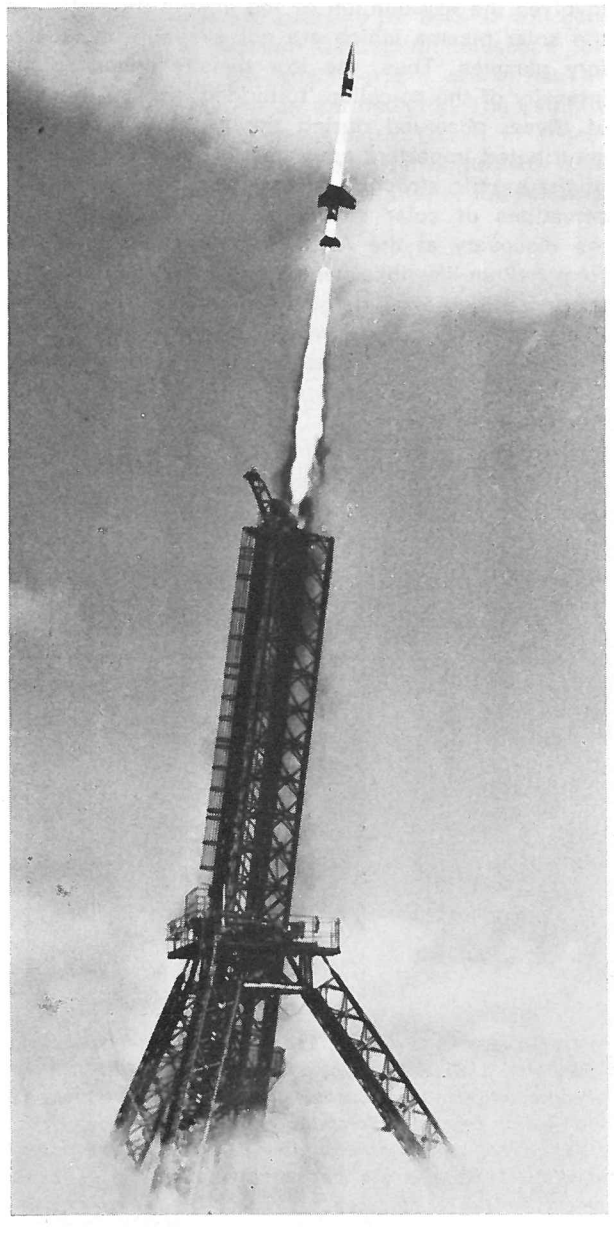
Dr. Gabriel is a Group Leader at the Astrophysics Research Unit with responsibility for the ARU Solar Programme. He was recently given a special promotion to Senior Principal Scientific Officer (see Quest Oct. '71, p. 14) and is an Honorary Lecturer at University College London in the Department of Physics.

the sun continued

Finally, the SRC Astrophysics Research Unit (ARU) at Culham is involved directly in carrying out solar experiments in the ultraviolet region. Many of these experiments are carried out in collaboration with other University Groups. All of these various activities are the responsibility of the Space Policy and Grants Committee of the SRC.

solar structure

A theoretical model of the quiet solar atmosphere developed by Woolley and Allen in 1950, and based entirely on observations from the ground, contained many of the essential features of the best models available today. In these, the temperature falls to a minimum just above the photosphere and then rises slowly to around 10,000°K at the top of the chromosphere. There follows a very steep transition region in which the temperature rises to nearly 1 million °K in only about 100 Km, leading to the corona in which the temperature rises to a maximum of nearly 2 million °K at a height of about 50,000 Km. The details of this structure are determined by the balance of energy flow through the region. This means that although the improvements in the temperature structure over the past 20 years have not been large, the implications of these changes on the mechanism of heating and formation of the corona will be very important. In particular, we require precise information in three areas. These are the value of the temperature minimum, the thickness of the chromosphere/corona transition region, and the temperature variation at the top of the transition region.



Observations are also complicated by the fact that the chromosphere-corona interface is irregular. The transition region varies in height from point to point by as much as 5,000 Km. Since this is more than 50 times the thickness of the transition region, it is clear that simple geometric observations will never be able to resolve this layer directly. The solution lies in combining such observations with an alternative technique, which involves the measurement of the absolute intensities of the spectral lines emitted. This technique, developed by Pottasch and by Jordan, determines in effect the quantity of material present at each temperature, in the line of sight.

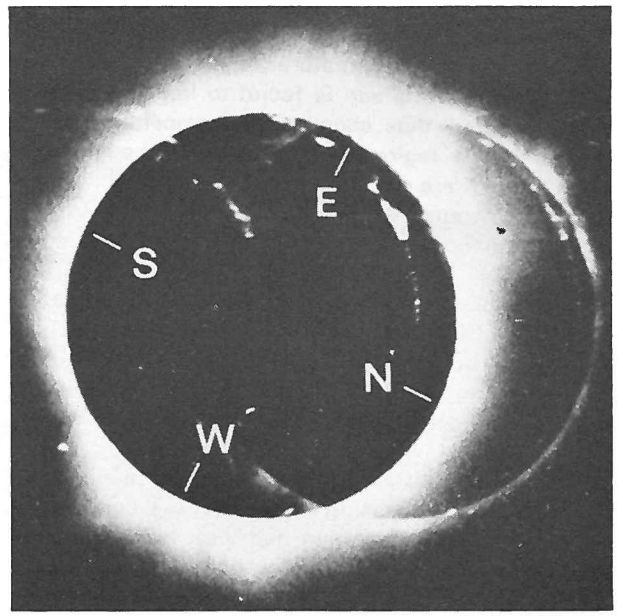
Several of the experiments carried out by the ARU are aimed at determining this structure. In one, the image of the solar disk is accurately stabilized on the entrance slit of an ultraviolet spectrograph in order to record the spectrum which is emitted by a clearly defined layer above the solar limb. Analysis of this data has confirmed the steep temperature rise in the transition region and also measured the extent of its irregularities. A further experiment, at present being prepared, will extend these measurements to the higher temperatures at the top of the transition layer. An experiment was carried out during the total solar eclipse of 7 March 1970, in which an ultraviolet spectrograph was launched into the region of totality using an *Aerobee* rocket from Wallops Island launch site in Virginia. For this experiment, which was carried out in collaboration with other US and UK groups, the rocket payload was designed and built at the ARU. The project was a spectacular success, and a series of 35 consecutive solar spectra was obtained during the second contact and totality phases of the eclipse. Analysis of this extensive data is still in progress and will continue for some time. It contains much information on a variety of solar phenomena, including the quiet transition layer, the corona, active regions and prominences.

Radiation from the solar atmosphere near its temperature minimum dominates the continuous spectrum lying in the wavelength region 1500 Å to 2000 Å. A study of this emission is thus of great importance and a number of groups, including the ARU have carried out such measurements. The precision which results from interpretation of this region has lead to a determination of the value of the temperature minimum which is probably good to within 5%.

The widths of low chromospheric emission lines in the visible spectrum were measured during the 1940 total eclipse, and found to be much larger than could be readily explained. The strong resonance lines of the ions formed here, occur in the wavelength range 1000 Å to 1900 Å, as do lines from the higher layers in the transition region. With space technique it is now possible to study these higher layers in greater detail and an ARU rocket payload has been designed for this purpose. It uses the crossed dispersions of an echelle grating and a concave grating to produce a two dimensional raster format spectrum, covering the above range with a resolution of 0.02 Å. This experiment has recorded emission profiles for a number of lines formed in the transition zone and shown that the observed ions have kinetic energies which are an order of magnitude greater than the local thermal kinetic energy. One possible interpretation is that these additional non-thermal components represent the passage through this region of the mechanical waves which are responsible for heating the corona. Experiments of this type are clearly very important in providing a unique method for increasing our fundamental understanding of the solar corona and it is therefore planned to extend their scope to include other ions formed over a range of temperatures.

the active sun

Some aspects of solar activity can be effectively studied from the ground. These include magnetic effects in the photosphere, sunspots ,the formation of plages or active regions, and the behaviour in the cooler layers of solar flares which represent the impulsive release of energy in very localized regions. These phenomena can be broadly understood in terms of the magnetic effects of a star in which differential rotation occurs, *ie* in which the equator rotates slightly faster than the poles. However, a detailed understanding of these phenomena is far from complete. Early observations in the ultraviolet and soft X-ray region showed that solar activity produces a relatively larger change in the emission at these shorter wavelengths. These results clearly indicated that the most important aspects of such phenomena might remain undetected if observations were limited to only the visible spectrum.



Pictures: far left *a stabilised Skylark rocket carrying ultraviolet solar experiments and,* **above,** *the Solar Corona during the total eclipse of March 7 1970, recorded in the emission of hydrogen Lyman* α *at 1216Å.*

While much useful work has been carried out from rockets, it is obvious that for the study of fluctuating or transient phenomena, the longer observing time provided by a satellite has important advantages. Thus, the first solar satellite OSO–I carried an ultraviolet spectrometer which was able to monitor the intensity variation of different emission lines as the sun rotated on its axis. As the principal active regions rotated with the sun, the degree of activity seen from the earth varied periodically. The degree of variation of the line intensities then showed which lines were characteristic of the entire quiet corona, and which came only from active regions. In this way it was shown that the temperature associated with active regions could be well above that of the quiet corona.

More recently it has been possible to obtain spectroheliograms in the ultraviolet. These are complete maps of the solar disk recorded in the radiation of only one spectral line. By selecting a series of spectral lines which are formed at progres-

sively increasing temperatures, the area of the emitting regions on the sun is found to become progressively smaller, thus showing the temperature structure in active regions, where peak temperatures of 10 million °K are observed.

As the temperatures increase, it is necessary to make observations at still shorter wavelengths in the x-ray region. Satellites such as the OSO–III, OSO–V and the Russian Intercosmos–4 have made detailed studies of flare spectra in the 1.8 Å region, which are formed by iron atoms so highly ionised that only 2 of the original 26 electrons remain. These lines are emitted at temperatures in excess of 20 million °K.

Observations of a different kind have been carried out by a US group using rockets. These concentrate on high spatial resolution but use broad spectral bands in the soft x-ray region. They show emission originating from arch-like structures extending some 100,000 Km high in the corona above active regions. It may be a few years before high spectral and spatial resolution can be achieved simultaneously in the x-ray region but one can then hope to unravel the detailed structure of active regions, and their relationship to the magnetic field. Much of this information could never be obtained if observations were limited to ground based observations.

the outer corona

The outer region of the corona is continually escaping from the sun's gravitational field and streams past the earth's orbit as the solar wind. Where this wind meets the magnetosphere, the region of magnetic field surrounding the earth, a shock wave of unusual properties is set up. Satellites, acting as probes, have successfully traversed these regions and sent back much valuable data, both on the solar wind and on the so-called 'bow shock-wave'. Analysis of the distribution of chemical species, velocities and charge states in the solar wind has important implications for understanding the physical processes occurring in the outer corona.

It will be seen that with the help of space observations, a great deal of interesting new information about the behaviours of the outer layers of the sun is being obtained. We are now entering a phase in which we can hope to fit this together to form a better quantitative understanding of the origin and heating of these layers; first for the sun and then for other stars.

6 Hebridean holiday

how our experiments get off the ground at South Uist

Eric Williams of the University College of Wales, Aberystwyth tells the tale his own way. He and Les France are part of a team who launch experiments in Petrel and Skua rockets from S. Uist and they drive 700 miles to do it. Pictures by author.

So you are off on a jolly to the Uists, flogging the old expenses racket and touring Scotland at the expense of the Science Research Council. Well that is how the tea-room have it and they could be right, for after all it is high summer and the hired, self-drive van has just been serviced. Actually it is a little after nine on the morning of Sunday July 4 and Les has just arrived with the vehicle.

'Apres moi le deluge', yes, pouring with rain and shows no signs of letting up. Still, consolation in all things, the Mid-Wales Golf Alliance is at Aberystwyth today and sure enough had you not been departing for the Hebrides you would at this time be half-way up the third and soaked to the skin already.

Always did fancy driving a truck. My god, gear changing's a lottery and third to second is impossible. Our language would evaporate the snow and we are not in Ponterwyd yet.

Turn and turn about, an hour and a quarter in the driving seat apiece and by lunch-time we join the M6 east of Crewe. Driving somewhat easier now, though with the heavy load of steel sections for our 24 metre aerial masts the van rolls at the slightest pretext and struggles up even the merest incline.

We have ensured the posterity of this vehicle by christening her 'The Pinking-Pig', a pretty obvious choice really when you bear in mind her performance in either third or top gear between 25 and 30 mph. Still she is only using one gallon every 25 miles and that does impress us.

Off the motorway north of Carlisle and into a garage at Gretna Green for re-fuelling. Dip-stick says 'Add-oil', cannot unscrew this filler cap. Try tapping it with a heavy tyre-lever. No good, though hello, it's not moving round, it's coming out. Ah, it pulls off, just swollen with the heat. Another problem solved – you can't beat the trained scientific mind.

A74 north is a pretty good road but time rolls by. Seven o'clock and we are still way south of

Approaching the Isle of Skye

Glasgow, we'll never make Dumbarton in time for dinner. Better ring ahead and see if we can't arrange a late meal at the Dumbuck. Chef's off at 8.45 and we estimate arrival at 9 o'clock – they'll leave us a chicken salad out. Make it a mixed grill – we only had a snack lunch.

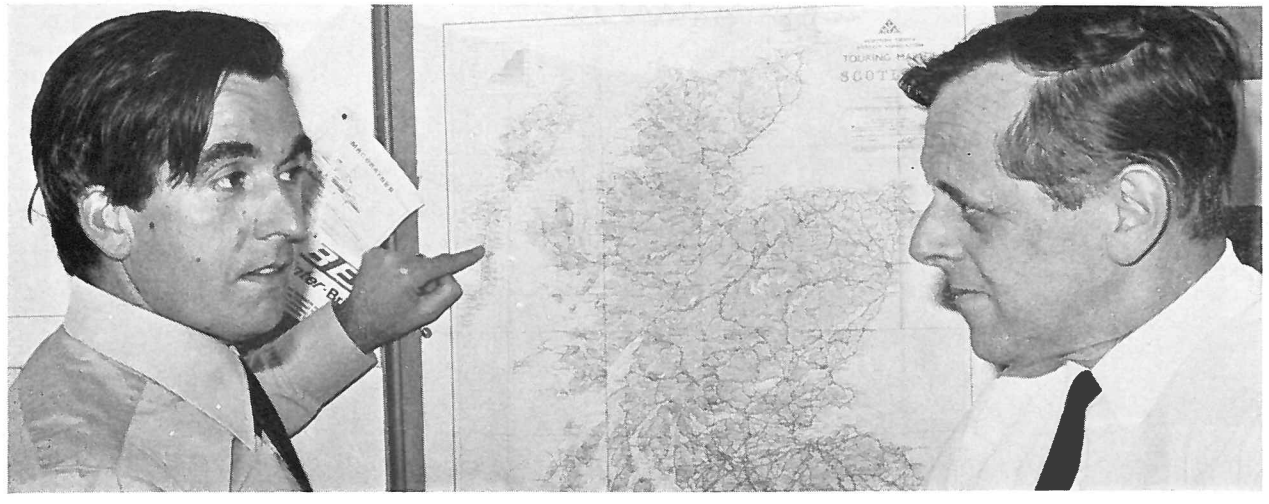
Diversion through Glasgow, my goodness they still have cobbled streets, littered with railway lines. Get into reverse as the lights change – chap behind fails to see the humour of the situation. Dumbarton at last, 9.15 and they's kept a steak for us, drop of vino to wash it down, ah, that's better. Walk round the block, wash up and bed. My god all the gear we've got in that truck and here's me minus toothbrush and toothpaste. Not to worry, worse things happen at sea.

Slept like tops, excellent breakfast and back on the road heading north by nine next morning. Loch Lomond's all it's cracked up to be but what tortuous narrow roads follow its banks. This vehicle's got a built in queue, 200 yards behind it. Dour people these Scots, not a single horn honked though one or two of them have got damned good headlights.

Refuelled at Ardlui and found reverse at the first attempt – pity I couldn't get out of it – still that sheepdog was pretty nippy. There was a massacre at Glencoe, wasn't there? If these brakes don't hold history could repeat itself. Thank god we wedged those boards behind us, don't fancy a ton of aerial masting behind my left ear if we have to stop in a hurry.

Loch Leven and the solitary piper, can't make that out. Standing right at the edge of the loch a Scot in full regalia, tartan kilt, sporran, the lot and blowing

The author (left) trying to convince Les France that his route is the best.



Hebridean holiday continued

away in blissful isolation. (Discover subsequently these chaps are tinkers and when they accumulate a big enough crowd of onlookers round goes the hat – they make fortunes at it).

Fort William for an early lunch and the 'pig' is in the garage for brake adjustments. Can recommend the tatty-leeky soup; was almost in a position to pronounce judgment on haggis but courage ran out at the last minute – pity we saw them in the raw in that butcher's window.

Brake adjustment has certainly been effective, heading north again up A82 and then west to the Kyle of Loch Alsh. Short ferry to Kyleakin on Island of Skye. Up the Isle of Skye and some of the most beautiful scenery yet, through Portree to Uig reached by 7.30 p.m. – better than last night. We're booked in at the Uig – find we're sleeping in the annexe, 'Primrose Cottage'. Quite picturesque this, no locked doors and an intriguing notice to close the garden gates to avoid the ravages of itinerant sheep.

Early start Tuesday morning, long ferry from Uig to Lochmaddy on North Uist and we have to be on the quay by nine o'clock to collect our tickets. Arrive there in ample time, in fact we're amongst the first alongside. There's a ton and a half of highland bull standing alongside us. Yes, so he is tethered but he's not happy about it and I'm staying right here in the comfort of the 'pig' – funny the attachments you can form.

Eventless crossing, these ships are remarkably stable and they only have a seven foot draught, well stabilized and very effective. Manoeuvring the van in the confines of the ship on docking not without its moments. Incurred the wrath of a Morris 1100, sporting four spinster teachers is our guess – Les silenced them with a glance or could it be they lip-read.

Last lap now over the bumpy single-track roads of North Uist, Benbecula and South Uist with their passing points marked by white diamonds. Seems to work quite well this passing point business, simple rules, pull in if the passing point is on your side except when you are driving up hill, you then have the right of way. Ignore these rules when the other vehicle is a lorry, especially if it is loaded high with seaweed as many of them are, these chaps operate on a might is right basis. Quickly gather that acknowledgement of correct passing procedures is by raising one finger, yes, ONE finger.

Our Guest house on South Uist reached in nice time for lunch. Science Research Council have negotiated some pretty good digs here, purple carpets, large lounge with TV (though reception is hopeless), darts-board, Scrabble and well thumbed packs of cards. Hello you two, where have you been, there was room on last night's ferry. By the way you're in the annexe.

Les has been in the annexe before – solid floors two foot thick of concrete, corrugated sheet walls and a tin roof; my wrangler pants will fit in here all right. Only thirty yards to the nearest hot water tap, keep the loo door closed with your foot, but the beds are very comfortable and the furniture adequate.

So was that lunch, now down to the rocket range and let's get these aerial masts up. No problem here, they've flogged these in large quantities to the Scandinavian armies we hear. Four men can put a 75 foot mast up in an hour and take it down in 40 minutes and with Ron specially flown up from Aldermaston to show us how we will soon sort this lot.

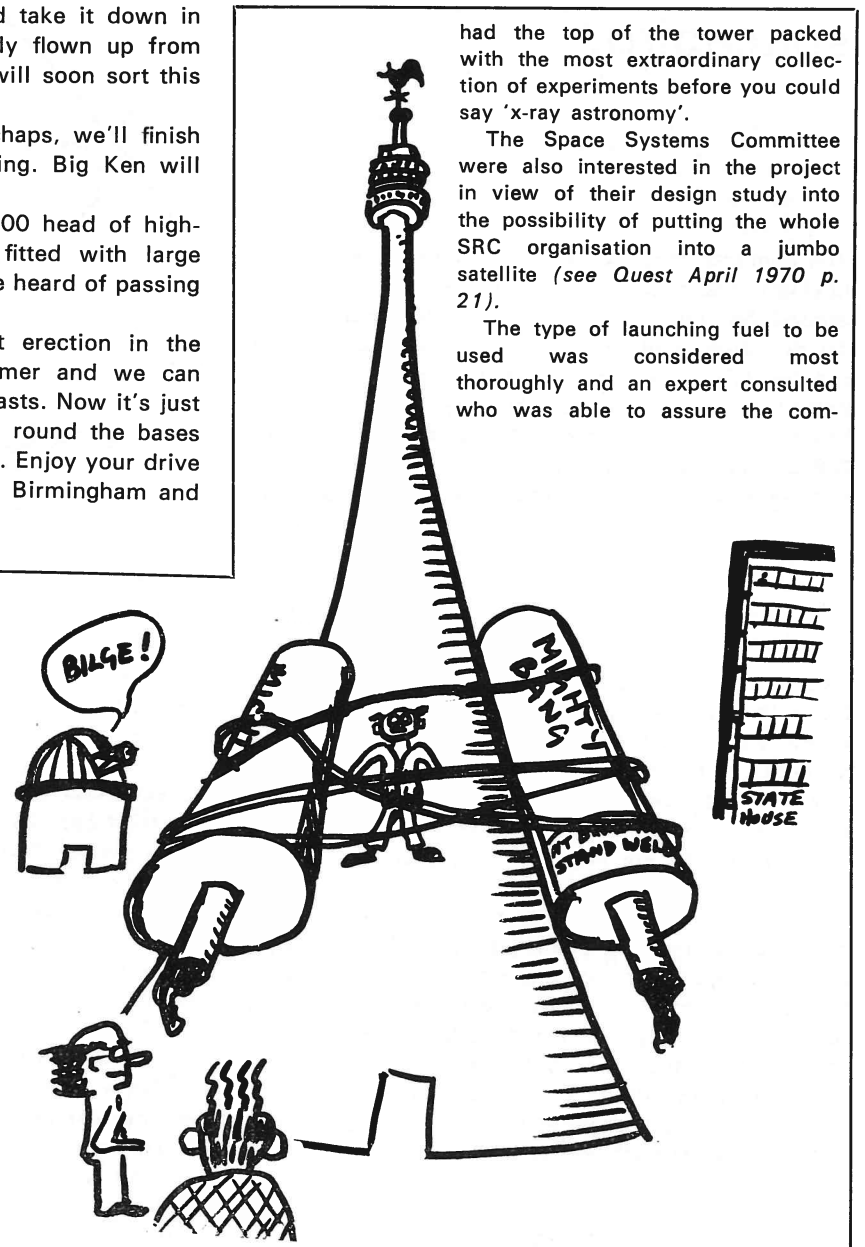
Six-thirty already, never mind chaps, we'll finish putting this mast up in the morning. Big Ken will join us from Aberystwyth then.

Found our way home through 200 head of highland cattle, many of which are fitted with large handle-bars and none of whom have heard of passing points.

Two more days of aerial mast erection in the chill wind of the Hebridean summer and we can stand back and admire our three masts. Now it's just a matter of stringing cattle fences round the bases and I'm on my way home on Friday. Enjoy your drive back Eric, that I will; I'm flying to Birmingham and Ken has left my car there!

The Ben Mor Guest House, South Uist, with the annexe in foreground of picture.

tall story



As we understand it the hot air brigade claim that they exploded the Post Office tower and the provisionals say that it was nothing whatever to do with them. If so both of them are wrong.

Now if Special Branch had looked a bit further, at a nearby fifteen storey building in fact, they might have found a hotbed of clues. This very tower had been the subject of discussion by the Astronomy, Space and Radio Board Satellite Committee for some years, in fact ever since this blatant instance of Total Technology first arose in the Landscape.

By 1968 some agreement had been reached to promote a design study. When that was scrapped Finance Division suddenly stepped in. They had become increasingly worried, they said, by the receipt of travel claims from the Whitley Council sub-committee on 'London Office – Dispersal or Disposal?' Each member of the committee had been given the powerful binoculars they had asked for (the 'best but most expensive' as recommended by the Consumers' Association) but being concerned about the occlusion of the view of the most likely western regions by the tower they had been doing their scanning at Ascot and Henley where, they claimed, they got excellent results.

Picture shows Professors O'Flanaghan and Rafferty, co-opted members of the ASR Satellite Committee, before the launch. 'F' can be seen on right shaking its head over travel claims.

Because of the seriousness of F Division's concern over the travel claims, the Satellite Committee knew that provisions of funds would be no further problem and they quickly had the top of the tower packed with the most extraordinary collection of experiments before you could say 'x-ray astronomy'.

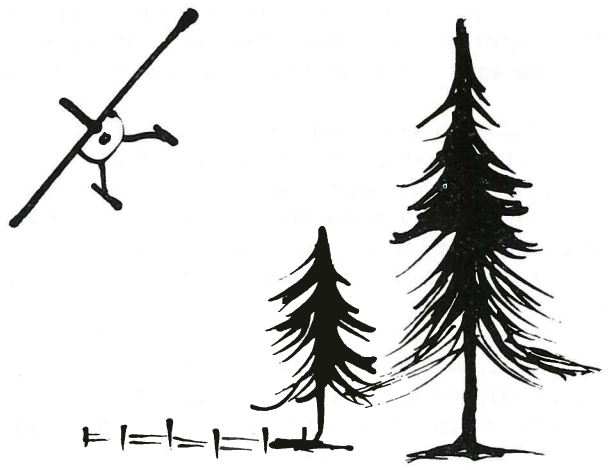
The Space Systems Committee were also interested in the project in view of their design study into the possibility of putting the whole SRC organisation into a jumbo satellite *(see Quest April 1970 p. 21)*.

The type of launching fuel to be used was considered most thoroughly and an expert consulted who was able to assure the committee that 'Just 15lb will be sure to blast the very soul of it and t'would as likely go round in space as land in the next world, being no sort of a christian', he said.

Well as you know from the press reports the top of the tower stayed where it was and at the next meeting the experiment was formally recorded as 'The Launch That Failed no. 40,291'. We also returned to the expert for his opinion which was as follows: 'Be jaysus ye've done it! Ye've done it!' This seemed rather unusual in the circumstances.

spacebird?

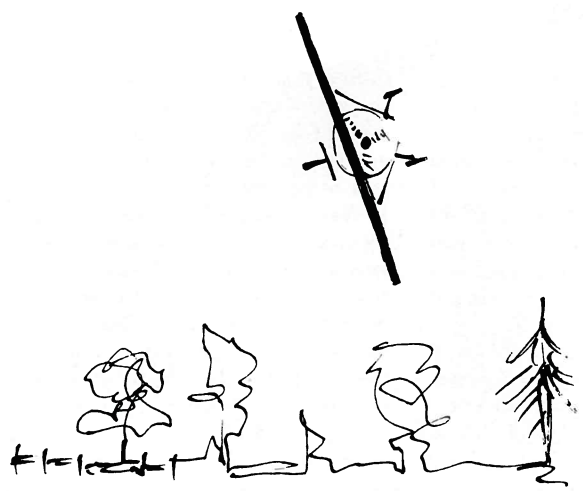
The contents of the cover on the last issue of *Quest* having caused so much comment, we searched around for some more talent for the Space issue. To our disappointment we found no female of the species SRC in a rocket package, on the launching pad or even up in a balloon. However we did find one in an aeroplane at Denham. Angela Killick of Private Office has just acquired a private pilot's licence and who knows where she may get up to now.



Angela Killick

'Would you like to fly upside down?' said the instructor, with his arm round my shoulder. It was at least a new approach, but I declined. We looped the loop a couple of times before I said 'You'll have to stop now or I shall be sick.' We always carry a stock of brown paper bags for emergencies and it is the only sanction left to the pupil pilot over wilder instructors!

I had been learning to fly for a couple of years, slowly acquiring the number of hours dual and solo needed to apply for a private pilot's licence. To gain a licence one must do certain long and short distance solo cross country flying and quite a stiff practical handling test, and there is also an oral exam on airframes and the principles of flight, a written exam on aviation law, and another test on navigation and meteorology. Everything has to be completed within a six month period – and therein lies the rub as the weather can hold you up mercilessly until time has run out.



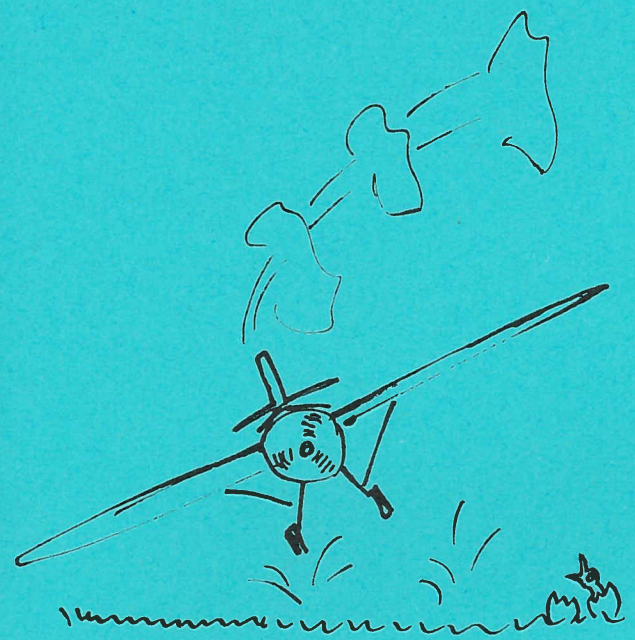
'Have you ever flown blind?' the instructor said and gave me the verbal directions I might get in an emergency from an information point equipped with radar. I promised not to cheat by looking out of the cockpit window.

The difficulty lies in believing the instruments. It is very easy to become convinced that you are flying crooked and that the instruments are wrong! Pilots' tales (rather like seamen's) assure you that people have been known to fly out of cloud upside down without knowing it. 'Fly 10° to starboard, you are now five miles from the airfield, descend 500′, change your altimeter from Chatham QNH to QFE 1012, turn onto 160° . . .' He brought me to within 300′ of the runway before I actually saw anything out of the window. It was good practice . . .

There are many tricks which instructors use to liven up the learner-pilot hours. Dodging imaginary radio masts is one. Pulling back the throttle 300′ after take-off is another. It is not so bad provided you have done the homework: nose down, trim for 70 mph, select any remotely possible patch for landing, as near straight ahead as possible, take a deep breath, check throttle closed (a sudden burst of speed on touch down could be disastrous), shut fuel tap, switch off magnetos, ignition, open door just before impact in case airframe should buckle and trap you inside. Speed is essential and you have to know the checks off pat: they must be automatic, there is no time to think.

Engine failures are practised from dizzier heights but at least one has more time. It was an immense relief to me when I first learned that I would not just drop out of the sky when the single engine was switched off. On the contrary, a single engined Cessna 150 can glide about 2¾ miles in still air from 2000′ before touching the ground. With a strong wind of course, the distance (and time) is sharply reduced. During these precious seconds, there are lots of things to do. If the height is sufficient, you might have time to discover why the engine has failed – perhaps the fuel tap or the ignition switch have been knocked to 'off', or the petrol tanks are empty. When you have noted the wind direction, selected a field, and decided on a landing course, you are supposed to give a radio 'mayday' (m'aidez) call, though to what purpose it is difficult to imagine. In any case, conversations are the last thing you want at such a moment – the mayday call being acknowledged and you acknowledging the acknowledgment.

Having practised this manoeuvre to within a few feet of the ground, you climb away by pushing in the throttle slowly – to apply full throttle at once gives a burst of sound, all the local chickens crack their eggs, the cows drop calves, sheep get stuck in the fences, farmers complain and the noise abatement societies ring up the police and write to their MPs.

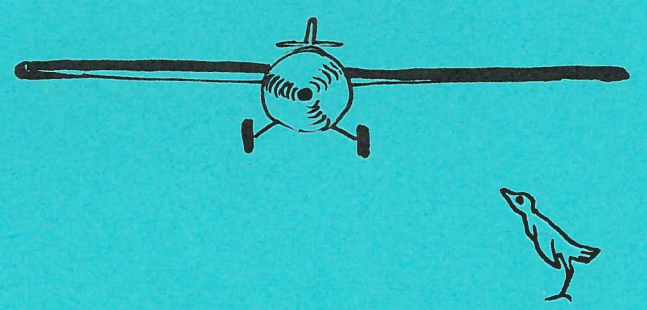


Other excitements of learning to fly include spins and stalls. The first time one is inclined to think 'O God, give me a ladder; I want to get down'. Then it becomes a challenge – to conquer emotions and instincts and master the machine, the air, and the curious feel of moving in three dimensions.

The exercises are exactly what the words imply. To stall, you point the nose high in the sky (the earth drops out of sight) and close the throttle. The sensation is like one of those bad dreams in which you run harder and harder only to fall further behind. For a fraction of time there is a sense of minus-G, and then you drop, your intestines apparently whizzing through your head.

For the spin, you let a stall develop. The nose drops steeply downwards, and the sky vanishes. The plane goes round and round – like an autumn leaf – and the fields 4000′ below whirl dizzily by. The degree of blood-pressure is an indication of how well developed the spin.

After all that and having spent what seemed to be enormous sums of money, the flying club sent off my application for a licence to the Board of Trade.

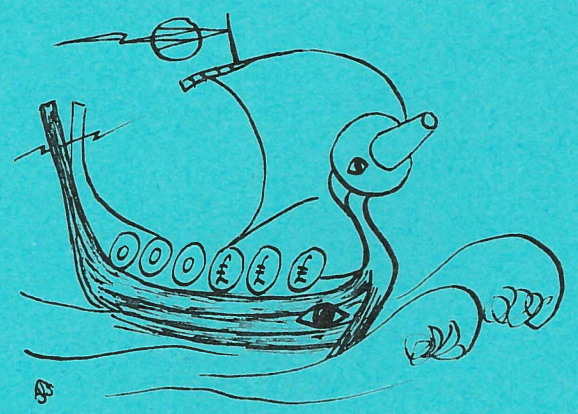


Drawings by the author.

stop press The following problem has just arisen. Please send your solutions – urgently – to **Quest** or a Council member. The names have been changed to preserve our natural reticence in such matters.

nutcracker 6 – collaboration

The six-member European Council for Underwater Transport is having difficulty in assembling a 4-nation consortium for its latest project, the Supersonic Nuclear Livestock Carrier, or SNARK. The idea is that each nation should be responsible for one of the four major design elements, but the plan has hit some snags. Belgium will only join if both France and Italy do, Austria will only join if Germany does, and cannot build the steering gear. The UK will only join if it can build the hull or the reactor, and even then only on condition that the reactor is not built in France or the electronics in Italy or Austria. Neither Germany nor Italy can build either the hull or the steering gear, and if both these countries participate, they can only be kept from quarrelling if France builds the reactor. France will only build the steering gear if the reactor is made in Germany. So who builds which piece of the SNARK?



SR at C

'. . . staff may be required for duty in aircraft in flight, in ships afloat or in submarines submerged'. Memories still survive of the earnest debate around the inclusion of this in the terms of service and six years later one of us at least began to think it was going to be altogether too apposite. Well, perhaps it wasn't exactly a duty, but when the SRC crew assembled at Gosport on October 22 for the Inter-departmental Race (yes!) to Cherbourg, gales had been blowing all week and the Channel reports were 'very rough'. Imagine *sailing* at the end of October! Well there we were – Skipper Paul Dickinson (RSRS), Phil Warner (LO), Norman Walker (RGO), Joan Paton (LO) and Les Barber who joined us when the sudden illness of Martin Hall (RSRS) left us without a 'qualified' skipper and Paul got promoted.

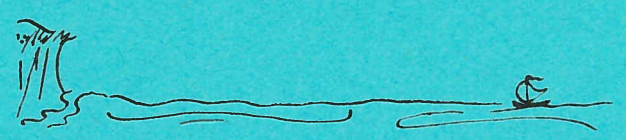
The cross channel race was a new venture organised by the Civil Service Sailing Association. The forecaster insisted that we should continue to get fresh to strong wind from the SW – just where we wanted to go. So, despite brave words from some members, I suspect that more than one was secretly relieved when the original plan was called off and the 'heavy weather' course substituted – Gosport to Cowes on Friday evening, with a second race on Saturday, aggregate results to decide.

We promptly set sail, reefed down as far as we decently could, in 'Precedent' – the new Hustler 30 belonging to the CSSA which we had been lucky enough to draw. Equally promptly the wind disappeared (we really shall have to tackle those chaps on the LO roof) and we were left battling a foul tide. Perhaps too we were under other handicaps – having to make do with cruising sails and having at the start suffered a broken jib halliard and discovered the need for one or two other things such as minor sail repairs. Oh well, it *was* the end of the season. Even without a log, we achieved a speed of nearly 1.5 knots. I suppose sailors get to be philosophical about these things.

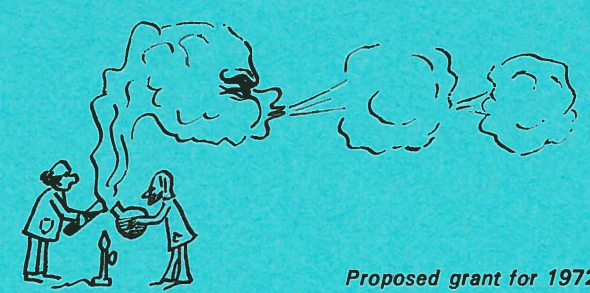
Saturday having seen the CSSA boats practically alone at the mooring piles at Cowes a conference of skippers agreed, as there was still little wind, on a circuit of the Isle of Wight for the second race. Again it turned out to be not so much a race as a trial of patience, despite the odd sacrifice to Poseidon (don't get me wrong – ½ np a time – I suppose we just haven't come to terms with inflation).

We drifted, we anchored, we did clever things with the tide, we discovered some new features of a foggy early morning Solent (the next morning). What might have been a tedious experience was lightened by a most splendid night – warm, clear, bright with stars and meteor showers. The description 'almost photometric' must have entered the vocabulary of several crews.

At last we completed the 60 mile course – in something over 26 hours – and somewhat wearily made our way back to Gosport. This SRC team can at least claim a satisfactory degree of consistence – we finished last each time – but somehow perhaps



because others were less persistent the final result gave us third place. If the general organisation had a faintly ad hoc flavour well surely even the Civil Service must relax. Anyway the crew certainly enjoyed themselves in the not altogether comprehensible way of sailors generally and hope to be allowed another try next year when maybe we will make a better showing.



Proposed grant for 1972

Q column by 'observer'

letters

If you want to make a protest, why not write to Quest while you're sitting. Your message could get to 3,000 people.

Dear Editor
There seems to me to be little doubt that the two persons posing with UK4 on the cover of the last issue of Quest *were not female. I have a strong suspicion, moreover, that they were members of SRC's scientific staff moonlighting (or satelliting) to enhance their meagre salaries. I fear there will yet be worse to come in the wake of the recent disgraceful pay settlement.*

Yours etc.
IPCS member

MISSING: SSO.SAL.2655–3255. Last used for tightening the bolts on the ARU package for Skylark rocket SL 902X.

It is believed that this may be the rocket that became directly involved in ping-pong diplomacy. If anyone's listening in (this page is bugged) please may we have our ball – sorry! – our rocket back. The SSO is replaceable.

Quest footnote to Ad. above **'fair copy'**

We have thought about this and have decided that in most cases the top man's secretary can't read his handwriting either. Like many another power behind the throne in fact she is expected to rewrite his notes and edit his speeches. His scrawl obscuring whether her transcript is like the original or not, serves to preserve the myth that He is the boss and She the mere amanuensis. We have also noticed that the handwriting of all the top women we know, and likewise of aspiring secretaries, is plain enough for anyone to read.

(inserted on behalf of FD (Feminine Deliverance) 2 Ed.)

wide open

Almost fifteen husbands, wives, children, and staff from various SRC establishments attended the 'SRC is one big happy family' Day at State House last month. After a brief visit to see the newly installed liquid soap dispensers, whose presence unequivocally demonstrates the proud part which Whitleyism plays in the everyday life of the Council, our guests toured the offices and meeting rooms to see the exhibitions and live demonstrations of LO activities specially arranged for them.

The high-spot of the day was to have been a visit to the Council Room to hear the third day of discussion on Foreign Postdoctoral Assistants (Employment on Grants) but unfortunately this had already been referred back to the Boards for further consideration. Instead, the visitors watched the Senior Officers' Luncheon Trolley Race, an event which has only recently been introduced but is already very popular, especially with the junior staff.

They also saw an example of the magnificent teamwork of which we are so proud when two of the scientific staff demonstrated the technique of transferring an incoming telephone call from one extension to another. The executive staff also played their part, with a notable lecture with lantern slides on 'The History and Development of the RG2 Form' and an equally lucid exposition entitled 'The Functional Directory – Fact or Fiction?' But perhaps most impressive from a visual point of view was the moment when the clerical staff released a million sheets of paper, representing a year's output of Committee papers, from windows on the fifteenth floor. It was a moving sight as they floated to the ground.

And so our guests left and we went back to our normal routine. We hope to see every one of them again next year – you have to have something to look forward to, after all.

top copy

Q. column

It has frequently been suggested that scientists are poor at expressing themselves in English. To refute this claim, we present extracts from the current Forward Look exercise. The Council minutes will be published in full in the Times Literary Supplement.

Brian Flowers of Holborn
By the Four Boards he swore
That the proud Nuclear Physics
Should hold its funds no more
By the Four Boards he swore it
And named a cutting day
And bade his minions all write forth
East and west and south and north
To summon his array.

But in his Northern fastness
Sir John did gird for war
Prepared to fight for Nimrod
Till he could stir no more
And Paul stood on his left side
(A leftish man was he)
'Now, who will stand at my right hand
To hold our funds with me'.

(and so on for 3850 more verses)

From 'The Merry Wives of Holborn'

Mistress Ford

Now is the winter of our discontent
Made glorious summer by our flowery king
And all the scorn that poured upon our heads
Beneath our metal mountains buried
Now are our cunning works displayed in galleries,
Our praises sung, and honours richly heaped.
But yet remain some envious, churlish, knaves
Who will not bow and render all they have
To raise the glory of great Engineering's name,
They shall not stand; their stiff necks shall be bowed
Now secretly to Flowers, then in Council room speak loud.

Meanwhile, back in Science Division

'We gotta act now', muttered Athenaeum Chris, absent-mindedly filing his nails on B/SR/986. 'So what's up?' asked Gentleman Geoff. 'It's the Oily Hand Gang, Adams' mob. They been growing too fast, and now we gotta bust'em once for all'. 'So who do we send in?' 'Crystals' Mason?' 'Nah, he's a new boy. Hatchets Henry 'ed make mincemeat of him. It'll have to be Many-Hans-make-light work Kornberg, and even he'll not do if the Brain's with 'em. We gotta problem'. 'Can we do a deal?' 'With the Oily Hand Gang, never. Hold it though. Maybe we make an alliance. Get me Big Jim.'

Footnote *All the names mentioned above appear in the SRC Directory of Council, Board and Committee Members, published by the Council Secretariat. B/SR/986 and many more like it may be found in SS & E Registry at London Office.*

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chaser

A recent advertisement in *Quest* for GEORGE (was it from Miss IR of Bromley?) got no less than seventeen calls (three obscene, five cranks, eight misunderstood husbands and a man who claimed to be the Isaac Newton Telescope) but they either turned out not to be George or to be the wrong variety.

But QUEST FOUND HIM! In fact we decanted him from a bottle of Chinon (no. 5) at a recent wine tasting at London Office.

After we had wrung him out to provide enough of the no. 5 for the gathering to taste he let fall a few broken words '. . . away . . . at Atlas . . . it worked! (*gurgle*).' It is our recommendation that the back of the Atlas computer should be taken off at once and the contents examined.

3C 48

all in a day's work

A. G. Wilson

Outside of the laboratories we in SRC have little chance of discovering anything of interest and we have no antiquity. It is of course different in many of the older Departments. Not long after the last war, in the Ministry of Transport, I was given the task of examining the old Board of Trade railway papers prior to their despatch to the Public Record Office. These papers had passed to the Ministry on its establishment in 1919, when it had assumed the statutory responsibilities for the railways hitherto exercised by the Board. Historical records of this character were required under the Public Record Office Acts to be deposited when no longer required departmentally, but oversight and war-time storage had delayed matters.

The papers were delivered to me from the registry. They were in bundles, well ingrained with dust and if ever they were adequately indexed the indices had become depleted or lost. Old records in bundles emit a fine dust which penetrates and irritates the skin. Pulling them apart was a disagreeable experience, but the contents soon had me fascinated. I was handling the original survey reports, drawings and correspondence from the time that the railways were laid down in the 1840's. Most were in the handwriting of the engineers, but occasionally a fair copperplate ended in a rough signature of another hand indicating a clerk's assistance. The plans were in ink and colour wash, identical with those shown today in the Science Museum.

As I sifted through the papers I recognised the signatures of men whom history had associated with early Victorian engineering, including George Stephenson, and one particular document in George's handwriting was of current interest. It was peculiar in that having filled up the sheet of paper, he turned it sideways and continued to write across what had already been written. It was not easy to read, but I saw that he was giving his views to the Government on whether it should control the new railway systems. This had particular relevance around 1947 as the Transport Act, which nationalised the railways for the first time, was under preparation.

During my examination of the letters among the documents I was at first puzzled why so many had holes in the middle. Then I noticed that they had been folded with the ends tucked in, and sometimes sealed with wax, before being posted without envelopes. The holes had been caused by some enterprising rogue's removing the stamps, the early and valuable Penny Blacks! I suspect that this had occurred during the war-time storage. I was anxious that the Stephenson letter should not find its way into some private collection so had it registered in the Ministry's strong room. The custodian, to whom I explained what I was depositing, took it upon himself to shew it to a colleague in the Railways Division, who in turn took it along to the Chief Inspecting Officer of Railways. This worthy was a typical retired army officer of the old school, who like his fellow inspectors had spent most of his active life in India. (Only in the army could experience be gained of laying down new railways of any magnitude at that time). He was Lt. Col. Sir Alan Mount, who was prominent in the Institution of Mechanical Engineers, and the I. Mech. E rightly honour George Stephenson.

The next I heard of the document was that Sir Alan had obtained the Principal Establishment Officer's approval to present the document 'that he had discovered' to the I. Mech. E. But Acts are Acts and after confirming that I was on safe ground with the Record Office I gained some small pleasure in formally telling my Establishment Officer that other claims on the document were paramount. The document duly went to the Record Office with the rest of the papers (among which was the file on the Tay Bridge disaster, starting with the telegram saying that the bridge was down) and for some time was in the museum in the Chancery Lane building. It was written up with photographs in, I believe, the journal of the I. Mech. E.

This little episode came back to me recently during a Sunday evening stroll through Putney Vale cemetery. My eye alighted on a stone emblazoned with the badge of the Royal Engineers. It was the grave of Sir Alan Mount.

centenary visit

A Divide-by-8 Scaler from the Cavendish Laboratory of 1932 must have stirred some memories during the Royal Society visit to the Rutherford Laboratory.

The visit formed part of the celebrations organised by the Royal Society to mark the centenary of Lord Rutherford's birth (see Quest October 1971 p.6). The Laboratory laid on special exhibitions and demonstrations. These included Nimrod itself, the K12A experiment (an RHEL-Birmingham University collaboration on Kaon/Nucleon scattering) and experimental techniques on counters and target technology.

The Laboratory is used to welcoming eminent scientists but perhaps not so many at once. In the photograph (taken in the coffee lounge) can be seen:

Professor H C Webster, Emeritus Professor of Physics, University of Queensland, and Scientific Counsellor at the Australian Embassy in Washington. **1**

Dr G H Briggs who was Chief of the Division of Physics, Commonwealth Scientific and Industrial Research Organisation (Australia) until his retirement in 1958. He then became an Honorary Research Fellow of the Australian National Standards Laboratory until 1969. **2**

Sir George Thomson, the son of the late Professor J J Thomson, is Emeritus Professor of Physics at London University. **4**

Lord Bowden is Principal of the University of Manchester Institute of Science and Technology. **8**

Dr D M Robinson is President of the High Voltage Engineering Corporation, Burlington, Massachusetts, USA. **10**

Dr J B Adams is Director of the CERN 300 GeV Accelerator project. **12**

Professor E Amaldi came as a representative of the Accademia Nazional Dei Lincei and he is also President of the CERN Council. **13**

Talking to the visitors are some of the Rutherford Laboratory hosts:

Dr G H Stafford, Director of the Laboratory. **9**

Mr D A Gray Head of Nimrod Division. **5**

Mr N M King Leader of the Accelerator and Beam Theory Group, Nimrod Division. **6**

Mr W Walkinshaw Head of Computing and Automation Division. **7**

Professor W D Allen who holds a joint appointment at the Rutherford Laboratory and Reading University. **3**

Dr. B. C. Fawcett

D Sc

The University of London recently awarded the degree of D.Sc. to Brian Fawcett, a Senior Scientific Officer in the Astrophysics Research Unit at Culham. Dr. Fawcett has been engaged in spectroscopic studies of high temperature plasma sources since 1957. After working at Harwell on the ZETA project, he moved to Culham in 1964 where his work has been concerned with the identification and classification of atomic spectra. Using the techniques of extreme ultraviolet spectroscopy, Dr. Fawcett has identified many new spectral lines of highly ionized elements and so provided data of great importance for astrophysics research. The D.Sc. degree was awarded in recognition of Dr. Fawcett's published work in the field of spectral line classification.

new year honours

We congratulate Dr. D. E. Adams who receives an OBE and Mrs. M. F. McMillan who receives an MBE.

Dr. Adams is a Senior Principal Scientific Officer in Engineering Division, London Office, and Mrs. McMillan, a Senior Personal Secretary, works for the Director of Science Division, Mr. Jolliffe.

Honours were also received by a member of the Council, Professor F. Hoyle FRS who is created a Knight Bachelor for services to astronomy, by a member of the Engineering Board, Mr. D. J. Lyons, Director of the Road Research Laboratory, now a CB, and by a member of the RSRS Committee, Professor R. L. F. Boyd, FRS, Head of the Mullard Space Science Laboratory, University of London — a CBE.

here and there

Promotions to Senior Principal Scientific Officer during the second half of 1971 include Mr. D. B. Shenton who is now Projects Manager at the Astrophysics Research Unit. Also included are Dr. A. H. Gabriel of ARU and Dr. P. F. Smith and Mr. N. M. King of the Rutherford Laboratory who received Special Merit Promotion. Quest apologises for an error in the October issue (p. 14) which indicated the wrong grade. Dr. B. E. J. Pagel of the Royal Greenwich Observatory is Deputy Chief Scientific Officer.

Mr. J. Fox of Rutherford Laboratory has a temporary appointment for three years at CERN as a Visiting Scientist on the 300 GeV project. He will work on the powering problem of the superconducting option for the machine and related power supply topics. He is also a member of the Power System Planning Committee of the IEE.

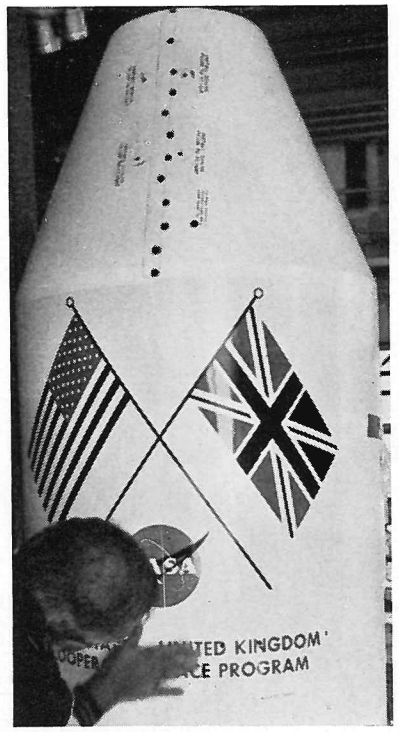
Mr. P. Wilde of Rutherford Laboratory has been appointed Visiting Professor to Westfield College, University of London.

Mr. C. T. Bocutt, formerly Secretary of the Computing Science Committee, has joined the Civil Service Department on a five year term of secondment.

1 2 3 4 5 6 7 8 9 10 11 12 13

Number references to photograph above — see 'centenary visit' opposite

report six



launched into 1972

The need for an independent Research Council entrusted with real powers and responsibilities is stressed by the Science Research Council in the sixth Annual Report. It points out that a Research Council is well able to judge the merit of educational and research proposals and to relate them to work in other disciplines and to the main needs of Industry and Government. It is also uniquely placed to attract people to voluntary public service who have the right experience and qualifications to advise on the best use of public funds. *(See page 2 of the Report).*

The report goes on to say that the Council is certain that there will not be sufficient funds to carry out the full programme that could be justified on educational and scientific grounds and expects that the university population will grow faster than the Council's resources for the support of research and higher education. Determination of priorities is therefore more important than ever. The pressure to spread resources more widely, and therefore more thinly, may make it more difficult to carry through the long-term capital projects that are needed if British workers are to continue to make an important contribution to scientific advance. *(p. 3).*

The Council is to continue to give priority to engineering and the applied sciences and to selected areas in the biological and physical sciences. It plans to increase support for neutron beam research and to maintain some priority for astronomy with a view to building a new northern hemisphere observatory. In the field of nuclear physics the domestic programme will have to be reduced to allow for the cost of taking part in building the 300 GeV accelerator at CERN. *(p. 3-4).*

In optical astronomy some projects which got under way in 1970-71 were: the decision to build a 48 inch Schmidt telescope on the same site as the 150 inch Anglo-Australian Southern Hemisphere telescope; the agreement with the South Africa Council for Scientific and Industrial Research to set up a new observing station in the Karoo based on the present Cape Observatory; and testing of possible sites for a new Northern Hemisphere Observatory. *(p. 13-15).*

The construction of the 5Km Radio Telescope at Cambridge was nearing completion, as were the repairs and modifications to the Mark I Radio Telescope at Jodrell Bank; and a detailed design study was commissioned for a 375 foot dish that could be linked to the Mark I at Jodrell Bank to form an interferometer with a baseline fifty miles long. Studies began on a proposal for an accurately figured dish to work in the millimetre band. *(p. 15-16).*

The building and dome for the 60 inch infra-red flux collector at Isana, Tenerife, were completed under the collaborative programme, ready for the telescope to be installed, and a design study was begun on a large 120 inch flux collector. *(p. 16).*

In space research preparations on the scientific satellites UK4 and UK5, due for launch in 1971 and 1973, were under way and the geosynchronous ultra-violet astronomy satellite project SAS–D was under discussion. The sounding rocket programme continued from the sites at Woomera, Kiruna and South Uist and included the first flight of the moon-pointing attitude control unit (ACU) and the flight of the first prototype model of the star-pointing ACU in Skylark rockets from Woomera. *(p. 17-21).*

The development of a young engineer's post-graduate education and training to meet both his own specialisation and the needs of industry was an immediate concern of the Engineering Board. It set up a working group which recommended wider training in the fields of research, development, design, production and marketing, their interrelationships, the function of management and the employment of

A new body in the sky brought 1971 to a fitting close for the space researchers. Formerly known as UK4 but now renamed Ariel IV to mark its successful transformation into a heavenly body, the satellite really begins to work for us in 1972 when data transmitting from the experiments gets into full swing. It should be visible through 7 x 50 binoculars from the United Kingdom by the end of January.

With our eyes rather on Europe at the moment, Ariel IV is also a reminder of the many ventures we undertake in collaboration with the United States.
Photos: on left is the satellite container and, on right, the four-stage Scout rocket ready for take-off.

economic criteria: a concept that has been labelled 'Total Technology'. *(p. 23).*

The completion of the CERN Intersecting Storage Rings four months ahead of schedule and within the original budget was a highlight of the year for the Nuclear Physics Board and so too of course was the Government's agreement to let Britain take part in building the CERN GeV Accelerator. The Board had pressed for this for four years. These two machines, with the other accelerators already on the site, will give CERN a collection of high-energy physics equipment superior to any in the world and British physicists will now be able to take part in work of the highest class until the end of the century. *(p. 26).*

At home the Rutherford Laboratory's work on superconducting magnets made great strides and a design study was completed on a 15/20 GeV electron synchrotron which could be built at Daresbury using NINA as an injector. Both Laboratories had teams working on important experiments and installations at CERN, and Rutherford began its collaboration with Karlsruhe (Germany) and Saclay (France) on development of the superconductors. *(p. 27-29).*

At universities a start was made to renew equipment for the film analysis units so that they could measure film from CERN's new large bubble chambers BEBC and Gargamelle (a heavy-liquid bubble chamber).

The Computer capacity at Atlas was about to be trebled by the installation of the new British Computer, ICL 1906A, due to be working by late '71, and the central computer at Rutherford was to be replaced by the IBM 360/195, six times as powerful as the present model 75, that could also be linked up to augment the new Atlas Computer. *(p. 34).*

A special section on Research in Physics is an important part of the report. Physics in its various fields takes about three quarters of the SRC budget and all four of the Council's Boards have some part in it. The Nuclear Physics Board supports high energy and nuclear physics; the Science Board supports atomic, solid state, plasma and applied nuclear physics through the Physics Committee and neutron-beam physics through the Neutron-Beam Committee; the Engineering Board supports materials and applied physics; and the Astronomy, Space and Radio Board supports astrophysics. *(p. 35-54).*

The special section concludes 'There is no doubt that the achievements chronicled here have made a substantial contribution to our knowledge of matter and radiation and are greatly to the credit of the people concerned in the universities and SRC'.