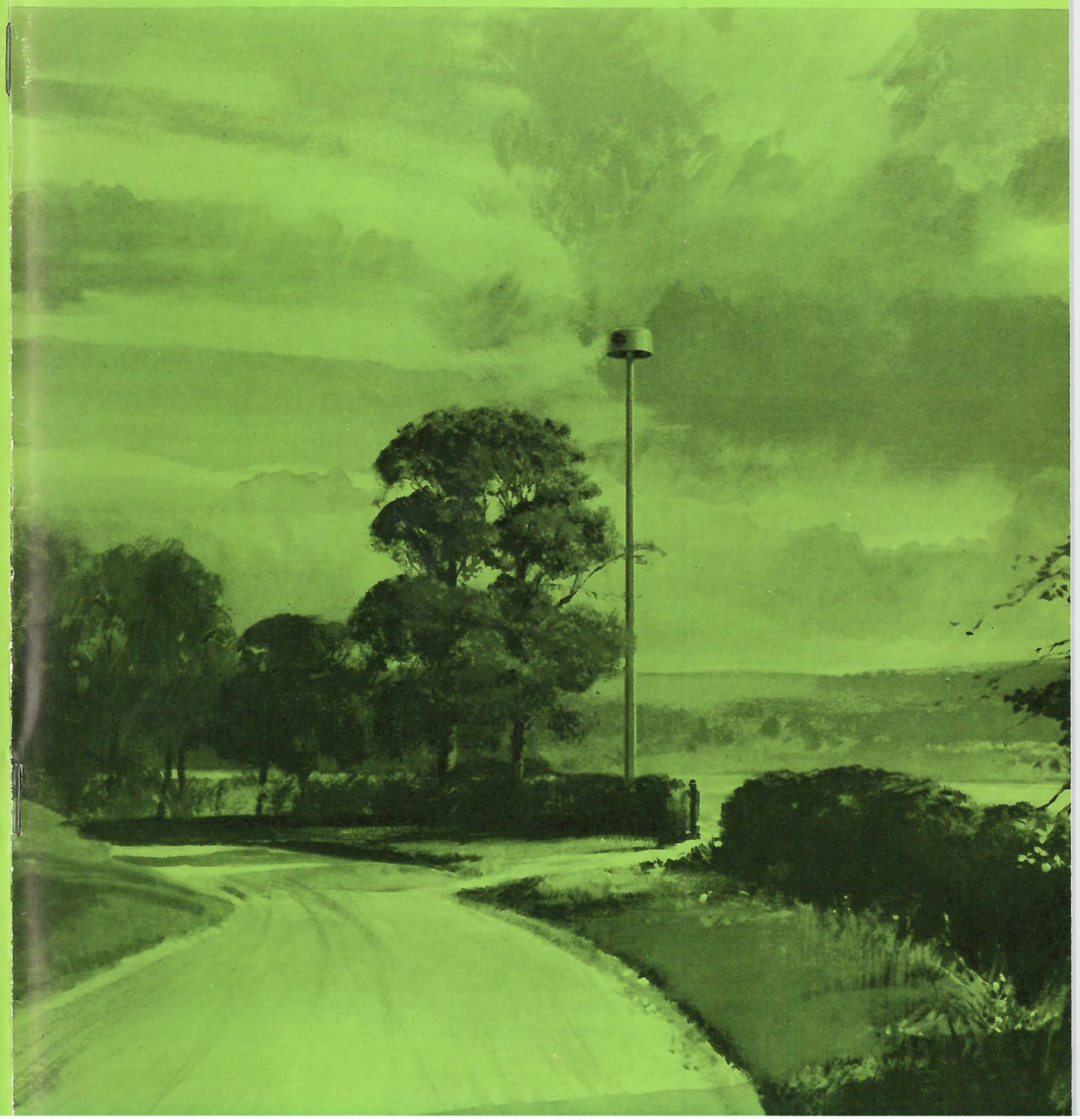
QUEST



Quest is issued four times a year by the Science Research Council for members of staff only. The Council is not necessarily associated with any individual views expressed.

QUEST

House Journal of the Science Research Council

Vol. 5 No. 2

April 1972

contents

Cover picture
An artist's impression of the slender pole that will carry Post Office microwave equipment of the future. The research into microwave propagation that is being carried out by the Radio and Space Research Station in collaboration with the Post Office and the ITU is described by John Lane in the article on page 14. In the picture the mast head canopy carries all the electronic equipment and the two dish antennas. It will be possible to lower it to ground level for maintenance using a cable and winch inside the pole.

Published by courtesy of the Post Office.

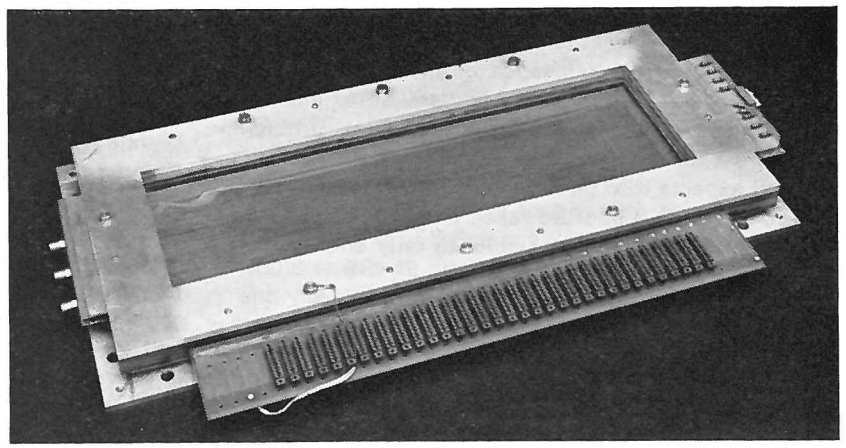
Published by the Science Research Council, State House, High Holborn, London, W.C.1. Set in Univers and printed by Wells KPL Swindon Press, Swindon, Wiltshire.

QUEST

The theme of the supplement in this issue is Technology. The supplement covers some aspects of how we help to improve the ways and means of carrying out basic research and, from another angle, how basic research leads to progress in technology.

Both sides have featured of course in the discussions, arguments and press comment following the Rothschild and Dainton reports on the organisation of Government research and development. The Science Research Council's own views, as expressed to the Select Committee on Science and Technology, are recorded in a shortened form in our first article.

An example of one of many new developments designed at one of our laboratories to help basic research, is shown in the picture.



The multiwire proportional chamber (seen right) is one of the newest types of instrument developed for the detection of charged particles in high energy physics experiments using particle accelerators. Designed and built at the Daresbury Nuclear Physics Laboratory, it allows high counting rates with good spatial resolution. The proportional chamber, signal wire electronics and the serial read out unit were shown at the 1972 Physics Exhibition.

after Rothschild

After the publication of the Rothschild and Dainton reports 'A Framework for Government Research and Development' as a Green Paper (Cmnd 4814), the five Research Councils gave evidence at an inquiry into the Government's involvement in and policy towards R and D. The inquiry was undertaken by the Select Committee on Science and Technology, Chairman Mr. Airey Neave, MP.

Speakers who appeared for the Science Research Council on March 8 were the Chairman Sir Brian Flowers, FRS, Sir Alastair Pilkington, FRS—a Member of the Council and the Engineering Board, Dr. J. A. Saxton—Director RSRS, and Mr. R. St. J. Walker, CBE – Director Administration.

The Council's comments on the Green Paper were published beforehand. The submission to the Inquiry stressed certain important points and four extracts are quoted here. The first two contain a summary of the SRC's programme and the kind of work it is supporting. The second two are a summary of SRC's comments on the reports and its proposals for the future management of the DES Science Vote.

What SRC does

The SRC manages some national services, such as keeping the time and providing data for navigation and radio communications. But almost all its funds are devoted to basic research and postgraduate training in mathematics and the biological, physical and engineering sciences. Nearly all the research is done by universities which employ about 14,000 academic staff in the science and engineering departments. SRC uses its resources of manpower (about 1,000 scientists) and money to supplement those already available in universities and similar teaching institutions in order to enable effort to be mobilised for

After Rothschild continued

promising research and to ensure advanced training relevant to national needs.

In many fields covered by SRC, firms and government departments carry out in their own laboratories, through research associations and through contracts, R & D which costs several times the SRC budget. The research which SRC supports is basic, as originally defined in paragraphs 6 and 7 of the Rothschild Report, and aims to provide the information, understanding and trained manpower required for applied R & D performed elsewhere. An additional aim, particularly in the engineering field, is to enable university departments to attract support from government departments and industry for applied work which helps to ensure the relevance of their research and teaching. When a programme undertaken to increase basic understanding also tackles a practical problem of interest to individual firms or departments the Council expects it to be funded jointly. It is, however, rare for an SRC-supported research programme to be valuable, or potentially valuable, to only one user.

Comments on the green paper

The Council finds it disappointing that Lord Rothschild gave such cursory attention to the two most difficult problems for government R & D:

a. determining which programmes are most worthwhile and what should be spent on them; and
b. ensuring that the results are exploited to the greatest public benefit;

and instead devoted disproportionate attention to the DES Science Vote in a report purporting to be concerned with the applied R & D.

SRC feels that a continuing dialogue between the users and the providers of R & D is essential to the solution of both these major problems. Much of the R & D financed by the government is for the general benefit of the community rather than for direct application by government departments. Most users of the R & D are in industry and the professions. Government organisation should therefore ensure that the knowledge and skill of industry, the professions, universities and polytechnics, executive departments, NRDC and other Government agencies contribute to the management of public expenditure on R & D. Wide participation in choosing research programmes not only leads to better decisions but automatically generates the dialogue which increases the prospect of useful results being applied.

So far as to the work of the Research Councils is concerned, the SRC thinks that a government department should certainly commission any applied R & D it needs for its own purposes. But the results of most of the work supported by Research Councils are potentially applicable by many users. Appointing a single department as a proxy customer for many users (including other government departments), coupled with the complete separation which Lord Rothschild recommends between the responsibility for basic research and applied R & D programmes financed by government through Research Councils, would lessen the chance of the right projects being chosen, would prejudice the natural interaction of research projects, would increase the difficulty of ensuring that the results are applied and would lead to wasteful duplications. To ensure that this does not happen, good governmental coordinating machinery as well as the continuing dialogue which Lord Rothschild recommends is essential. This machinery can readily be developed through the research council system on the lines suggested by the Dainton Committee with the added advantage of wide participation in the management of the programme.

Whatever framework for government R & D emerges for the future, Lord Rothschild's proposals for strengthened departmental chief scientist organisations are most welcome. Since these organisations will take two or three years to become fully effective in determining policy toward R & D the sooner they are set up the better. SRC would be glad to help in this. However, the timetable suggested for the transfer of responsibility for whatever part of the Research Council programmes is eventually agreed to be applied R & D commissionable by government departments is much too short to allow the build up of the necessary chief scientist organisations, to examine what work should be covered by the transfer and to ensure the maintenance of financial control.

the DES Science Vote

In its proposals for the future management of the DES Science Vote the Council says that executive departments cannot play their proper part in helping to manage the work of the Research Councils simply by being given an arbitrary fraction of the budgets of some Research Councils so that they can decide whether to commission R & D or to spend the money for other purposes. They need to be able to influence appropriately the course of whatever applied R & D and basic research (especially the part which the Dainton Committee describes as strategic) is undertaken by the Research Councils. Whatever arrangements are made for the commissioning and control of research, departments will only excercise influence if they set up effective chief scientist organisations and actively use the machinery of government to further their own policies. The present research council system provides a good basis for developing the necessary arrangements along the following lines:

- Each executive department should be responsible for commissioning the applied R & D (as defined in paragraphs 6 and 7 of the Rothschild Report) which it either needs for its own purposes or for whose potential users it is manifestly the best proxy customer
- The remainder of the Research Council programme should continue to be financed through the DES Science Vote
- Members of the Research Councils and their committees should be appointed either in consultation with the appropriate departments or in part on their nomination. The industrial and professional organisations concerned should also be consulted directly about some appointments to councils and committees. Departments should ensure that at least one member of each body with which they are concerned carries the departmental brief
- The appropriate departments should be represented on a new Board for Research Councils on the lines of that recommended by the Dainton Committee
- Departments should make effective use of the existing machinery of government to influence the allocation of resources to all R & D programmes including the DES science budget.

The SRC believes that the re-allocation of responsibilities for programmes between Departments and Research Councils in accordance with these arrangements should be made in the light of joint reviews of the current programmes and needs. Such reviews will be required whatever decision the Government takes about the future organisation of R & D. The Department of the Environment, the Department for Trade and Industry and the SRC have therefore begun a joint review of the work which they support in selected fields to check whether there is any undersirable duplication, whether any work now funded by the Council would be more appropriately funded by the Department (or vice-versa) and whether any improvement can be made in the present arrangements for collaboration both in managing R & D programmes and in trying to ensure that the results are used. The first fields to be considered are control engineering, transport, mechanical and production engineering and computing science.

Finally the SRC says that setting a framework for managing the DES Science Vote on the lines proposed would enable all departments concerned with research and development to have an appropriate say on the broad allocation of resources between programmes, on the division of the DES science budget between individual Research Councils and on the programmes pursued by the Research Councils with the resources made available to them. It would ensure that the important research financed through the DES Science Vote continued to be managed openly with regular reports laid before Parliament and with typical users of the results having a voice in the determination of programmes. It would give the benefits sought by Lord Rothschild's proposals without administrative complications and without enervating the creativity and inspiration which alone makes scientific research worthwhile.

£1M A YEAR FOR ATOMS MOLECULES AND PLASMAS ++ BEST DATA YET FROM SKYLARK SPACE
PROBE IN SOLAR ULTRA-VIOLET SPECTRUM ++ SYMPOSIUM ON ELECTRON AND PHOTO INTERACT
++ £59,000 HARDWARE FOR MULTI ACCESS COMPUTER SYSTEM ++ BRITISH EXPERIMENT IN ORI
ING SOLAR OBSERVATORY OAO-G ++ FIRST LUNAR SAMPLES FOR BRITAIN ARRIVE AT SRC ++
[illegible] FOR SRC O
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 ANLYSIS OF BUBBLE CH
BER PHOTOGRAPHS BY SWEEPNIK AIDED BY SRC GRANT OF £40,475 ++ SUCCESSFUL LAUNCH O

council commentary

december

The main item on the agenda was preliminary consideration of the Government Green Paper "A Framework for Government Research and Development" (Cmnd 4814), on which the Secretary of State had asked for the Council's comments. The Council gave guidance for the preparation of its reply and agreed to consider the question again in January.

The lease of the Annexe to the London Office expires in 1973 and, in view of the Government dispersion policy and the high cost of accommodation in central London, the Council considered the whole question of future accommodation. Proposals for a joint London Office have been discussed with the other Research Councils but there is not a close enough identity of circumstances to enable an immediate plan for sharing accommodation to be feasible. The Council decided that, wherever the London Office was to be established, it would be necessary for ease of communication to have a base in London for holding meetings of Council, Boards

and Committees. The Office were asked to prepare for consideration at a later meeting proposals for the future accommodation of the London Office staff. It is hoped to submit these proposals in May, following a survey by a joint Official/Staff Side Working Party.

Council went on to consider the future role of the Atlas Computer Laboratory. The Laboratory was set up in 1961 to help provide central computing facilities for universities. For the most part universities now have access to their own computers provided through the Computer Board and the University Grants Committee and have less need to use the ACL. Council approved the new function of the Laboratory, put forward by Dr. Howlett, that the Laboratory should concentrate on carrying out large or otherwise special projects for universities, particularly projects supported by SRC grants and requiring substantial guaranteed blocks of computing time. In addition the Laboratory will continue its own programme of development of system architecture, software and computing techniques.

january

The Council finalised its submission to the Secretary of State on Cmnd 4814 (The Rothschild and Dainton Reports) in the light of the discussion at the December meeting and subsequent developments, including discussions with the Department of Trade and Industry and the Department of the Environment. The submission was subsequently published. The main points are summarised on page 1.

Council approved a grant of £155,000 to Dr. Pounds at Leicester University for his part of a joint experiment with American Science and Engineering for flight in the NASA OSO-J satellite. The aim of the experiment is to carry out detailed high-resolution studies of the active and quiet coronal regions. Observation of the inter-relation and development of physically identifiable features will greatly help the study of the quiescent corona, the large-scale solar magnetic fields and the structure and evolution of the active regions. Council also approved expenditure of £300,000 for a rocket campaign to be held at Kiruna or Andoya in 1973. There is considerable interest in space research experiments flown at high latitudes, because of the upper atmosphere conditions in the auroral regions, and the 1973 campaign will include both Petrel and Skylark rockets to enable experimenters to get the maximum scientific return.

In engineering, Council approved a grant of £243,700 to Professor Rosenbrock at the University of Manchester Institute of Science and Technology to continue his work on design of multi-variable control systems. The UMIST Control Engineering group is one of three in this field on which the Council has concentrated support. The central research of the group represents a new approach to control of multivariable systems and the first version of the design package has now been developed. After detailed assessment, a second more advanced version will be produced and it is expected that the highly developed system capable of implementation will be available by late 1975. This work involves the use of results from a series of industrial projects and the system being developed will have many applications in industry.

Whenever a suitable opportunity arises, the Council discusses the work of one of its subject Committees, in relation to the health of UK research in that subject.

february

At this meeting it reviewed the work of the Mathematics Committee and Professor Cockcroft, Chairman of the Mathematics Committee, and Professor Jeffrey, Chairman of the Engineering Mathematics Panel, took part in the discussion. Professor Cockcroft spoke of the substantial growth in mathematical research in recent years and particularly mentioned the useful part played by symposia in making advances in chosen areas. Notable examples were the symposium in topology of manifolds held at Cambridge in 1964 and more recently, that in differential equations at Warwick. The Mathematics Committee are hoping to arrange symposia in statistics, operational research, numerical analysis and other branches of applicable mathematics. Professor Jeffrey spoke about the recently published report of the Engineering Mathematics Panel. The Panel had been set up to assess the mathematical needs of engineering and technology and to consider how these needs could be met. The most benefit is likely to come when engineers and mathematicians are working side by side and the Panel are considering joint engineering/mathematics projects at postgraduate level, study groups where research workers from industry and government laboratories would be invited to discuss their research problems with mathematicians, and seminars in areas of engineering which rely heavily on mathematical techniques.

The Council went on to review its various post-doctoral Fellowship schemes. It was agreed that in future there should be one unified scheme providing about 60-70 awards each year. It is proposed that the value of the new Fellowships should be linked to the university lecturer scale, which would bring them more into line with other sources of support, and Government approval for this increase in their values is now being sought.

Council also approved purchase of an IBM 370/165 computer for the Daresbury Nuclear Physics Laboratory, at a cost of £2.1m., to replace an existing IBM 360/65 which will be transferred to Liverpool University. In order to satisfy the requirement of the on-line links to experiments and interactive computing by the use of display terminals, the Laboratory's need is for computing speed. The maximum power of the 370/165 is about four times that of the present 360/65, which was purchased in 1966. If the Government approve the purchase, the new computer should meet the needs of Daresbury up to 1980.

selectivity

'Staff Side will wish to know that RHEL propose to introduce a new industrial shift system called the Second Harmonic Cavity Assembly Shift.'

O. S. Letter

Do they do it with tuning forks and amalgam and then transpose – or the other way about?

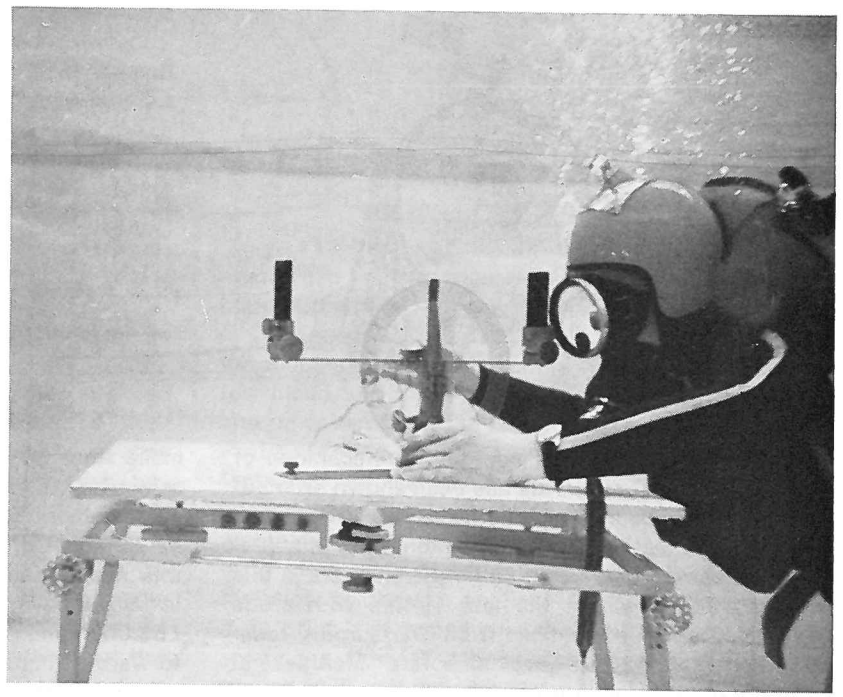
oceanology

A new method for surveying the seabed that is being developed under grants from the Science Research Council and the Natural Environment Research Council was displayed at the Oceanology International Exhibition held in Brighton recently (March 20–24).

The SRC grant, to Strathclyde University, covers the development of surveying instruments for use underwater. These include a modified plane tabling system, to use with an underwater alidade, and an illuminated target staff.

The NERC grant covered the design and construction of a collapsible catamaran which is suitable for both diving and hydrographic work and can be packed up and carried in a car-drawn trailer.

The exhibit was displayed by the Department of Education and Science (on behalf of the two Research Councils) and formed part of a joint display to show the UK Government's part in oceanology research and development.



In the picture Dr Peter Milne, Lecturer in Civil Engineering at Strathclyde, is seen testing the alidade and table in the University swimming pool.

summer school

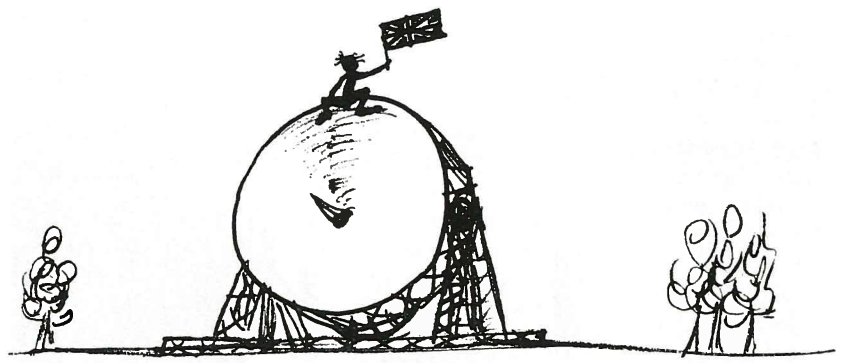
Culham Laboratory is running another Summer School introductory course on Plasma Physics and its applications in other branches of physics and in technology. The course is suitable for final year undergraduates and postgraduate research workers. Apply to UKAEA Culham for further details.

concentration

On the flight to a meeting at London Office, two chaps from ROE were busily going through the paperwork in case they found something they should know about, when one took time off to remark 'I must get hold of that Rothschild/Dainton report sometime.'

He nearly leapt out of his seat when a man across the gangway leant over and said 'I think you'll find it's out of print but I have a copy here I can let you have'.

'Who are you then – Lord Rothschild?' he said, recovering a little. 'Oh no I'm Dainton' he said.



a place in the sun

How and why we built a 60 inch Infra-red Flux collector in Tenerife

Richard Harris

. . . the grant was increased . . .

The rewards of entering a new field or technique of science are often great. This has been shown dramatically in the last quarter century by radio astronomers: UK scientists have drawn inspiration from the pre-eminent position enjoyed by radio astronomers in this country who started in the late 1940's with crude radio telescopes, often built from war-surplus radar equipment, and now have elaborate facilities at Cambridge and Manchester.

Back in 1968, infra-red astronomy was judged to be another such exciting new field. Already groups in the USA were making infra-red observations with small telescopes, or rather "flux collectors" as they are called, since infra-red astronomy does not demand the same optical precision as optical astronomy.

In 1968 a proposal was put to SRC by Professor Jim Ring, head of Imperial College's Infra-red Astronomy group for a large — probably 120 inch — flux collector which would be available to UK infra-red astronomers. As a first step, a simple 60 inch device was to be built quickly and cheaply for site testing before embarking on more permanent and costly facilities.

Other groups expressed interest and it was decided to provide a joint facility. A grant of £27,000 was made to Imperial College in October 1968 for the construction of the site testing instrument and for a design study on the larger one. All the interested groups were associated with the project and a Management Committee was constituted including not only members of these groups but also a number of engineers including Gordon Carpenter of the Royal Observatory, Edinburgh. As design work went on it became apparent that a little more money spent on the flux collector structure and on the building would make the 60 inch instrument capable of useful scientific work for a number of years. The 60 inch mirror, then being polished by Sir Howard Grubb Parsons & Co. Ltd., was known to be adequate for this more exacting role without additional cost. So in September 1970 the grant was increased to £56,000 and detailed design work was pressed forward at Imperial College on the new basis.

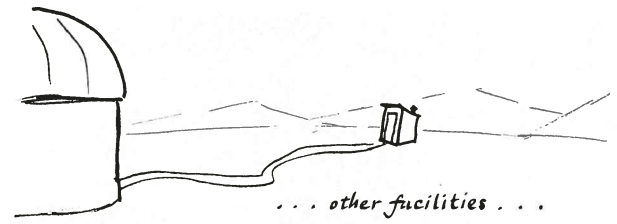
It was clear that there could easily be a lot of delay in getting the flux collector operational unless the job was planned adequately so Astronomy section of London Office weighed in with a series of network analyses of the project.

The contractor for the flux collector structure was Dunford Hadfields Ltd. of Sheffield whose research and development team undertook the work in one corner of the company's huge erection shop (their normal work is making rollers for use in steel rolling mills). Working closely with the designer, John Long of Imperial College, the firm was able to meet his exacting specifications accurately with the result that a highly engineered job has been produced.

The list of possible sites for the flux collector read like part of Thomas Cook's brochure. Finally the choice lay between a spot near a remote meteorological station at Izana on the island of Tenerife and a site in the Sierra Nevada mountains of Southern Spain, so site testing was started. There is no space to record this process in detail here (somebody may write the troubled story of astronomical site testing one day), let it suffice to say that the attractions of Tenerife proved to be stronger. A building contractor was instructed to erect a circular concrete structure on the slopes of Mt. Teide (an extinct — we hope — volcano) in readiness to receive the flux collector and the dome.

Then due to a misunderstanding, workmen engaged in re-laying a nearby public road extended their operations horizontally rather than vertically, as they had been directed, with the result that the road surface, somewhat thinner than planned, extended almost to the door of the observatory. The dome was prefabricated in USA and shipped in segments to the site for erection under the guidance of the manufacturers.

Meanwhile, back at Dunford Hadfield's the flux collector had been shop assembled and people from the Royal Observatory, Edinburgh, had arrived with black boxes containing the complex drive and control system, which had been designed and built in the ROE workshops. After trials had been completed successfully, the flux collector was despatched to Tenerife where it arrived in January 1972. It was followed soon after by the mirror, which had been aluminised in the Isaac Newton Telescope coating plant at the Royal Greenwich Observatory.



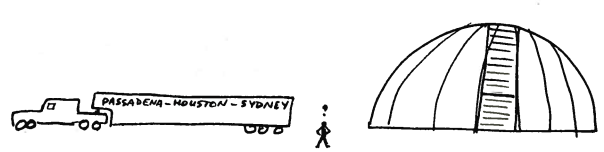
. . . other facilities . . .

On Tenerife, transport to take the flux collector up the mountain road and a crane were ready but dense low cloud and three metres of snow also visited the site. In spite of this the flux collector was installed by Professor Ring and his team and the dome securely fastened over the whole. We know that it is secure, because there was a storm of unprecedented violence within days of completion. All that remains to be done is to build a small office and workshop, with other facilities, on the site near the dome. By the time this is in print it is hoped that the flux collector will be sending a flow of astronomical data to the various groups of IR astronomers in the UK.

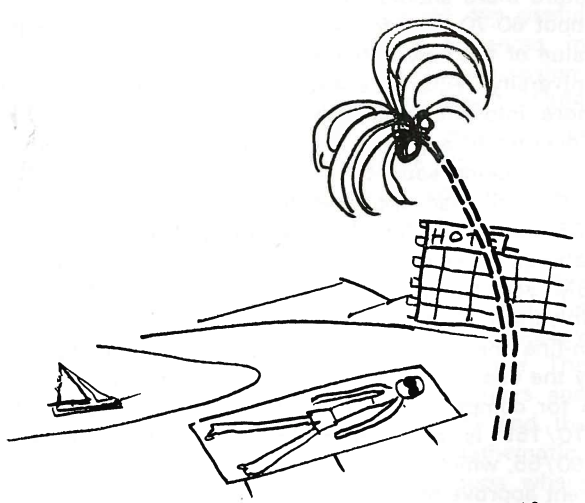
Already the design of the larger flux collector—the goal of the whole exercise—has been narrowed down to two possible concepts and design studies will be put in hand shortly. This next step is essential if UK astronomers are to achieve and maintain a significant role in the field of infra-red astronomy. The creation of the first instrument provides a good example of cooperation between SRC establishments and University groups, led by Imperial College.

Richard Harris is an SSO in Astronomy, Space and Radio Division.

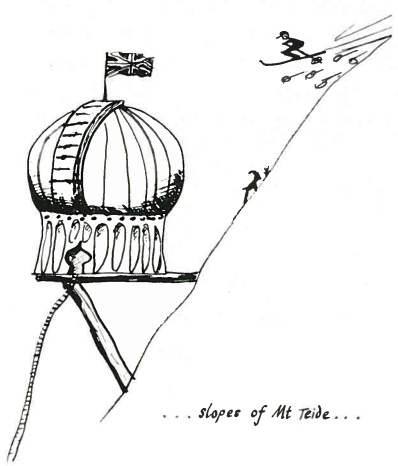
Drawings by the author.



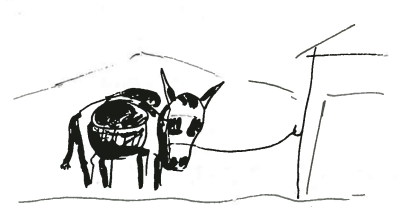
. . . shipped in segments . . .



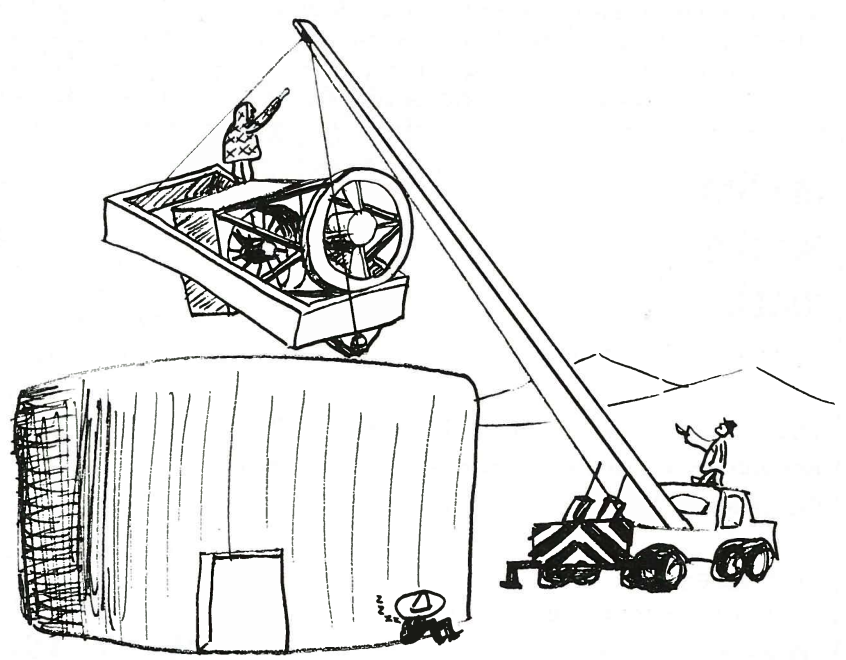
. . . attractions of Tenerife . . .



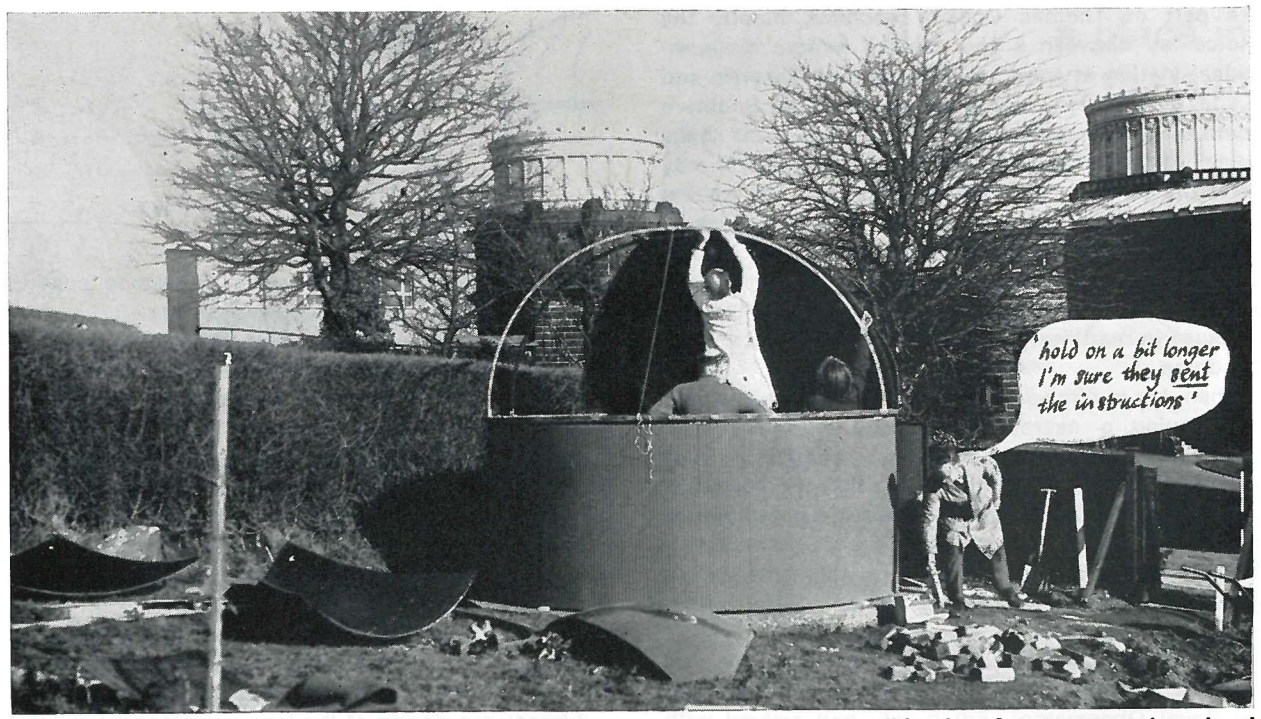
. . . slopes of Mt Teide . . .



. . . transport . . .



. . . the flux collector was installed . . .



We think this may be the long-lost team from ROE who have been studying possible sites for a new northern hemisphere telescope. Apparently, no doubt worried that a site south of the border might be chosen after all, they have taken the matter into their own hands. The new astrophysical dome is 9ft. 3ins., built at a cost of £12.97* and we believe may be used to house a 6 inch magnifying glass for observing astronomer's frostbite.

**Unfortunately work did not begin until March when funds for 71-2 were sorely depleted by 'Foreign Travel' (cf seasonal greeting under sub-head A.2).*

SEARCH

An exhibition called 'SEARCH' of scientific research supported by the SRC and the Agricultural, Medical and Natural Environment Research Councils is now on at the Science Museum, South Kensington, until the end of October 1972. The overall theme of the exhibition is the relevance of scientific research to everyday life and exhibits are designed to show the general public and especially young people what research scientists are doing. The four aspects of the theme are science and agriculture, science and health, science and the environment and science and space. Four associated lectures will be given to science teachers. The exhibition is sponsored by the Department of Education and Science.

maths
moths
meths

— or divine inspiration ?

What lies behind closed doors in the labs of SRC? Are you, for instance, the spanner in the works or the genius of the lamp of progress ?

TELL QUEST
SEND IN ARTICLES, NEWS, PICTURES AND ODD ITEMS WHENEVER YOU CAN.

The theme of Quest's July issue will be SRC in Europe and international co-operation generally. If you have any ideas, short anecdotes or pictures please tell your local correspondent or the editor (as listed inside the cover) **before May 26.**

The theme for October will be computers and their uses. Please send articles (250 words to 1000), pictures and suggestions as soon as possible and **before July 14.**

write for Quest now

QUEST INTO TECHNOLOGY

Supplement on technology and research in the Science Research Council

In the days of DSIR "technology" was used as the generic term for all activities other than the sciences. In the UGC structure the "Technology" Sub Committee incorporates "engineering and other technologies." In SRC however it is the "Engineering" Board which covers the traditional engineering disciplines and some other subjects which are primarily technological. By extending the scope of technology to include the methods of human and social sciences as well as the physical sciences the circle is completed with the adoption by the Engineering Board of "Total Technology" as the definition of a proper subject of study for a general background in engineering. So much for our understanding of the meaning of the terms we use.

In SRC it is a cardinal point of policy to give special support and encouragement to engineering - and its relevant technologies - independently of any support which arises as a natural consequence of the pursuit of the "big sciences."

Space availability here permits only the briefest statement. In 1962 out of nine sub-committees of the Research Grants Committee of DSIR, only one was devoted to technology. Its grants totalled in that year about £1m., some 40% of the sum committed by the "little sciences". In 1963 metallurgy and materials was recognised as an independent subject incorporating what had been low-temperature and solid state physics. Despite its partial content of pure science this was later, with technology, to be incorporated into engineering. At this time the two subjects committed £2m. about 60% of the sum committed by the pure sciences. In 1964 the Computing Science Committee came into being, another subject to be incorporated later into engineering. With the setting up of SRC in 1965 several more engineering committees were instituted. Recognition of the special requirement to help the development of engineering in the universities was highlighted with the setting up of the Engineering Board in October 1969. Compared with one committee and £1m. of grants in 1962 the situation in 1972 is nine committees and nearly £9m. of grants – more than the total for the "little sciences".

A physicist at the Daresbury Laboratory operating a remote graphics terminal to examine the nature of the data being collected.

fast data links

The development of on-line computing and data links at the Daresbury Nuclear Physics Laboratory.

Trevor Daniels

The term 'On-line' computing, like many concepts in a rapidly expanding field, is not precisely defined, but at the Daresbury Laboratory we mean the intimate connection of computers and experimental equipment for the purpose of data acquisition and experimental control. If the computer and equipment are not adjacent, 'Data Links' are used to transmit information between them.

Fast data links continued

In the course of a high-energy physics experiment four distinct phases may be identified: design, setting-up and checking-out, data taking and data analysis. Each of these phases can benefit tremendously from the application of on-line techniques. For example, in the setting-up and checking-out phase, on-line connection to a computer enables the tedious checking of electronics or the measurement of magnetic fields to be performed quickly, accurately and with full documentation. In data acquisition a computer is almost vital as a means of data collation and validity checking. If it can also perform partial analysis on-line and feed graphical results back to the experimenter, as well as keeping an eye on the correct functioning of experimental equipment, it becomes a powerful tool.

early uses

On-line computing is not new. Small computers were first attached to experiments a decade ago, and considerable improvements have been made since then. Small computers are, however, unable to perform complex data analysis on-line, and we cannot afford to dedicate larger computers to a single experiment. Clearly one answer is to share the facilities of a large powerful computer between many experiments. This has been achieved in several laboratories by a variety of techniques. At some there is intermittent connection to the central machine while others provide a continuous service to selected users. At Daresbury we have attempted to provide a continuous service to many users.

the Daresbury system

The data link system at Daresbury was developed with the following aims. The system should be painless to use and users should not have to be aware that between their own equipment and the central computer there is a complex system of data handling equipment. All users should be insulated from the activities of other on-line and normal users. In particular it should not be possible for an error on the part of one user to have a disastrous effect on another. The links must be capable of handling the highest data rates likely to be produced by experiments and it must be possible to invoke any data analysis program and have its results relayed to the experimental area. The adoption of these ideas has covered many fields in hardware and software design. These include the writing of a complete operating system for an IBM 1802 computer which controls the operation of the data links and the design of a communication system between the IBM 360/65 and the IBM 1802, which is not susceptible to users programming errors and which permits the users to write programs for the IBM 360/65 in a simple language (FORTRAN) for on-line operation. The reliability of the IBM operating system also had to be improved in order to achieve the design aim of a mean-time to failure (for any reason) in excess of 24 hours. The hardware design included the development of fast reliable data links and graphics terminals which allow two-way communication with the on-line program.

The system has been developed during the past few years and by now most experimental groups are reliant on their on-line programs for the normal running of their experiments. Most groups use the power of the main computer to make extensive checks on the validity of incoming data and on the correct functioning of the equipment, and to follow the course of the experiment by partially analysing data as it is collected.

The benefit to the physicists was best described by one of the group when the IBM 360/65 broke down, due to hardware failure, and he said 'We can continue to run, but it's as if we were running blind'. At Daresbury we have tried to provide facilities which will enable experimental physicists to run with their eyes fully open.

---

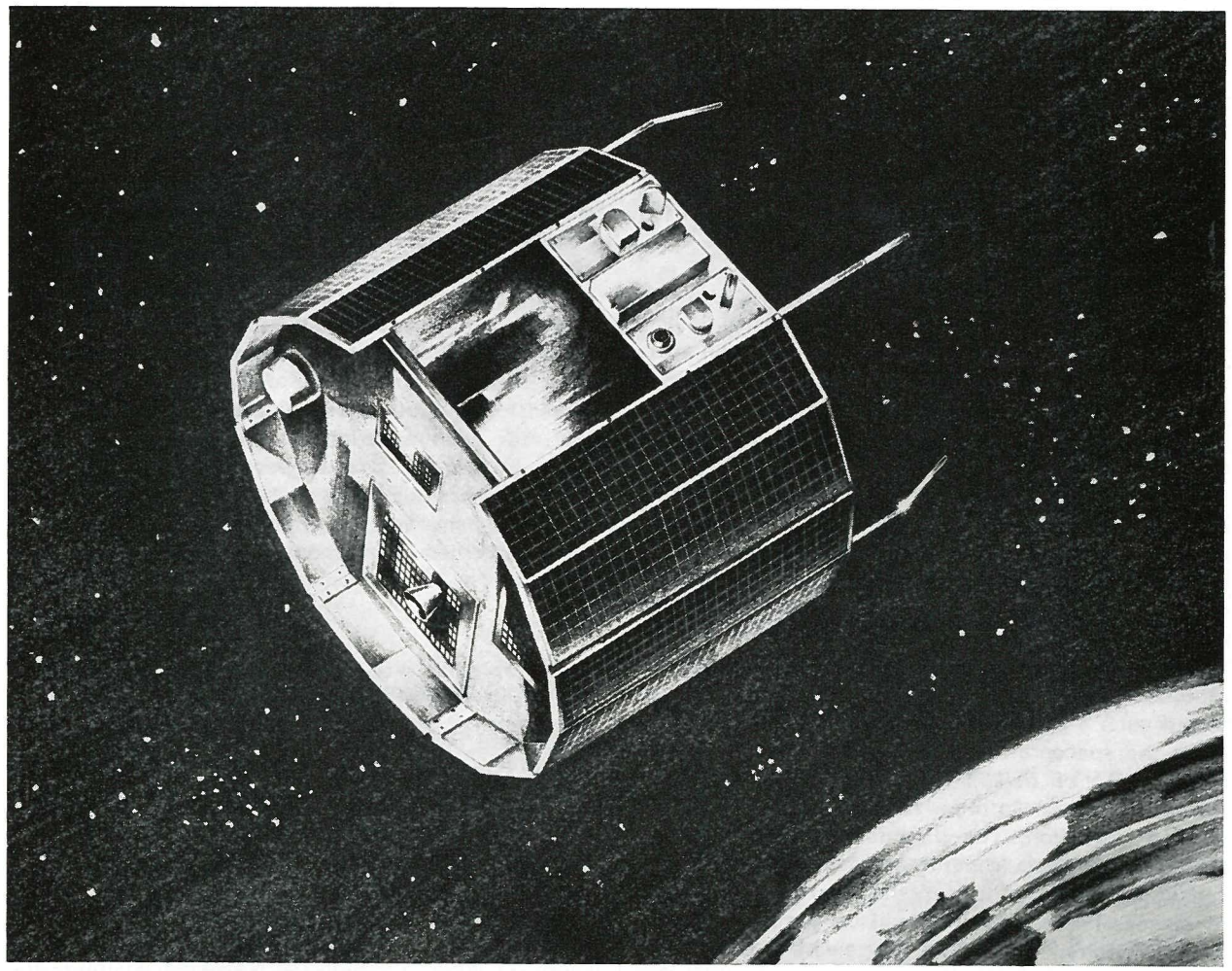
problem

The Engineered Mathematics Committee has obtained approval from the Pure Science Board (motto "To the pure, all things are pure") for a high growth rate for its Parallel Lines programme. In a slight fit of absent-mindedness the Board has allocated £1m. for the first year of the programme and agreed that expenditures may increase at an average rate of 20 per cent a year for the next five years. The Committee are confident that this is a bankable assurance.

What expenditure, in total, has the Board committed itself to or, looking at the situation from a different point of view, for how much has it been taken?

answer

If your answer is about £10m., or if you have given any numerical answer, you're wrong. The Committee can (and will) take the whole of the Board's funds in years 2, 3 and 4 whatever the growth rate specified, provided that it takes nothing in years 5 and 6. It all depends what you mean by "average".



Artist's impression above is reproduced by courtesy of Marconi Space and Defence Systems.

satellite technology UK5

J. F. Smith

The overall management of the scientific satellite programme in this country has been the responsibility of the SRC since its formation when the Space Research Management Unit was transferred to it from the Office of the Minister for Science. The satellites concerned comprise the Ariel series (called 'UK' before launch) which are the product of collaborative programmes with the US National Aeronautics and Space Administration (NASA) who supply the launch vehicles. Ariels I and II were American satellites with British experiments, whereas Ariel III was built in this country. Ariel IV was a development based on Ariel III, with increased control capability and an attitude control system. It also had, for the first time an American experiment on board, and had an overall scientific objective rather than being a collection of experiments.

The UK5 satellite is devoted entirely to x-ray astronomy, an exciting new science (*see Quest January 1972 page 9*). It is the most sophisticated SRC satellite to date and its construction is well under way. The launch will probably take place from the Italian San Marco platform off the coast of Kenya using a NASA Scout rocket, in late 1973. Launching from this site will enable an equatorial orbit to be achieved, which is preferable so that the payload of six cosmic x-ray experiments will be less affected by the radiation belts and the South Atlantic anomaly.

The UK5 Programme Management covers all aspects of the project and is concerned in all its phases. It has a headquarters function in collaboration with both NASA Headquarters and the Ministry of Defence Procurement Executive Headquarters staff. MOD (PE) act as SRC agents in the procurement of the spacecraft from contractors who are, for UK5, Marconi Space and Defence Systems, Portsmouth. The management team also work at project level with

UK 5 continued

the Goddard Space Flight Centre of NASA, with the Royal Aircraft Establishment (RAE), and with the experimenters. It has a special responsibility for the experiments to ensure that they are produced on time, correctly tested and built to the right standards. All aspects of the programme are covered – from payload inception through to launch operations, post launch control and data processing.

UK5 is a spin stabilised spacecraft which is designed to rotate at 10 rpm in orbit. During launch the Scout fourth stage and the payload will be spun up to about 170 rpm to give stability to the assembly while the fourth stage is burning. After separation from the motor the satellite spin rate will be reduced using gas jets, fired on command from the ground, until the correct rate is achieved. The gas used will be propane, and a ten pound charge of this will be adequate not only for de-spin and subsequent spin maintenance operations, but also to power the attitude control gas jets for all the attitude movements required for about two years of operation. This will be the first time that propane has been used in a satellite attitude control system although RAE has already tested such a system in a Skylark rocket payload.

As the spacecraft is spinning the attitude control jets have to be pulsed one at a time at a specific rotational position in order to tilt the spin axis in the required direction. The direction is determined by reference to signals from the spacecraft sun roll-phase sensor, and the amplitude by the duration and number of pulses. These quantities will be computed at the control centre, based on the existing spacecraft attitude and the next point in the sky at which the satellite and the four pointing experiments will be aimed. The other two experiments observe sideways from the spacecraft and hence continually scan the sky as it rotates.

Although one experiment uses a relatively simple and direct command system to turn it on and off and to control its modes of operation, the others, and also the attitude control system, use command registers. Commands from the ground station are given in a tone-digital form, and these are decoded in the spacecraft, routed to the appropriate register, and then a succession of noughts or ones are, as it were, pushed into it from one end until it is full. There may be as many as 25 of these, which in theory means that that particular register can be loaded in 2^{25} ways, each of which could represent a different command state. Of course only a fraction of these possibilities are used but it still represents a large number of available conditions. After the register has been loaded the exact state of each part is telemetred back to the ground where it can be checked. The command condition which has been set up is not acted upon by the satellite until a further enabling command is sent, and this is normally only transmitted after checking the command register loading.

The data obtained from the experiments will be sorted, and stored in one of two core stores on board the spacecraft. These stores and their accompanying circuitry act as computors with a limited number of programs which can be selected by command. In general the experiment outputs obtained while the satellite is in one particular sector of its rotation are stored, and added to on later rotation, this being carried out over a finite (and variable by command) number of sectors. Once in each orbit signals representing the contents of the stores are transmitted to the ground, on command, and these represent, for each experiment, a set of x-ray pictures taken in each scan sector and integrated over the orbit. By combining the signals in this way in the spacecraft, the amount of information to be stored and transmitted is enormously reduced.

'the most ambitious undertaking of its kind'

Satellite control is a disembodied type of activity, as one can never see or touch the equipment one is controlling. The UK5 control will be the most ambitious undertaking of its kind to be operated from this country. The satellite will be in an equatorial (or near equatorial) orbit and will not pass within telemetry range of the United Kingdom. There will only be one NASA STADAN station covering UK5, at Quito, Ecuador, although the NASA Ascension Island station will be acting as a back-up facility. UK5 will pass over the Quito station once in each orbit, 15 times a day, when transmission of the core store data should be commanded. All of the data taken will be collected together, probably at the Goddard Space Flight Center (GSFC) near Washington, and sent via the NASA data links to the control centre at RSRS once a day. This data will be processed on the control centre small computers and the station 1904A, and passed by data links using telephone lines to the experimenters in Holmbury, Leicester, and Imperial College. The necessary commands will be decided by the control centre staff based on the previously agreed observing programme and requests from experimenters and the project scientist, and technical limitations or problems.

In addition data from one pass will be transmitted directly it is received, to RSRS, so that the spacecraft attitude can be computed using both the data from the on-board sensors and the known orbital positions when the data was taken. The commands decided will be checked by computer and then transmitted over the data links to Quito where they will be verified and stored in the station command encoder. On the appropriate pass the commands will be passed to the spacecraft, the achievement of the correct state verified either at the station or at the control centre, which would then be receiving the data at the same time over the links, and after verification the enabling command will be sent. The spacecraft will then execute these commands, *eg* by changing atitude or experiment command state, and the next 24 hours observing will begin.

The technologies involved in UK5 cover telecommunications, data processing, electronic components manufacture, structural design and testing, gas control system design and proving, electronic equipment and test equipment manufacture and test, and environmental testing. No one person can have a thorough knowledge of all of these subjects but it is this wide variety of technological activity together with the scientific interests and the range of personalities encountered, and also the excitement of a live project which make satellite programme management such an absorbing occupation.

John Smith is the Satellite Programmes Manager (Eng I) in the Space Research Management Unit (SRMU). The Unit was transferred from London Office to the Radio and Space Research Station on February 1, 1972.

The UK experiments in UK5

- **Measurement of source positions and sky survey in the energy range 0.3 — 30 KeV. MSSL/UCL.***
- **A sky survey in the energy range 1.5 — 20 KeV. LU***
- **A pointed experiment to study the spectra of individual sources in the 2-10 KeV energy range. MSSL/UCL***
- **An x-ray polarimeter for the 4-20 KeV band. LU***
- **A pointed experiment to study high energy x-rays. IC***

the experimenters*

The Mullard Space Science Laboratory of University College London (MSSL/UCL)

Leicester University (LU)

Imperial College, University of London (IC)

all systems go

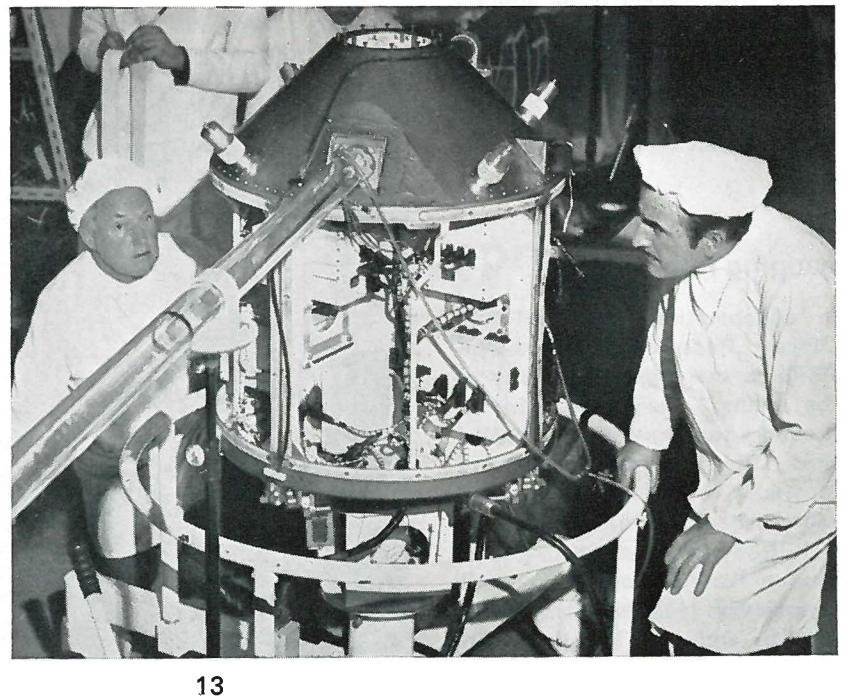
Fine adjustments to the data output systems before the launch are most important in satellite technology.

a systematic look

'Investigations are under way into the yields and reliability of strippers' says the first NSF newsletter. Eager to find out more we began at the beginning and discovered that the newsletter is an account of progress on the design study for a new nuclear structure facility – a large tandem electrostatic generator.

If it is eventually decided to build the generator it will be a national facility and studies are centred on siting it at Daresbury. The newsletter will be published periodically for the benefit of possible future users to give them a chance to comment on the proposed plans – and, no doubt, on the peripheral studies on which we look forward to hearing more.

Seen in picture below are V.A.W. Harrison (I) and D. G. Carter, of the Radio and Space Research Station, carrying out a pre-launch check of the UK 4 (renamed Ariel IV) pay load. The satellite went into orbit in December and is now transmitting data from all five experiments to measure the intensity of the electromagnetic radiation (noise) over a wide band of radio frequencies (for details see Quest Vol. 4, 3 p8).



microwave propagation

millimetre investigation at RSRS aids progress in communication

J. A. Lane

A feature of modern technology is the rapid growth of radio-communication links, in both terrestial and earth-space systems. Telephone traffic, data communication and telex services are all expanding rapidly and several new systems may be in use by the 1980's. While some of the demands can be met by the installation of more coaxial cables, considerable extension of radio links will be necessary, especially at very short wavelengths—'microwaves'. But the existing microwave system which has formed a major part of the Post Office trunk network in the last 20 years, has no more channels available. The use of even shorter wavelengths is now vital.

Unfortunately, the advantages of very short wavelengths – large information capacity and compact equipment – are off-set to some degree by the fading caused by various weather conditions. Large changes in humidity and temperature on the radio link can occasionally cause serious fading. Even more important is the absorption produced by heavy rain. For example, at a wavelength of 1 cm, thunderstorm rain could cause a reduction of ten times in received power for every kilometre of path through the rain. These effects need to be studied so that the most efficient use can be made of millimetre waves, for both ground-to-ground and earth-space systems.

gauging rain fading

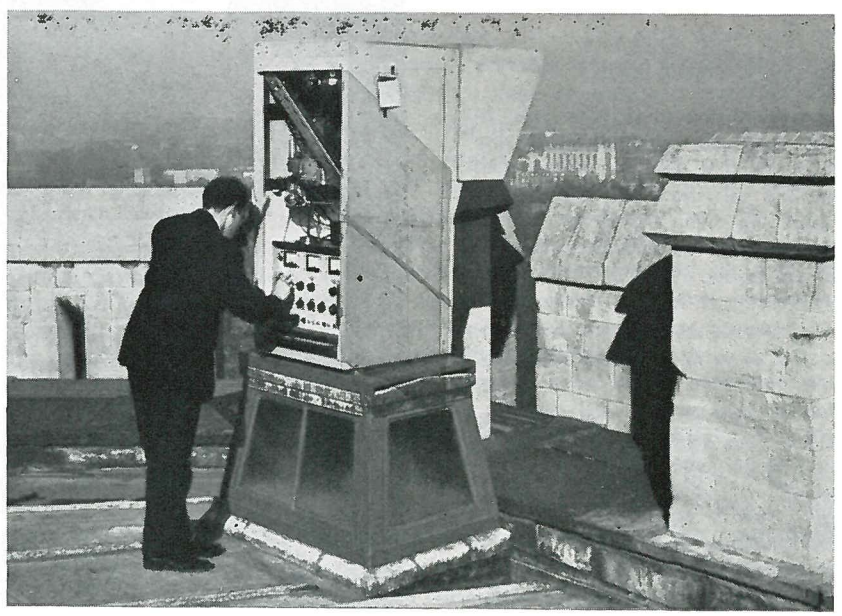
In collaboration with the Post Office Research Department, RSRS is carrying out a study of the fading caused by rain on ground - to - ground microwave links. The main experiments are located in the Martlesham-Mendlesham area of Suffolk.

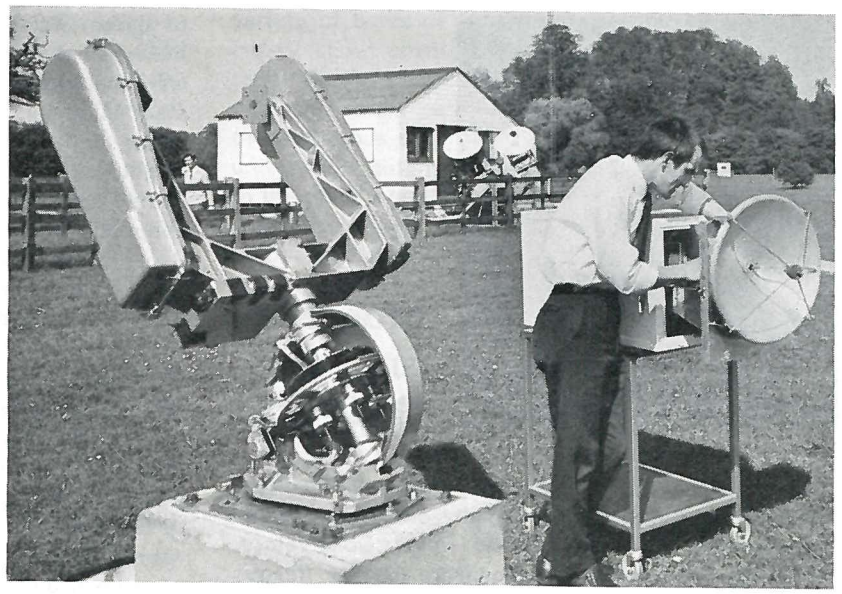
RSRS has constructed a new type of rapid-response rain-gauge specifically for use in these studies and has installed forty gauges on two lines of a network of microwave links near Mendlesham. The readings from each gauge can be transmitted, via a radio telemetry link, to a central control and data-handling station. A reading can be obtained every 10 seconds and will be recorded together with data on fading from the several links. The latter are of various lengths, spacings and frequencies so that a comprehensive investigation will be possible of the experimental and theoretical features of fading caused by heavy rain. A particular requirement of great practical importance is the study of the spacing needed between adjacent, alternative routes in a microwave system so that if serious fading occurs on one path an alternative route with little fading can be used.

To supplement the rain-gauge information, two radars (one 3-cm band; one 10-cm band) have been installed at a site just to the NW of the network. These radars will provide information on the location and approximate intensity of rainfall structure over the network. Radar observations and combined microwave and rainfall measurements are now in progress, and the full scheme will be be in operation later this year.

Several other investigations are in progress which will extend the experiments on terrestrial links to wavelengths shorter than in use at Mendlesham .For example, a 3mm link was set up in 1970 between Windsor and RSRS, a distance of 2.7 km. The results on the fading observed during 1970 and 1971 show that even wavelengths as short as 3mm are of significant practical application for local distribution of telecommunication services, and the information has already been used by the Post Office to make a preliminary assessment of the feasibility of such local networks.

Studies of the theory of absorption by rain are also in progress, using results from a short link (500 m long) equipped with 4 rapid-response rain-gauges. Furthermore, on the basis of both the Suffolk experiments and the more fundamental studies at the RSRS site, attempts will be made to extrapolate the results of the effects of rain on millimetre links to other regions of the UK.





other obstacles

In relation to terrestrial microwave links, experiments have been carried out in collaboration with, and largely funded by, the Post Office, to measure directly the extent to which tall buildings can scatter microwave energy. Such scattering could seriously limit the information capacity of radio links. The technique used is to irradiate a building with pulses from a radar transmitter mounted in a helicopter near the building. A fixed receiver a few kilometres away measures the relative amplitudes of the direct and scattered signals.

Other studies are related to the important problem of the reliability of earth-space links. Microwave radiometers are being used at several wavelengths to measure the fading caused by varying weather conditions and to investigate the relationship of the results to meteorological data. Two techniques are employed. In one, the radiometers automatically track the sun, which serves as an extra-terrestrial microwave source. In the other technique, measurements are made of the "noise" radiation from the absorbing media in the troposphere (rain, clouds, water vapour and oxygen). The results obtained at wavelengths near 1 cm have already been used to provide a guide on the reliability of earth-space links for the UK area. The results are also being used in international discussions, especially in the International Radio Consultative Committee of the International Telecommunication Union, to help establish an agreed procedure for predicting the performance of earth-space links on a world-wide basis.

Equipment is being assembled for a project, in which several international groups will participate, designed to acquire information about the effects of rain-storms on the propagation of 2.5-cm radio waves transmitted from a nominally geostationary Communications — research satellite called SIRIO, to be launched in 1973. RSRS will be using 5 receivers at various spacings along an East-West line together with an additional receiver to the North of the line. The results will provide data both on the spacings required for "switched-path" operation (to minimize the effects of rain), and on the information capacity of the links. Data from the receivers will be fed to the Station over land-lines and recorded on magnetic tape for subsequent analysis.

pictures: left installing a radio telemetry link on a church tower near Mendlesham.

Above: R J Powell at RSRS adjusting one of the solar-tracking radiometers.

Dr John Lane is a Senior Principal Scientific Officer and leads a Division at RSRS that carries out Troposphere and Radio Wave Propagation work.

---

spring

Give me green fields
Give me blue skies
Give me cool breezes to cool my brow
A track to walk through
A dog at my heels
A singing bird in the tree
A bee a-humming
A pair of eyes to see the beauty of life
My favourite season of all: Spring.

Jeanette Aird, RHEL.

Figure 1

progress on GALAXY

N. M. Pratt

The General Automatic Luminosity and X Y Measuring machine, GALAXY, at the Royal Observatory, Edinburgh, was designed to measure the star images on photographic plates taken with Schmidt telescopes. The 48 inch Schmidt telescope being constructed for the Science Research Council for erection in Australia in 1973 can photograph an area of sky 6½ degrees across on a single 14 inch square plate. Such an area of sky is nearly that of the bowl of the Plough. With this telescope, one plate with an exposure of about ten minutes will contain of the order of one million star images, the faintest of whicn are one million times fainter than can be seen with the unaided eye.

To measure such a store of star positions and brightnesses by hand is out of the question. GALAXY was designed to carry out this task completely automatically. The machine was designed in consultation with ROE staff and built by Faul Coradi Scotland Limited. A description of the machine and its modes of operation appeared in *Quest* Vol. 3 No. 2.

The prototype machine was completed in March 1969 and by October that year had exceeded the performance specification and had been formally accepted. An automatic fire system installed in January 1970 increased the usable time on the machine from about 8 hours a day to full 24 hour operation, including weekends. This has been achieved with two full-time operators, whose duties include preparation of the plates and the preliminary examination of the output by means of an offline computer and two part-time operators — part-time because of other associated duties. One of them (the author) is responsible for developing the computer software necessary to handle the enormous amount of data output by the machine.

In the two years of full operation, GALAXY has measured four and a half million star images on 400 plates sent in from fifteen establishments.

About half of GALAXY's output has originated at ROE. The very first job involved the measurement of about 20,000 stars on each of nine plates, four inches in diameter, of the same region of sky. Software had to be devised to identify each individual star, using its X and Y coordinates only, on all the plates and to bring the measures of position and brightness for that star from the different plates together. Writing the basic procedures required only about six weeks, but building them into an operational system which could cope with different conditions and requirements required a further fifteen months — an example of the ratio of design to development.

Areas of sky including galactic clusters, general fields and parts of the Large Magellanic Cloud — one of the nearest external galaxies — have been measured and the results are now being analysed GALAXY has enabled the measurement of faint stars in a cluster which is embedded in nebulosity, and results of work on very young T Tauri variable stars have been given at an IAU Symposium. Other plates have been measured to study the interstellar polarization of distant stars. On each of these plates there are three images for each star, corresponding to different orientations of the polarization analyser. The software to reduce these plates is stil being developed. GALAXY has also been used for the measurement of timing gaps in satellite trails.

Originally designed for the study of Schmidt photographs, GALAXY can also measure plates taken with refracting or reflecting telescopes. In order to do this, three different magnifications are available in the measurement system to meet different ranges of image size. The positional accuracy of all three systems is about half a micron in both X and Y. The accuracy of the brightness measures of the high magnification system is about 2 per cent, better than the intrinsic errors in photographic emulsions of 4 to 5 per cent.

So far, sixty plates have been measured for observers at the Royal Greenwich Observatory, some for proper motions, others for star brightnesses and colours. A second GALAXY machine, a copy of the prototype, has recently been delivered to Herstmonceux.

GALAXY has measured eighty plates for other British institutions which include plates taken with the Isaac Newton Telescope and also the Hartmann test plates for the 150 inch mirror of the Anglo-Australian Telescope. A series of parallax plates for an investigation of the distance of the nearby Hyades star cluster has also been measured.

About half of GALAXY time has been spent measuring 150 plates for foreign observatories: Lund in Sweden, Padua in Italy, Leiden in Holland, Max Planck Institutes in Germany, Copenhagen in Denmark, Laurentian University in Canada and Kitt Peak and NASA in the United States. The types of measures have been varied: multi-colour photometry, proper motions, quasar positions, searches for very young objects, a search for variable stars in a nearby dwarf galaxy, and meridan circle plates used to derive fundamental star positions.

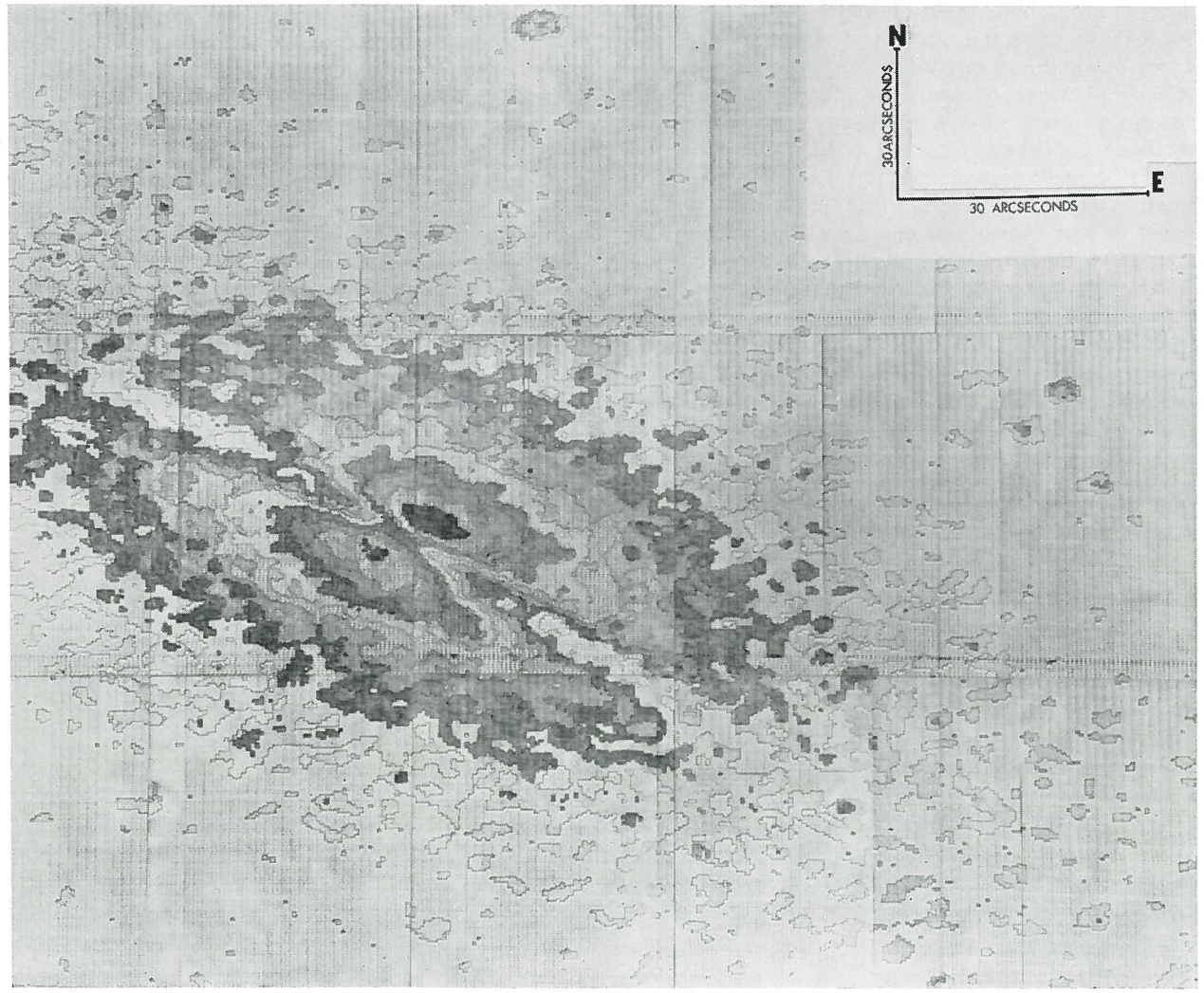
The actual measurements have been sent to most of these investigators, always after some reduction at ROE. Coping with the unprecedented quantity and quality of data which GALAXY has provided presents a major problem. When one investigator received part of the data for the half million images which GALAXY had measured for him, he wrote back by return of post to say that he was happy to wait until ROE had developed the software to investigate the material!

A number of modifications have been carried out on the prototype machine. Several of these have been to simplify the operation of GALAXY and to make the operator's task easier when handling such a large variety of types of plates from many different telescopes, about twenty so far. Others have been to extend the use of the machine. At first there was only one paper tape punch, allowing about twelve hours of continuous use. Now there are two and a control unit which automatically switches from one punch to the other when the paper tape is low.

Another major modification has been to the plate-holder carriage. Originally the largest size of plate which GALAXY could measure was ten inches square. This has now been increased to 14 inches square so that GALAXY can measure the 48 inch Schmidt telescope plates when they come. The positional accuracy of GALAXY was measured before and after the changeover, and remained unaltered.

Yet another modification was intended to investigate the fact that the Search Phase apparently only found about 80 per cent of the stars on a plate even

Figure 2 — A brightness map of the edge-on spiral galaxy NGC 7814.
Figure 1 (opposite) is the original Schmidt photograph enlarged from 1 mm square.



progress on GALAXY continued

though some of these stars were not very faint. In the normal search phase, using a spot size of say 16 micrometres in a raster scan, an image of 100 micrometres diameter is recorded in several elements on each of five or six successive scans. This is taken into account in the electronics logic and the parameters of the image are stored until the image is passed and complete, when one set of coordinates is calculated giving the approximate centre of the image. To investigate the missing stars, an 'all increments' facility was incorporated which outputs every element of the star image found in search—say thirty outputs for the 100 micrometre image.

With this facility the cause of the fault was soon found – a poor connection which gave an intermittent fault causing occasional errors in the search calculations. This is now corrected and a 100 per cent finding rate has been achieved on plates with few enough images on them to enable us to check.

It was then realised that a new and powerful mode of operation had been devised which enabled GALAXY to carry out surface photometry! *Figure 2* shows a brightness map of an edge-on spiral galaxy, NGC 7814 which is about one millimetre across on the original plate. This is the first time such a picture has been published. *Figure 1* shows a copy of the original object (reproduced by Courtesy of Dr J Peach, Oxford University). The band dividing the object in two consists of opaque clouds of gas and dust which hide the large numbers of stars near the centre of the galaxy behind the clouds.

At present, this facility is fairly slow, depending on paper tape output, and requires much computer time to compile a contour map which has half a million elements. However, when developed, this should become an extremely powerful tool for the investigation of external galaxies, and nebulae in our own Galaxy.

The machine has also completed two non-astronomical applications. One was the measurement of features on aerial photographs for photogrammetry – the accurate determination of the relative separations of points on the surface of the Earth. The other was the measurement of the intersections of grid lines on a photographic réseau plate which is used as an offset reference for measuring aerial photographs. The symmetric crosses on the réseau plate were measured well. When the aerial photograph was measured twice in the same orientation, the normal accuracy of half a micron was achieved. However, when the plate was rotated through 90 degrees, offsets were found which were traced to the asymmetry of the amorphous features and slight differences between the sensitivities of the X and Y servos.

A steady flow of enquiries is still coming to ROE which range from the counting of elephants to the measuring of the strain in soil under piles during construction work. Others fall into the field of pollution – counting fibres trapped in filters to assess their effectiveness, and into that of Earth resources – measuring the extent of different types of vegetation, ice, etc., from orbital photographs. It is not always easy to convert the records in such requests into a form suitable for actual measurement in GALAXY.

GALAXY is fully scheduled for the next twelve months, and we may look forward to another exciting year with the machine.

Dr Neil Pratt is a senior scientific officer at the Royal Observatory Edinburgh. He carried out the initial testing of GALAXY, has developed the computer software for handling the reduction of the GALAXY output and now schedules and supervises the work on the machine.

the universal law of cussedness

This law is well known, possibly by a shorter name, and it states that

"Inanimate objects are Perverse"

However the widspread and devious ways in which this law makes itself felt may be recognised in the following corrollaries to the law as applied to a specific situation.

FAULTY EQUIPMENT COROLLARY

1. *The Fault will occur when the equipment is most needed.*
2. *An obvious cause of the Fault is remedied, but does not cure the trouble.*
3. *The Fault will not occur for demonstration or for diagnostic testing.*
4. *When the repair man has left, the Fault returns.*
5. *Most Faults occur in inaccessible places.*
6. *Faults in easily accessible places conceal their accessibility until the equipment has been dismantled.*
7. *The Fault will lie dormant until the maximum amount of data obtained from the equipment has been invalidated by the Fault.*
8. *Instruction manuals hide.*

However one must bear in mind the important fact that

"The Law will not operate reliably if its operation is anticipated"

In fairness to The Law it must be exonerated from blame for the following axiomatic situation

"You always find it in the last place you look"

(only a nut would go on looking)

PHGD, RSRS

whither technology

John Andrews

The following article is an extract from a paper read at the Society of Arts on March 5, 5000.

Discoveries at Chilton

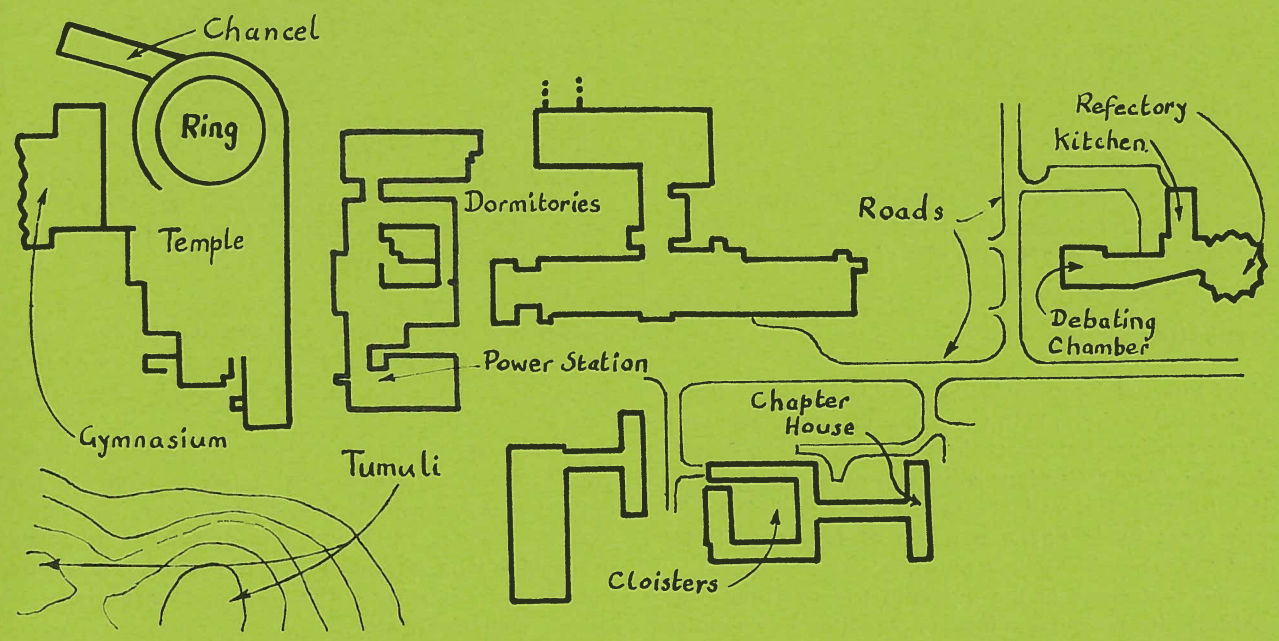
Interest has been aroused amongst anthropologists by the discovery of a site near the ancient village of Chilton in Berkshire believed to have been inhabited by people living in the 20th Century. The foundations of several rectangular buildings have been uncovered, and also a large area in the centre of the site sunk below ground level.

In its original state this area was covered with earth, and inside it lay the foundations of a curious circular 'ring'. It was first thought that the 'ring' was the remains of an ancient temple and that the site was inhabited by an exclusive sect who lived an enclosed life in the surface buildings and conducted secret rituals in th etemple. There is evidence of a communal eating place within the complex. No records have come down to us to explain why the temple was constructed underground, or to indicate what rituals were performed there.

A research team led by Professor Kokcroft, who claims descent from a long line of eminent scientists had discovered further evidence that large quantities of iron and lead were used in the construction of the ring. Professor Kokcroft has advanced the startling theory that the excavations are the site of a 20th Century laboratory, which contained apparatus for a specialised form of scientific research. A world-wide search is being made for similar sites and at present, two have been recognised from satellite surveys. One lies in Britain on the northern border of Cheshire, and the other site, much larger and apparently containing two rings, lies near Geneva in Switzerland. Reports have also been received of further sitings in America and Russia.

Dark Ages

We in the 50th Century have very little evidence as to what life was like in the 20th Century. Older civilisations have left a permanent record of their culture – primitive man made drawings on the walls of caves; the ancient Egyptians and Greeks carved their records in stone, and left a legacy of sculpture and architecture which survives to the present day. It enables us to see clearly the heights to which their civilisation reached. The Babylonians, having little access to suitable stone, resorted to clay as a writing



Sketch map showing the present extent of the excavations at Chilton

material. Inscriptions were pressed into a clay tablet by means of a stylus resulting in the formation of wedge-shaped (cuneiform) characters. The tablet was then baked to a hardness which resulted in a permanent record.

The people of the 20th Century, however, committed all their records to paper, important events were photographed and recorded in nothing more substantial than a thin gelatine immulsion. Nothing written or recorded in this era has survived the ravages of time. Such pieces of sculpture that have survived depict the inhabitants as grossly misshapen figures with expressionless features. We know nothing of their architecture as their buildings, constructed of concrete and steel, have long since crumbled to dust.

The 20th Century is truly known to us in the 51st Century as the dark ages. Legends handed down from generation to generation tell of great technological achievements at this time. We know, for example, that the people succeeded in reaching the moon and that great advances were made in all of the scientific disciplines, but they left us no permanent record of their discoveries, or of their experiments and the apparatus used. Of all the civilisations that have existed on earth, that of the 20th Century was the most ephemeral; it rose like a rocket in the sky, burst into a shower of stars and disappeared without trace.

The Ideal of Learning

The excavations at Chilton are therefore particularly important in throwing some light on this mysterious age. Interviewed at his home, yesterday, Professor Kokcroft said: 'We have indeed made some very exciting discoveries at the Chilton dig. We have been able to date the building within a reasonable degree of acuracy: they appear to have been constructed between the years 1955 to 1965. My physicist colleagues who I have consulted, are of the opinion that the excavations are the site of an ancient laboratory used for research in nuclear physics. You must bear in mind that we have no primary sources covering 20th Century physics and that we rely chiefly on manuscripts dating from much later periods. Historians writing in the 30th Century mention fragmentary documents relating to the site and containing cryptic words such as RHEL, NIMROD, PLA, HFBC. These were thought to be the names of deities worshipped at the site, and lent support to the temple theory.

'In my view, however, our investigations completely discount this idea. We are unable at present to explain what the names refer to; it may be that the earlier historians were wrong and that the documents did not relate to this site at all. It has always been thought that the laws of natural forces were a comparatively recent discovery but the evidence we have found at Chilton indicates that the people of the 20th Century were already conducting experiments in this field and they may well have achieved considerable success. The site appears to have been abandoned as a laboratory at the turn of the century; the equipment which would have been valuable as scrap metal was removed.

'This makes our work all the more difficult but we have at least two other sites to work on which may give us clues as to the existence of this lost civilisation. One thing we can say for certain is that the people who lived in this community were little different from us today; they too were pursuing the ideal of learning, seeking understanding through mind and matter. They were the worthy descendants of those who in previous ages searched for the philosopher's stone.'

John Andrews works in the Service Unit for grants and Awards at London Office and is perhaps better known as the Staff Side Secretary of the SRC Whitley Council. **He is grateful to Mr. J. R. F. Hayes, Joint Secretary of the Mechanical and Production Engineering Committee for checking the archeological references.**

a bit further off

Have you fixed your holidays yet? Do you like informal travel and what do you think of a trip to Israel? These are questions that might be answered by Dennis Fogerty (Audit Section) who wrote about his minibus trips to Turkey last year *(Quest Vol. 4, 2 p 16)*. This year he is taking a group of fifteen to Israel and the trip will include an eight day sea cruise.

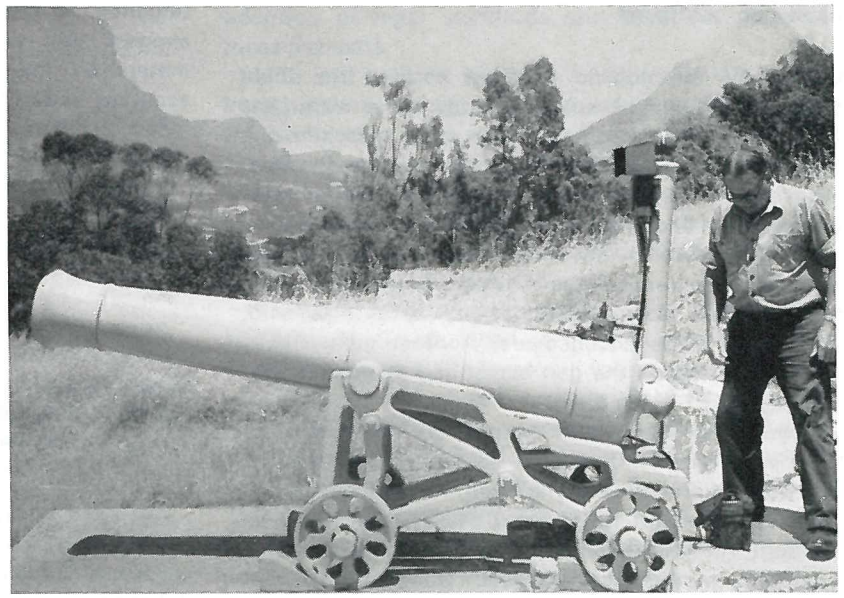
The first stage is the overland trip to Turkey (as before), the second is a four day Mediterranean cruise from Istanbul to Haifa with time ashore at many ports of call including Izmir, Rhodes and Cyprus. The third stage is eleven days visiting the most interesting places in Israel, many of them off the beaten track, including a desert journey to Eilat in the far south, near Akaba on the Red Sea. The return journey is a repeat of the outward journey and fits in some extra time at Istanbul.

Dennis has had full cooperation from the Israel Tourist Office and Camping Union in planning the holiday which takes 30 days from Friday, July 14 to Sunday, August 13. If you like camping, odd stops at wayside inns, and have an explorer's curiosity why not ask for a brochure. The address to write is:

Dennis Fogerty,
Topkapi Safari,
48 Earls Court Road,
London, W8 6EJ.
Tel: 01-937 4569.

noon gun

How timekeeping kept pace with technical progress 150 years ago at the Cape Observatory Time Department.



G. A. Harding

Every visitor to Cape Town whose stay extends over the middle of a day realises that the time of noon, South African Standard Time, is indicated by the firing of a gun from Signal Hill which overlooks the city. The gun is fired by an impulse from the Time Department at the Observatory, in continuation of a service which has existed for nearly 150 years.

Although the chronometer was available to the early nineteenth century navigator, thus enabling him to find his longitude at sea, no means of checking the rate of the clock was available in the southern hemisphere. The inauguration of the Royal Observatory at the Cape of Good Hope in 1820 must therefore have been very welcome news to the navigators rounding the Cape because after two or three months at sea on the passage from Europe their chronometers had probably accumulated considerable errors.

The erection of the instruments for time-determination began in 1821 and within a few years the astronomers were ready to provide a time-service to ships in Table Bay but the problem lay in how to signal it. Unlike the present when urbanisation prevents a direct view of the Bay from the Observatory, in those days there was no obstruction and so it was decided to use a visual system operated at night from the Observatory roof. Still on the inventory of the Observatory is the flash pistol and powder magazine which were used. This item also appears in the cash book entry for 1833, January 4:

'To John Constable for castings . . . and for a brass percussion pistol for the making of night signals to vessels in Table Bay, for the regulation of their chronometers — £5.5.0.'

However, the weakness of the flash made it difficult to detect three miles away so Sir Thomas Maclear put a daylight 'time-ball' system into operation. The first 'ball' consisted of a black cube which was to be raised on an apparatus constructed in Simonstown Dockyard and dropped at an agreed time. Unfortunately this device did not conform to normal naval standards of workmanship and having no springs or checks of any kind, eventually disintegrated on impact.

Poor visibility was, of course, still a problem and so in 1850 a 'two ball' system was started. A specially constructed wooden tower was erected in the Observatory grounds and the ball was mounted above it in full view of the signal station on the hill overlooking the bay. There, at the repeater station, a similar ball was erected, and the signalman, on seeing the Observatory ball drop, would immediately release his trigger to provide the time signal. Unfortunately, such a system must involve the 'time constant' of the two operators and the navigator and could sometimes be in error by two seconds. Nevertheless an extremely useful service for the mariner was provided by this apparatus for many years.

With the coming of telegraphy in the latter half of the nineteenth century the instantaneous transmission of signals became possible and an impulse from the Observatory clock was used to operate a time-ball and fire a gun on the waterfront. Then soon after the beginning of this century a gun was moved to Signal Hill and its firing mechanism connected to the Observatory time service. The first recorded firing of this gun was on August 4, 1902.

To this day the gun remains a muzzle-loader and just before noon a soldier of Lion Battery removes the stopper from the muzzle, cleans and dries the barrel and loads the three pound bag of gunpowder.

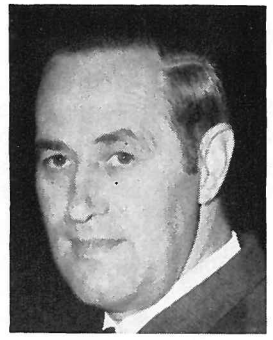
Occasional misfires do occur and it has been

noon gun continued

known for the gun to be fired early – no doubt because the gunner anxious to get to a date, has cocked the firing mechanism too soon, thus allowing detonation by an earlier time signal impulse. In either case the Observatory switchboard is immediately loaded with enquiries as to how the mishap occurred. Then there is the story of the careless soldier who forgot to remove the ramrod from the gun – on firing it shot down into the city and, it is said, knocked a horse unconscious! Another gunner they say was sitting on the gun barrel and at noon he too almost landed in the city!

Legend also has it that the gunners befriended the local wild cats leading to a substantial increase in the population. When this was discovered by an inspecting General he ordered their immediate destruction. An unorthodox but humane, and certainly economic, method was adopted. Bacon titbits were placed in the barrel after loading to entice the unsuspecting: precisely at noon they met their end.

Although the telephone calls when things go wrong can be annoying it is encouraging to know that the public do still take an interest in the continuance of this tradition. Although we would not suggest that a navigator should set his chronometers by the Signal Hill gun when he can use accurate radio time signals, it is nice to see the 'noon gun' tradition retained in a bustling modern port.



George Harding, a Senior Principal Scientific Officer, was Officer-in-Charge of the Royal Observatory, Cape of Good Hope, for the three years 1969-71. During this time the plans for the development of the South African Astronomical Observatory as a joint SRC-CSIR project were completed and the design and construction of the new observing station at Sutherland begun. Under the new administration he becomes Deputy Director of the new Observatory.

It has been said that the present method of choosing SRC Board and Committee members is not the fairest that could be devised. Perhaps we should try a different one – like open competition.

The Chance of a Lifetime— in our FREE Competition !

1st prize

3 years on the Board or Committee of your choice

2nd prize

4 years on the Board or Committee of your choice

plus

500 consolation prizes of 1 Research Student each!

Just answer this simple quiz.

1. How many letters do you have after your name? ('Failed' counts as –1.)
2. Is this year's prevailing style of administration:
   a) ivory-tower purity?
   b) white-hot technology?
   c) please, ma'am . . . ?
3. Is a Van de Graaff Generator:
   a) a pop group?
   b) the Council's standby power source?
   c) an excuse for a £200,000 consolidated grant?
4. Place in order of difficulty
   a) getting approval for a £5M project.
   b) getting approval to travel to Paris.
   c) getting through to the right extension at State House.
5. Are you prepared to move to Bristol?
6. What has the SRC achieved? (Answers to the Select Committee on Science and Technology.)
7. In which years were these famous catch-phrases popular:
   a) selectivity and concentration?
   b) timeliness and promise?
   c) total technology?
8. Are you willing, if required, to play Bach piano duets for an SRC film?
9. Finally, complete in not more than 2587 words:
   'I think Sir Brian Flowers is wonderful because . . .'

Set by **PC**

# of pips and peeps

So They were at it again. Last year it was decimilisation and this year They turned the BBC's traditional six pips into five pips and a peep. Was this another step towards internationalism we asked. Yes it was.

This time though it was the new Universal Co-ordinated Time (UTC) we were getting in step with and if there's one thing this Country is a leader not a follower in, it's time. The new UTC is a compromise between an atomic time standard based on the fundamental properties of the caesium atom, and Greenwich Mean Time also known as Universal Time (UT) which is based on the rotation of the earth on its axis.

Under the new system standard frequency emissions and radio time signals are now broadcast in conformity with the International Atomic Time Scale in which the time intervals between pips correspond exactly to the second, as defined in 1967 by the General Conference of Weights and Measures (CGPM), the international body concerned with the adoption of legal standards and units for physical measurements.

UTC will be kept within 0.7 second of UT by the introduction of a leap second, when necessary, on the last second of a month and, preferably, on June 30 and December 31. In BBC terms a plus second will give six pips and a peep and a minus second four pips and a peep. The start of the peep (or lengthened pip) indicates the exact minute (0h0m0s on the first day of a month).

Soon after the new system was introduced, Humphry M. Smith, Head of Time Department at the Royal Greenwich Observatory, spoke about the new way and the old at the Institute of Navigation. Mr. Smith is Chairman of a special Working Group of the International Radio Consultative Committee which is concerned with the practical aspects of getting UTC generally adopted. His talk is published in full in the Institute's journal (Vol. 25, 1, Jan. 72). We reproduce a summary here by permission.

Another article 'International Time and Frequency Co-ordination' will appear in the special Time and Frequency issue of the Proc. IEEE in May.

right on time

time-keeping in the age of technocracy

Ninety years ago the Greenwich meridian was adopted as the standard meridian for the world for two very good reasons: nine-tenths of the sea charts in use were based on it and the observatory had been carrying out regular uninterrupted observation for more than two hundred years.

It seems that the unique significance of the Greenwich meridian was rather thrust upon the observatory, for the Astronomer Royal, Sir George Airy, was not at all enthusiastic and wrote 'It has been custom of Her Majesty's Government to abstain from interfering to introduce novelties in any question of social usage, until the spontaneous rise of such novelties has become so extensive as to make it desirable that regulations should be sanctioned by a superior authority.'

The Astronomer Royal for Scotland, Piazzi Smyth, was dead against it and regarded 'all attempts at breaking down the ancient bounds between nations as the work of the dread International Commune, and an attempt to form all mankind into one vast headless society.' If you think that argument has been brought out for an airing recently you may be interested to hear that France and Brazil abstained when twenty-two nations voted for the Greenwich meridian (at the Washington Conference in 1884) – France because it favoured the Paris meridian, or failing that the meridian of the Island of Ferro, or failing that a completely neutral one.

GMT corresponds to the average of solar time measured at Greenwich throughout the year. Solar time gives days of varying length because the annual path of the Earth around the Sun is not a circle and because the Earth rotates daily around an axis which is not perpendicular to the plane of the Earth's annual orbit. The mean, or average, length of a day forms the scale of Mean Time, and the difference between mean and solar time (the Equation of Time) may amount to about a quarter of an hour in each direction, as may be seen by comparing a clock and a sundial.

The two main variations taken into account in UT time scales are Polar Variation, the movement of the Earth in relation to its axis in space, and Seasonal Variation whereby the Earth turns slightly faster in summer and slower in autumn and winter. The three time scales are known as UT0 (UT as observed), UT1 (UT0 corrected for PV) and UT2 (UT with both PV and SV removed).

A Photographic Zenith Tube (PZT) is used at Herstmonceux to measure the Earth's rotation by observation of the times at which selected stars cross the observer's meridian near the zenith, in their diurnal

right on time continued

apparent motion across the sky from east to west. An interesting development has been the establishment of a PZT in Canada in the same latitude, which uses the same stars, the same adopted star places and the same methods of reduction. By exchanging results the Canadian observers and our own gain the full benefit from having similar observations at two stations. If we could persuade the Russians to put a PZT on the same parallel, this would strengthen the determination even further. (N. O'Hora of RGO will write about the PZT in the next issue of *Quest*).

A uniform time scale, the forerunner of UTC, began at Greenwich in 1944. Time signals were kept at a uniform rate based on the mean of the best quartz clocks available. 'Jump' corrections were made when necessary to maintain agreement with astronomical time. Atomic clocks brought in a much higher standard of uniformity and it was possible to introduce jumps or 'steps' to match UT within agreed limits.

Most atomic clocks use caesium because it can exist in either of two states and the transition from one state to the other is accompanied by an absorption or emission of electromagnetic energy at a frequency which is characteristic of the transition. The atoms in the two states are affected differently by a magnetic field. The clock contains an evacuated tube along which a beam of caesium atoms is directed towards a detector at the far end. The beam passes between the poles of a magnet which deflects the atoms in one state and allows the others to pass into an area where there is a radio frequency magnetic field. If the frequency of this corresponds to the characteristic transition frequency some of the atoms will absorb energy and change state. The beam then passes through the poles of a second magnet, the unchanged atoms are deflected and the changed atoms reach the detector. By this means a maximum number of atoms reaches the detector when the radio frequency is tuned exactly to the correct atomic transition frequency.

Atomic time scale intervals are uniform and free from all the periodic and irregular variations characteristic of the time scales based on the earth's rotation but they have no corresponding 'time of day' except in so far as one measures from a zero expressed as an instant of astronomical time.

'breaking down the ancient bounds between nations . . . '

At Herstmonceux the atomic time scale is based on a mean of selected caesium beam atomic standards at the observatory. Comparisons with national time scales in other countries are made by using the Loran C radio navigational system or vlf phase comparisons as well as conventional radio time signals.

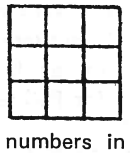
Loran C emissions are monitored from Sylt (Germany) and checked with the master station of the Norwegian Chain at Ejdes (Faroes) and the Estartit (Spain) station on the Mediterranean chain. The system uses specially designed receivers that 'lock on' to a chosen point in the build-up of signal pulses and this is timed on a local clock to an accuracy of 0.1 microsecond. Comparisons are checked by periodic 'flying clock' programmes arranged by the US Naval Observatory in which a clock is taken from Washington to various observatories in Europe. 'Flying clock' checks have confirmed the routine comparisons to within a few microseconds *(see 'Operation Synchran' in Quest Vol. 4, 1 p 14).*

In 1936 when Mr. Smith went to Greenwich to take charge of the Time Department there were pendulum clocks, tape chronographs and 'wireless' equipment that could be tuned by moving external coils. The BBC time signal service had begun in 1924 and the international signals from Rugby in 1927. At one time equipment had to be developed and made at the observatory, nowadays it can usually be bought commercially and the Time Department's skill and ingenuity is devoted to getting the most out of the instruments.

Caesium beam atomic clocks are now being used to the limit of their capabilities but perhaps someone somewhere is working on an idea that will take precise time measurement into a new era.

Quest

magic squares

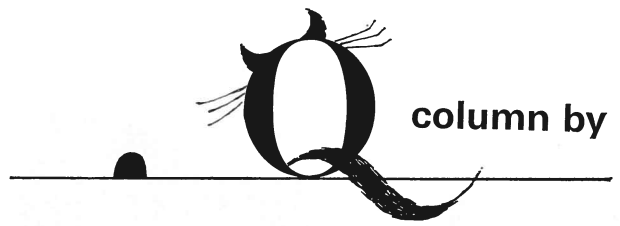


In a magic square the numbers in each row, each column, and each diagonal add up to the same total (called the 'magic number'). Can you make a magic square (3 x 3) using the numbers 1 to 9? Each number must be used once only and the 'magic number' is of course 15.

If you find this problem easy, or know the answer already, can you find a logical way of arriving at the solution, rather than using trial and error?

A 4 x 4 square is rather more difficult, but it is helpful to know that certain groups of four numbers other than the rows, columns and diagonals must add up to the magic number. Can you say which these are? Using the numbers 1 to 16 in the square the magic number is 34.

Solutions next time, with some notes on larger squares and 'supermagic' ones.



Dear Auntie Joan
I recently applied for a post as a Principal in the Civil Service but they told me that I was not eligible To make matters worse I was told that I should try to get some administrative work to do here. This seemed to me to be a pretty silly answer in the circumstances. Please help me because I have no one to turn to.
Yours hopefully
Worried Blue-Eyes

Dear Worried Blue-Eyes
You must face up to reality. It may be difficult for you to accept the fact, but scientists (with a few notable exceptions) are not good enough to be in the Administrative Class. A first-class degree and a PhD are no indication of a person's suitability for the First Division. The ability to ad lib for thirty minutes on any subject presented to you is a much better test of the qualities needed and scientists fall down very badly on this. Try to recognise your limitations and I am sure you will be able to find more contentment in your present work.

Please write to me again at any time if you feel I may be able to help, but please do not use Council stationery for personal letters.
Yours sincerely
Auntie Joan

Dear Editor,
I note in recent vacancy notices that specific age groups are mentioned. I don't feel old but to see constant reminders that applicants between '20–40 years only' need apply is rather turning the knife.

Who said 'Life begins at Forty'. I feel I have been wiped off the slate already!

Sad at Heart
LO

a place for rowing

The Cygnet (Civil Service) Rowing Club at Chiswick has room for new members who can row or scull or who would like to learn. The Club is doing quite well and will be racing two, or possibly three, crews in open regattas this year, including the 'Thames Cup' at the Henley Royal Regatta.

This club is for men only but the boathouse at Dukes Meadows is shared with the Civil Service Ladies Rowing Club. Both are open to SRC staff. Write to: Roy Ellison, Civil Service Boathouse, Dukes Meadows, Chiswick W4 2SH, or telephone 928-7878 ext. 7845 for details.

Wanted SO cadet, good wages for keen young man

Every March we receive the new edition of the LO Functional Directory, a useful work of fiction full of interesting stuff about what they think we do all day. On this occasion, the Directory contains no less than two Georges, one at the bottom of p 14 and the other bang in the middle of p 25. Alas, neither Training Section admitted to knowing his whereabouts, nor could those in Eng. Div.* help. However rumour of a yellow Mini 1275 GT and an ever growing heap of Ch Canteloupe 1964 bottles (empty) at the prime focus of a certain 98 inch telescope, coupled with recent enquiries about gardrobes in medieval castles give a clue to his whereabouts.
GMT – beware!

** not apparently English Divinity as I thought*

spectators and sportsman

are welcome at

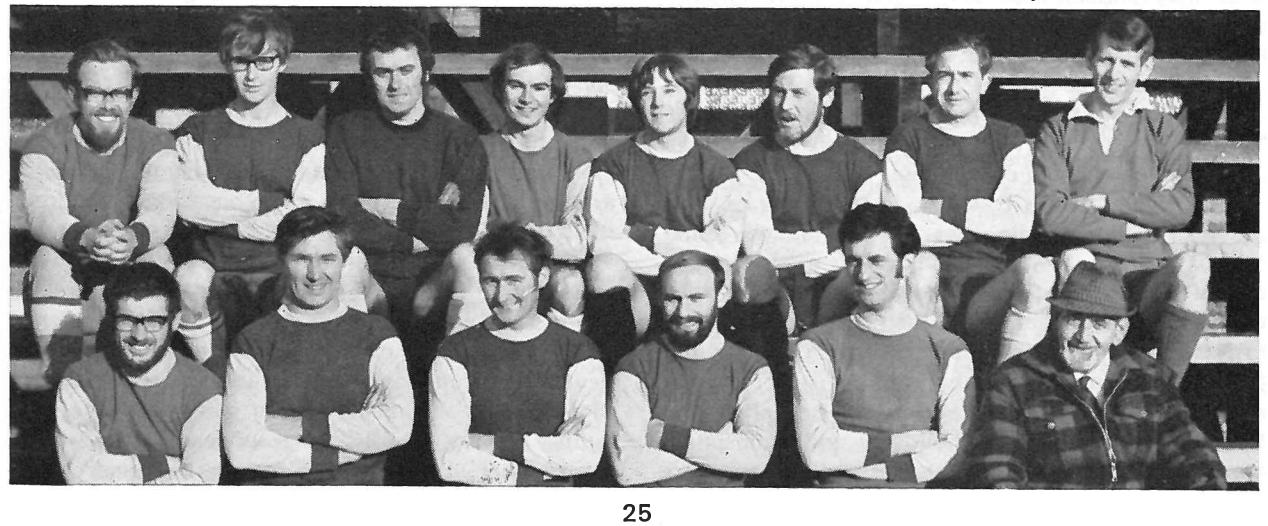
sports day 1972

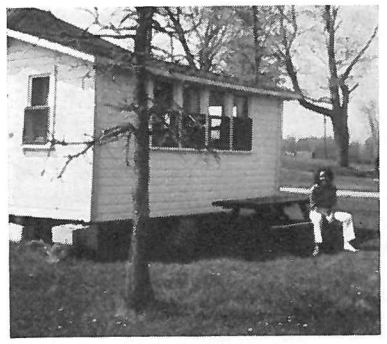
date: Monday June 19

place: Civil Service Sports Ground, Chiswick.

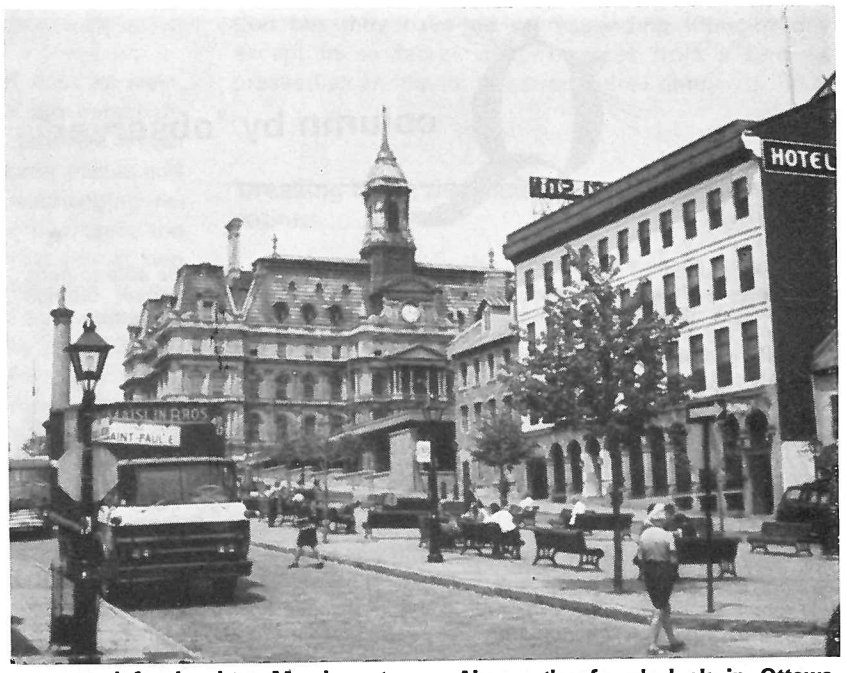
Picture below is the full ROE football team who sent a six-a-side team to win the cup in 1971 but lost in the final to Rutherford C team.

Back row: W. Sherwood, M. Hartley, A. Houston, G. Barrett, E. Laidlaw, J. Hart, A. McLachlan, V. McCann.
Front row: R. Eberst, J. Campbell, A. Rosie, J. Johnstone, R. Tannoch, A. Kerr (Coach). photo by Ian Sheffield.





travels with a daughter



Pictures: left, daughter Mandy outside the log cabin near Toronto. Above: the french look in Ottowa.

Phyllis Beaven

Last May, having saved up my money and my leave, I took advantage of one of the Civil Service Sports Council's charter flights to America for a stay of three weeks to visit my daughter.

My main impression of the flight was that of tedium; there wasn't much room to move and there was just too much noise to make sleep a real possibility. But we had an excellent meal with drinks provided and several friendships blossomed rapidly.

We landed at Kennedy on time and I was pleased to see that it looked in much the same state of untidy half development as Heathrow. The Customs Officers weren't interested – I might have been carrying a case full of cannabis (surely it's the unlikely ones they should look at) – and the immigration officer used my christian name, which was probably intended to be friendly, but which annoyed me somewhat. I hadn't so far seen the famous skyline and didn't do so until we went over – I think – the Throgs Neck bridge on the way out and even then it was partly hidden in a veil of pollution.

New Haven where I stayed, is the home of Yale University (Elihu Yale was a rich Boston cloth merchant in the 17–18th century who made a donation of £562 when funds were first being sought for the Collegiate School, as it then was, on its move to New Haven. It was hoped by naming it after him to elicit further support but he did not oblige it seems). One could very well imagine oneself in Oxford or Cambridge – the buildings and atmosphere are very similar. My daughter is a librarian there and the library, which houses more than 2,000,000 books, is a huge rather gloomy Gothic style structure of recent date (1930s I think) with a tower that looks like a cathedral but is in fact book stacks. There is also the Beinecke rare book library whose walls are made of slabs of marble and glow like amber when the sunlight shines through them. There is a Gutenberg bible and I saw a document dated around 1620 relating to the original founding and funding of many of the Colleges at Oxford and Cambridge. Among many other interesting exhibits were some family letters written during the absence of the husband at the American-Mexican War. I would have liked to have been able to spend more time there.

I loved the large comfortable wooden houses and the way everything just seems to grow out of its surroundings in New England; there were rarely boundaries marked by brick walls or fences and it somehow makes one belong.

The formal elegant simplicity of the churches was delightful and so, as the Spring progressed, was the combined effect of pale green foliage, red maple flowers and white paint with occasional redbrick. It all seemed to be looked after with such thought and care and had such individuality.

Returning to New York to visit what a tremendous contrast it was there with its huge stark science fiction outlines and dilapidated scruffiness. One would develop a claustrophobic restlessness if one lived there, I think. I didn't have too many language difficulties (thanks to BBC TV I suppose) but was surprised when, determined to sample the local delicacles, I ordered an ice cream soda and 'pie à la mode' at lunch and found myself with two huge portions of ice cream served to me by a waitress who looked at me doubtfully, as well she might.

Washington was a city of beautiful buildings and tension; a feeling one could almost touch. The administrative part seemed somewhat too formal – it hadn't grown, it had been put there with great deliberation, but Georgetown was delightful and the White House had a pleasantly intimate atmosphere – I was embarrassed to discover the identity of the 'enemy' who burned it in 1814.

We also managed a trip North to Canada with our Plain Jane (an unromantic but efficient VW) through wide open spaces which in view of the urban sprawl practically all the way from New England to Washington I thought I wasn't going to find. Niagara was breathtaking and no amount of commercialising could alter that impression – it was also breathtaking in the air that came over the ice which still covered the basin; almost unknown at that time in May it seems.

We passed through miles of peach and pear blossom to visit London, Ontario, which has a Thames River and an Oxford Street (what nostalgia these familiar names must have held for those early immigrants who knew they would never see 'home' again) and we avoided Toronto to spend a night in a real log cabin by a beautiful Canadian lake surrounded, in picture book fashion, by conifers and birch trees.

Ottawa was dignified and restrained and slow moving. In Montreal one thought one was in Paris – even the smells were Continental and so were the drivers; but a city with a tremendous personality.

So to the journey home through great stretches of rolling countryside and some small Quebec towns which looked as if they had been built rather 'ad hoc' and back again to the well organised tidy beauty of New England.

As to impressions of life and people, I thought the Americans less relaxed than the Canadians who had some of the familiar steadiness of England. The amount of anti-American feeling in Canada was surprising considering the frontier is more or less a line on the map and the English language is common. (Vietnam desertions have something to do with it I think).

Canada would still seem to have an integration problem with her two peoples but as a matter of fact I was impressed by the basic loyalty of the coloured people in the States. The sense of tradition in New England is strong – even to the Puritanism which the original settlers brought to their sanctuary there and in Canada (Ontario anyway) there is almost defiant loyalty to English traditions – in St. Catherine's on Saturday afternoon I saw, of all unexpected things, a cricket match, played in the grounds of what was really an English boarding school. But I must add that everyone everywhere was very kind to me, and the standards of comfort in living were consistently impressive. And so, after a last awe-inspiring but very delicious dinner at the Yankee Silversmith I found myself at Clapham Junction at 7.30 am on a wet English Sunday morning. What a wonderful three weeks I had had and what pleasure it has given me to relive them by writing this.

I have since heard that Plain Jane has had to visit the doctor – I hope her 1500 miles in seven days were not too much for her.

Phyllis works in the London Office Administration Division. She has one daughter Mandy, who comes into this article, and a son Colin who also visited the States last Summer as a Camp Counsellor. Phyllis has appeared before in Quest as the poet 'Nona'.

DRAFT DUS LETTER

Dear Uncle Stan

I'm feeling very guilty about not replying sooner to the friendly note you sent me before Christmas letting me know when I am allowed to ride in a taxi at the Council's expense. I must say it really is a comfort to know that if I

a) arrive at the station after the meeting I am due to attend has started
b) cannot find any local inhabitant who knows (or will admit to knowing) anything about the geography or public transport of his native town
c) have more than two heavy articles of luggage
d) find myself in the sort of weather conditions which today's tiny tots will remember as old men
e) am not in Central London

I am actually allowed to claim the cost of a taxi. There is just this little doubt in my mind, Uncle, that there is a kind of 'Catch 22' (or should I say 'Catch 14/71'?) tucked away in your note. The trouble is that I am expected to explain the whole situation 'briefly' and, frankly, if this really happened to me I'm not sure that I could. And if I decided to write out a long explanation, I'm afraid I might be thought to be wasting Council time, because I would have to take time to write it and you would then have to read it. I know you're busy because you have to send us all these notices telling us how to interpret all the regulations.

I've just been wondering if we couldn't save a lot of time if we didn't all have to remember the clarification set out in LO Instruction 14/71 of CEM 5B.7 which reinforces CEM 5B.3. Couldn't we have a system whereby if you don't trust me to decide when I should take a taxi and refuse to repay me I simply overcharge you on something else the next time I go anywhere?

I hope, by the way, that while you are travelling round the country looking for a new roof to shelter us all, the trains are all on time, the natives numerous, knowledgeable and communicative, the weather always fine and your luggage neither bulky nor ponderous.

Love to you and Auntie Joan
Your affectionate nephew

newsfront

retirement

Mr. R. A. J. Savage B.E.M.

seen in picture with Dr. J. A. Saxton (r) Director of RSRS, and

Dr. D. H. Sadler

seen below right with Dr. A. Hunter (l) A/Director of RGO

Members of staff at RSRS were conscious of a milestone in the fifty-year old history of the laboratory when Mr Savage retired on 25 February. For forty two of that half century of years, Jack Savage has worked here making his particular and valuable contribution to the progress of radio science. He joined as a carpenter in 1930 with the Radio Research Station (as it then was) under the superintendence of Dr. Watson-Watt (as he then was). Within a few years, the first British radar experiments had been conducted by staff from Ditton Park, and with their success and subsequent incorporation into specialist groups working secretly at Orfordness and later at Barnsley, Jack found himself involved in matters of national history. His skills then and later were officially acknowledged by the award of the BEM in 1953 and his continued services at RSRS have been much valued.

His retirement was marked by a ceremony at which Dr. Saxton, the Director, presented him with a token of our good wishes for a happy future.

Our best wishes go with Dr. D. H. Sadler, Superintendent of the Nautical Almanac for thirty-four years, who retired in February. A Deputy Chief Scientific Officer by special merit promotion, Dr. Sadler's career with HM Nautical Almanac Office (which is now part of the Royal Greenwich Observatory at Herstmonceux) started in 1930. During the war he was also put in charge of the Admiralty Computing Service and received an OBE in recognition of his services.

Dr. Sadler's main interests have lain in the design of almanacs for use in astronomy, navigation and surveying and in developing improved methods for their computation. He has contributed a great deal to various national and international organisations of astronomy and navigation, which has been recognised by various awards — such as his honorary degree from the University of Heidelberg.

In 1970 Dr. Sadler was granted special leave of absence from his post of Superintendent to conduct his own research and to organise the 14th General Assembly of the International Astronomical Union. Dr. Sadler was General Secretary of the IAU from 1958 to 1964 and has also been Secretary and President of the Royal Astronomical Society and President of the British Institute of Navigation.

In his spare time Dr. Sadler was an active member of the Observatory's Social and Sports Club – from the day it started in 1949, and for many years a leading member of the Hockey Club. He also took part in staff side affairs and was Chairman for a time of the 'Association of Astronomers', the former title of the local branch of the IPCS.

An antique chair was presented to Dr. Sadler (both seen in left hand picture) as a farewell gift, by Dr. Hunter (l), Acting Director, on behalf of the staff of the Observatory and the NAO, who all attended the ceremony. Several former NAO staff who had worked with Dr. Sadler for many years came to a special luncheon party and to attend the presentation. Mr. P. S. Laurie gave a talk on the history of the Nautical Almanac and the NAO, and publications past and present were on display. Another display of photographs of the staff at work and at play over the past thirty years sparked off many more reminiscences.

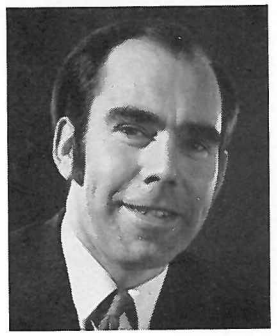
Continued at foot of next column

photo David Calvert RGO

bread of charity

If you visit the Royal Greenwich Observatory on a Wednesday, you have a choice of lunches. There is the staff restaurant fare as usual or if you prefer to dine in the spirit of King Wenceslas there is bread and cheese set out upstairs in aid of good causes. Everyone who takes part in the second pays the usual lunch price for the cheaper fare and the profit goes to Oxfam and other charities. The lunches were started by Michael and Margaret Penston and are now organised by Elizabeth Epps. In three years the scheme has raised £340. Congratulations!

SPSO



Dr. B. R. Martin

Dr. Barry Martin of Radio and Space Research Station has recently been promoted to Senior Principal Scientific Officer as Head of the Division responsible for Space Systems Analysis and Computing facilities.

Dr. Martin, who is married, with two children, is a graduate of Merton College and joined RSRS as an SSO in the computer group just over four years ago. In July 1970 he obtained a D Phil. at the University of Sussex.

Footnote to Technology — an engine from the age of steam

(see pp 9-20)

Above: traction engine Red Gauntlet with Ken Humphries of Atlas Laboratory (left) and his 'steam gang' mates Jack Green and Ron Coventry from Burghclere. Restoration of this general purpose Burrell traction engine has been a spare time hobby for the gang led by Jack Green who made up to pattern by a good old-time 'steam age' blacksmith and some specialist welders made a new fusable plug crown housing, by reducer method, to a very high standard. The team put in nearly 1,000 hours' work and 17 of these had to be spent inside the fire box – 4 feet x 3 feet x 4 feet.

The engine was used for general haulage and farm work in the west country until the owner brought it to Jack for restoration. It weighs 11½ tons, has a capacity of 75 hp (6 steam) and moves at 4 mph in the small gear and 10 mph in the large gear. Now that the engine is fit again it works for its keep at sawing, hauling and tree pulling. It can pull out 14 large trees, root complete, in 7 hours.

Like the Scarlet Pimpernel, the gang say, it turns up in all sorts of places – occasionally at rallies but more often at charity functions. These are seldom refused unless dates clash. The gang are always there ready to answer questions but it is Ken who is usually pushed to the front.

Ken is an experimental worker V at the Atlas Laboratory. He is going to bring the engine to the next Families' Day on Saturday July 15.