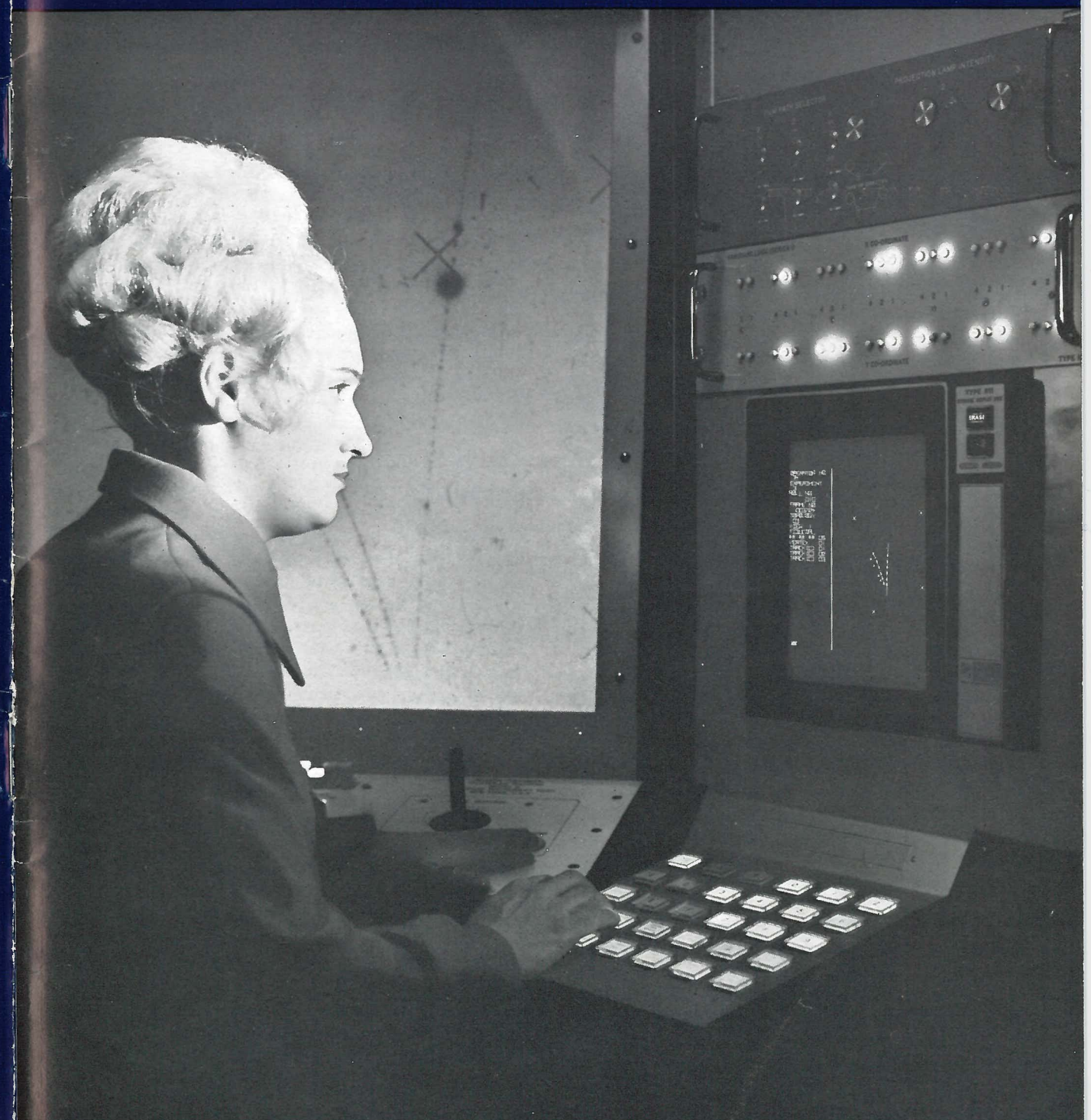
QUEST



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QUEST

House Journal of the Science Research Council

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contents

Cover picture shows an operator, Elizabeth Gillespie, studying a display screen which is connected on-line to a computer at the Daresbury Laboratory. A description of how the system works is on page 6. Photo Arthur Pickett, DNPL.

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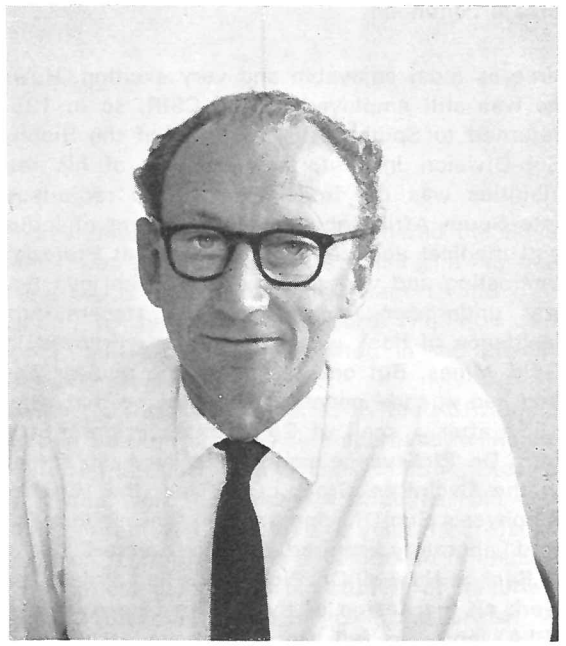
profile

Dr. G. H. Stafford, Director

Rutherford High Energy Laboratory

'The Science Research Council is a very exciting organisation to work for, concerned as it is with fundamental research in conjunction with University scientists. It has great potential in the future for one has faith that some form of fundamental research will always grasp the imagination of scientists and that the Rutherford Laboratory will be associated with this work. Our work at the moment is very exciting, but we must have the necessary flexibility to change wth the science.'



Exciting organisation; exciting work; potential; flexibility; faith; one feels that these words are the key to the mind of this quiet spoken man. His deep and genuine interest in everything that is happening at the Laboratory at all levels is apparent from his habit of quietly visiting various sections of the establishment to see and talk to people about their work. His insistence on good communication as a basic essential of the successful running of the Laboratory is also evident. He is very approachable and has what is an invaluable asset for those in command, the common touch. He has a mind which has been described as both probing and analytical. This probing mind, as many people can testify, can be devastating in a discussion as the slightest suspicion of a weakness in any statement is demolished immediately.

Dr. G. H. Stafford, Director of the Rutherford Laboratory for the past year, was born in England in 1920 and moved to South Africa with his family at the age of eight. There he attended the Rondebosch Boys High School then continued his education at the University of Cape Town. Life in those early days was not all study, as he played both rugby and soccer, although his favourite pastime was surfing at the Strand Beach. He took his M.Sc. in physics in 1941 having spent some of his final year on research into cosmic rays resulting in the publication of his first paper on 'The Second Maximum in the Rossi Curve' in *Nature*, April 1942 and his second 'The Production of Cosmic Ray Bursts by Mesotrons' in the Proceedings of the Royal Society in 1944. Further studies were interrupted by the second world war when in 1941 Godfrey Stafford joined the South African Naval Forces as a Lieutenant Electrical Officer concerned with de-gaussing work in the southern hemisphere. The Temporary Commander of the South African Naval Forces from 1941-46 was Professor Goodlett who had taken the Chair of Electrical Engineering at Cape Town in 1940, eventually leaving that post in 1950 to take up an appointment at the Atomic Energy Research Establishment (AERE) Harwell as Head of Engineering Research and Development, a post he held until 1956. In the early days of his naval service, Lt. Stafford was based on Robben Island, which before the war had been a leper colony. Since the war it has become a prison camp! He then moved to Durban to take over command of a new de-gaussing unit. After 18 months' service in the southern hemisphere he came to England (in 1943) to undertake research work on radar at the Admiralty Research Establishment near Haslemere in Surrey, but after a period on dry land decided that a sea-going appointment was preferable. His final move in his Service life came when he joined, on recommissioning, a fighter direction ship based first in home waters and later with the East Indies fleet.

With the end of hostilities came the opportunity to resume his education and he entered Gonville and Caius College, Cambridge, as Ebden Scholar of the University of Cape Town, obtaining his Ph.D. in 1950. During his time at Cambridge he had become interested in nuclear physics, but his future career was still somewhat obscure. As he says himself: 'Nuclear physics was mostly a shot in the dark as I could have chosen a number of other lines, including crystallography.'

At the end of his time at Cambridge he accepted a post with the South African Council for Scientific and Industrial Research (CSIR) under Sir Basil Schonland who was at that time President of the Council, and later Director of AERE. Dr. Stafford came to AERE, Harwell, under this appointment in 1949 and stayed for just over two years. For the last part of this period he worked on the Cyclotron under the Group Leader, Dr. Pickavance. He recalls this

profile continued

time as most enjoyable and very exciting. However, he was still employed by the CSIR, so in 1951 he returned to South Africa as Head of the Biophysics Sub-Division in Pretoria. Here part of his responsibilities was the importation of all radio-isotopes into South Africa and the development of industrial and medical applications. The work at Pretoria was interesting and varied; for example, an investigation was undertaken using radioactive tracers into the incidence of hook worm in natives employed in the Gold Mines. But one feels that the nuclear physics bug had already penetrated deeply, so that when, in 1954 after a spell of $2\frac{1}{2}$ years in Pretoria, a letter from Dr. Pickavance arrived offering a job at Harwell in the Cyclotron Group, CSIR lost the Head of its Biophysics Sub-Division and the then unborn Rutherford Laboratory acquired a future Director.

Back at Harwell Dr. Pickavance had already started work on the design of the Proton Linear Accelerator (PLA) and the full story of those early days has already been told (see *Quest* Vol. 3, No. 1, Profile of Dr. Pickavance, and *Quest* Vol. 2, No. 3, Research at Rutherford). The Rutherford Laboratory came into being in 1957 with Dr. Pickavance as the first Director and Dr. Stafford as the Head of the PLA Group. The PLA was still under construction at this time achieving its first full energy beam in 1959. By 1963 with the PLA a well established machine he extended his activities and became responsible for the high energy physics programme for Nimrod.

In December of that year a large reorganisation took place at the Rutherford Laboratory resulting in the formation of a number of Divisions in place of the original group structure. Dr. Stafford became Head of the High Energy Physics (HEP) Division whilst still retaining control of the PLA until some time in 1964.

The completion and commissioning of Nimrod made 1963 a year of intense activity and excitement. The experimental programme had to be prepared ready for the full operation of the machine and the HEP Division, as it became at the end of 1963, was and still is responsible for the organisation and the co-ordination of the high energy research programme on Nimrod. This brings the Division into close contact with visiting teams from universities and other research establishments, especially as a large percentage of the research physicists and supporting staff in the Division are attached to visiting teams. The setting up of such an organisation was a mammoth task, but his experience in setting up a similar if smaller organisation in the PLA obviously proved of great value.

On the first of April 1966 Dr. Stafford became Deputy Director whilst continuing as Division Head of High Energy Physics. During this period he also worked as a member of one of the research teams on Nimrod. For many years he has had a close association with CERN, the European Organisation for Nuclear Research, and still attends the CERN Nuclear Physics Research Committee. He was a keen supporter of the idea of a European Physical Society (EPS) and became a Member of the Steering Committee for its formation. He later acted as Scientific Secretary to the Organising Committee for the inaugural meeting of the Society which was held at Florence in April last year. At the present time he is Chairman of the Conference Committee and as such attends meetings of the Executive Committee and the Council of the EPS.

He regularly attends major conferences throughout the world, has found time to visit all the leading laboratories and has written over 40 papers. This intense activity has given rise to many a story that (a) he never sleeps and (b) he lives at the Laboratory. Readers are assured that he does have a house in Abingdon and he has in fact many interests outside physics.

In 1950 Dr. Stafford married Helen Goldthorp Clark, an Australian biologist, who is at present having a year off from teaching. He has a son of 19 who has just finished his first year at Cambridge where he is reading mathematics, at his father's old college, Gonville and Caius. Twin daughters of 17 complete the family and they are attending the John Mason School at Abingdon.

Motoring has always been an interest and during his years at Harwell he owned three Rileys. The first was one of the famous Monaco fabric bodied cars, and this was followed by a rather obscure 6 cylinder model. The final Riley was the 1.5 litre, the last of the conventional models. *Who's Who* lists camping as one of his recreations and this interest and a growing family brought a change in his motoring, so the Riley went and in its place appeared a Mark VII Jaguar. These days he is seen around in a red Hillman Imp.

He confesses to a liking for holidays in Italy, remarking on the need 'to dry out once a year'.

He is also very fond of exploring the English countryside, in particular stately homes and churches. An outward sign of this is a brass rubbing by his son which hangs behind his desk. However, the demands on his time limit such trips to the nearby Cotswolds. Music is another interest and he is a regular supporter of the Abingdon and District Musical Society. He is a keen theatre goer and he and his wife visit Stratford-upon-Avon whenever the opportunity arises.

Asked by a journalist what his aim in science was, Dr. Stafford said: 'A better understanding of the world around us.' One feels that 'the world' is not limited to nuclear physics but includes human beings as well.

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

Council commentary

June. Following the earlier discussion at the May meeting, the subject of the future of co-operative European space research was taken up again and advice was tendered to the Government on the issues arising at the forthcoming Ministerial meeting of the European Space Conference.

Six grants recommended by the ASR and NP Boards were approved. These included the continuation of support at £200K p.a. or more each for three large groups; Professor Boyd's space science group at University College, London, Professor Cassels's bubble chamber film analysis group at Liverpool and Professor Wilkinson's electrostatic generator group at Oxford. A grant of £65K over 2 years continued the support of the exciting cosmic radiation studies by Professor Fowler (Bristol) using photographic emulsion exposed at balloon altitude, in which some of the tracks appear to have been made by elements heavier than uranium. The Council endorsed a proposal to carry out at a cost of £240K a design study for a possible major nuclear structure facility at Daresbury. Finally, a draft of the annual report for 1969/70 was considered, and its completion and issue was authorised.

July. As so often at the last ordinary meeting of the academic year, the agenda for July was long and varied. There was an interesting discussion of a proposal that the SRC ought to support short courses for its research students, to develop their interest in and aptitude for work other than research. An interim panel, with Dr. D. S. Davies as Chairman, was set up to develop the proposal.

Increases in the estimated cost of the S-68 experiment to be installed in satellite TD-1 have been a cause of concern to the Council, and earlier in the year the Chairman had appointed a committee of enquiry into the matter. He was now able to report the committee's recommendations, aimed at preventing any repetition in future projects. The full review of the design for the experiment had also been completed, and a revised cost estimate of £1.2M was submitted. Taking into account the international commitments involved, continuation of the experiment on this basis was approved.

The draft report of a joint working party of all the Research Councils on pollution research was considered, and with slight amendment was accepted for publication jointly with the other Councils. This will be the first such joint publication on a matter of common interest. The Council considered the Royal Society's report on postgraduate training in engineering and technology (the Lighthill report) and comments on it by the Engineering Board. The latter were accepted, and are to be published in the Board's forthcoming programme review.

Nineteen grants, recommended by the ASR, Engineering and Science Boards, were approved, while one was referred back for further consideration. Most of these grants were of moderate amounts, but they included a grant of £300K over 5 years to Professor P. B. Hirsch (Oxford) for the development of electron and ion optical techniques for studies of materials, one of £215K over 3 years to Professor M. W. Thompson (Sussex) to provide a 3 MeV accelerator for solid state and ion implantation research, and one of £176K over 3 years to Professor J. F. Coales (Cambridge) for work on the adaptive control of industrial processes. The Council also accepted a proposal to give some support to the Institut des Hautes Etudes Scientifiques, a high level research institute in France which is considerably used by British mathematicians, and is becoming more and more international. For the Atlas Computer Laboratory, additional equipment costing £170K was approved and for the Royal Observatory Edinburgh, upgrading of the electronics of the Galaxy machine was approved at a cost of £60K.

The conclusion of the industrial productivity agreement with the Trade Unions was reported, and was welcomed by the Council. The Council also heard a report on the successful visit by representatives of the French Centre National de la Recherche Scientifique, headed by their Director General, Professor Curien, for discussions with the Chairman and staff, and visits to SRC and university laboratories.

Quest Quarterly Quote

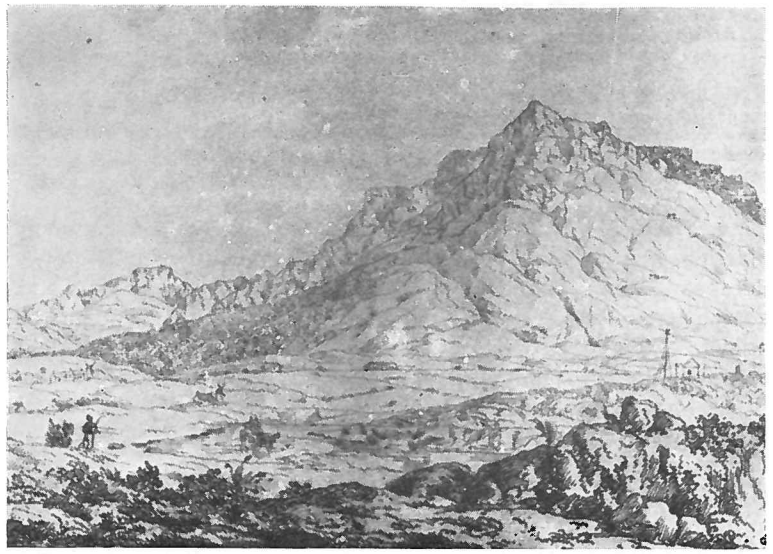
'What does it cost?

These [grants] pay University fees and £530 p.a. for a young single fresh graduate and up to £955 for a married man of 24 with a child and approved experience'.

from a University brochure sent in for SRC to approve before publication

150 years at the cape

G. M. Harvey



Devil's Peak, as seen from a point close to the Observatory. The drawing is by Sir Charles D'Olyly, made on May 17, 1833. This is a scene which all Cape staff remember, except that now, of course, the flat ground, and even the lower slopes of the mountain, are covered with suburbs and freeways.

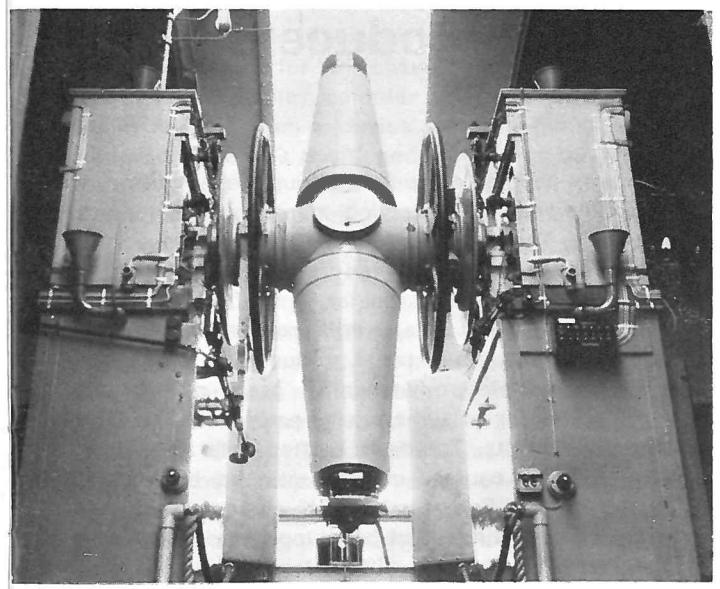
This year the Royal Observatory at the Cape of Good Hope celebrates its 150th Anniversary. Although an excellent article by John Alexander about the Cape Observatory appeared in *Quest* two years ago (Vol. 1, No. 4, pp. 6-9), it was felt that the Sesquicentenary could not be allowed to pass by without mention – hence this review.

The Royal Observatory was established in October 1820 'for the improvement of practical astronomy and navigation', and was placed under the control of the Admiralty. The Reverend Fearon Fallows was appointed the first HM Astronomer at the Cape of Good Hope, and on his arrival he set about selecting a site for the Observatory. He chose Slangkop, an isolated, rocky rise in the ground about three miles east of Cape Town. The name is Dutch for Snake Hill and was all too appropriate, as the creatures abounded there, as did mosquitoes from the marshes nearby, and a variety of other hazardous wild animals. However, it satisfied two requirements, sufficiently close proximity to Table Bay to enable time signals made at the Observatory to be visible from the harbour, and sufficient distance from the 3500 foot Table Mountain and Devil's Peak to afford an unobstructed meridian. Construction of the Observatory buildings took some years, during which time Fallows, in addition to his astronomical work, opened a school and taught the children of neighbouring farmers, the fees being one load of soil per lesson. The soil was used to cover the rocky site, helping to cut down the number of snakes and allowing vegetation to be grown.

Although some observations had been made in the intervening period, it was not until 1829 that the transit instrument, mural circle, and a new Harrison clock were ready for operation, and observing of star positions commenced in earnest. With these instruments, Thomas Henderson, Fallows' successor, obtained data which enabled him to make one of the first determinations of the distance of a star, a significant event in the progress of observational astronomy. The instruments were used until 1855 when they were replaced by an 8-inch Airy Transit Circle, twin of the one at the Royal Observatory, Greenwich, and this telescope remained in service until 1950. In 1905 a reversible transit circle, designed by Sir David Gill, was installed, and, with modifications made in 1950 and 1960 it is still in regular use.

Gill, who was the fifth HM Astronomer, realized the immense power of photography as an astronomical tool, and initiated a program which led to the publication of the Cape Photographic Durchmusterung, a catalogue containing the positions and magnitudes of nearly half a million southern stars. This was followed by an international project of a similar type, but on a much larger scale – the Carte du Ciel. A new telescope, the Astrographic 13-inch refractor was obtained for this programme, starting its service in 1892.

At the turn of the century the Observatory was presented with a fine instrument, consisting of two refractors, a 24-inch and an 18-inch, with an 8-inch guider, all on one mounting. Initially it was used for spectroscopy, but since 1926 its main use has been for the determination of stellar distances, motions, magnitudes and colours by direct photography. Direct photography, both for photometric and astrometric (positional) work, is also carried out on the MRM



The Reversible Transit Circle used for determining star positions.

The Observatory

(Multiple Refractor Mounting), which was acquired in 1964. As its name suggests, this instrument also consists of several telescopes on a single mounting.

The more modern technique of photoelectric photometry is exploited on several of the Observatory's instruments, most notably the 40-inch and 18-inch reflectors, both of which are in continual use for this type of work. Photoelectric photometry is a relatively slow method of obtaining stellar magnitudes in that it takes between five and ten minutes to obtain one set of measures of a single star, whereas one photographic plate exposed for, typically, thirty minutes, yields data on many, perhaps hundreds of stars. The advantage of photoelectric work is its much greater accuracy, essential for some aspects of astronomical research.

Until recently the Observatory was involved in a large programme of spectroscopic work, particularly radial velocities, using observations made with the Radcliffe 74-inch reflector at Pretoria. Photographic plates for sunspot counts have been taken for many years, and a solar flare patrol started at the time of the International Geophysical Year is still carried on. In 1967 a kinetheodolite was moved to the Cape from the Royal Greenwich Observatory and is used for tracking artificial satellites.

Thus, in its 150 years of existence the Royal Observatory at the Cape has always been involved in the broad advance of scientific knowledge, often well to the fore. To celebrate this Anniversary, an Open Day is being arranged towards the end of the year, when the Observatory will be open to the public. Those attending will be able to see the telescopes and have some of their questions answered. The pre-

G. M. Harvey is an experimental officer from the Royal Greenwich Observatory. He is at present on a three year tour of duty at the Cape Observatory (picture in 'news-front')

-ceding afternoon is planned as a VIP occasion when distinguished scientists and administrators from all over South Africa will be invited to visit the Observatory. They also will be shown the various instruments, and have the work of the Observatory described to them. Following refreshments in the late afternoon, there will be a popular lecture.

In addition to these events, a special commemorative booklet, compiled and edited by Mr. J. D. Laing of the Observatory, is to be published in October. Copies of this will be sent to all SRC establishments and those interested will be able to read about the history and work of the Observatory in much greater detail than in the present article.

What lies ahead? With the amenities of a city close at hand, and the many material advantages of a technological society, the life of a Cape astronomer today must be very much more comfortable than that of his predecessor. However, the suburban sprawl of Cape Town, which has long since overtaken the Observatory, has meant not only the departure of the more dangerous of the local fauna, but the ruining of the sky by industrial haze and the glare of street lights, which make it impossible to use the instruments to their full potential. A most desirable step, clearly, would be to remove to a site with a better 'astronomical climate', a step which incidentally would serve to enhance the astronomer's appreciation of material comforts. Such a development we trust will come – but not even astronomers can foretell the future.

from the computers

The next four pieces are from computer folk – at work and play.

1. film analysis

At Daresbury, as at many other high energy physics laboratories, machines used for the manual measurement of pictures taken with bubble and spark chambers have been connected on-line to a computer. A programme in the computer is used to direct the operators and to check their measurements, with a view to eliminating errors which would otherwise result in the event being measured failing to pass through the subsequent analysis programmes.

The Daresbury system has been built up in modular form using standard components wherever possible. All forms of local output (*eg* punched cards, punched paper tape) have been eliminated, and communication between operator and computer is achieved by means of visual displays and keyboards rather than by the use of typewriters. The computer programme has been written in Fortran to facilitate programme modification and testing.

One machine has been equipped with a storage display scope, on which the display can be built up piece by piece and retained throughout the measurement of a picture. The operator's instructions are successively displayed, and a reconstruction of each measurement is made on the display, together with a representation of each track as determined by the computer from the measurements. Thus, at any instant, and in an easily understood way, the operator is shown not only what she should do next, but also all that she has already done. Any errors detected by the computer are brought to the attention of the operator by means of an audible alarm, and an error code displayed on the screen.

The photograph on the cover of this issue of *Quest* shows an operator studying the scope screen, on which are displayed the instructions (on the left hand side), the reconstruction of the measurements (crosses), and the representation of the two tracks the operator has finished measuring.

2. film producers

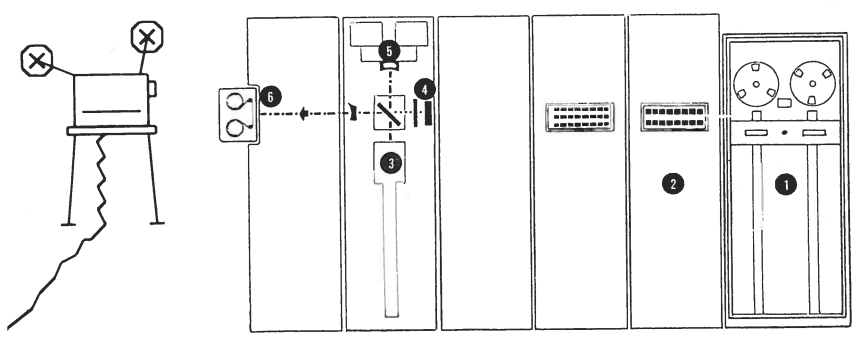
Paul Nelson

To many people, computer output means reams of fan-folded paper containing numbers and cryptic messages. The words are generally in one case only, *ie* capital letters, and to read very much of this soon proves irksome. This particular form of output originates from line-printers and still provides for the bulk of directly readable material produced by computers.

Sometimes electro-mechanical graph plotters are used as a means of summarising previously extensive numerical results. Trends in plotted data are readily seen and, of course, objects may be drawn and viewed from different angles. If character sets are made up using lines then both upper and lower case characters, as well as different alphabets, become freely available.

Although reasonably priced, the electro-mechanical graph plotter is not always fast enough to cope with some requirements. Recently, the more expensive Cathode Ray Tube (CRT) terminal has come to the fore. The simple form known as a Visual Display Unit or VDU is somewhat similar to a television set in appearance, but is only capable of displaying numbers and alphabetic characters. These characters are formed by electronic processes on computer command and are then displayed on the face of the CRT. Usually, both case sets are provided for in the 'hardware' or electronics of the terminal.

The full graphics terminal is more elaborate in that it is also capable of producing lines at any angle and may be activated by using a keyboard and light-pen. The latter is able to detect the displayed data and send signals to the computer as to the location of the 'hit' or detection point. Connected in this manner, whereby electronic signals are transmitted in either direction between computer and terminal, provides for what is known as 'on-line interaction'. The input may optionally be used to modify the output, the changes taking place virtually instantaneously. Alternatively, the computer may be programmed to produce a set sequence of pictures.



SD-4020 Microfilm Recorder (left)

1 Magnetic Tape Deck
2 Buffer Unit
3 Cathode Ray Tube
4 Forms Flash Unit
5 16mm or 35mm camera
6 Photo-paper camera

These terminals with no mechanical inertia to overcome provide for high speed output. The graphics terminal can display complex drawings in seconds and it is from such a device that cine-films can be made. A camera is positioned in front of the screen (see diagram) and is set off in synchronisation with the picture changes. The general appearance of these films is mainly one of lines, alphabetic characters and symbols on a high proportion, in area, of uniform background. They have more in common with cartoons than of normal, or continuous tone, films. The lines and characters may be positioned as the result of highly complex mathematical calculations carried out by the computer, which an ordinary animator would find virtually impossible to match. And it is in this area that computer films are of importance in the teaching and scientific applications field. Artists are also becoming increasingly interested in these products as a means of expression.

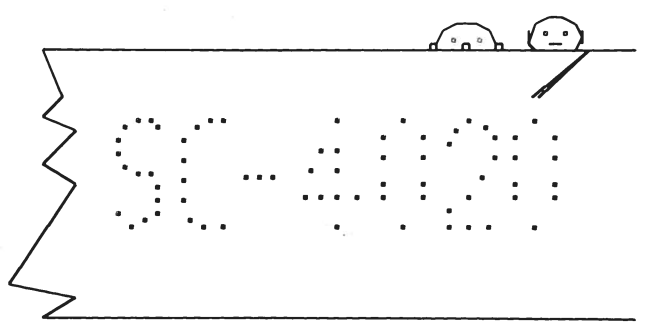
Graphic Terminals are not generally suited to quantity production of high quality film output and machines have been specially developed. One such device known as a CRT microfilm recorder manufactured in the USA by Stromberg DatagraphiX is installed at the Science Research Council's Atlas Computer Laboratory, Chilton.

The microfilm recorder operates from instructions prepared on magnetic tape, produced by programs running on an ICL Atlas computer. In some installations these recorders are connected 'on-line' to the computer, *ie* connected by information-carrying cables, for immediate response. Standard programs save the user knowing in detail how lines and characters are specified to the recorder. For example, he could draw a cross by punching the following statements on two program cards:-

CALL LINE (300, 500, 700, 500)
CALL LINE (500, 300, 500, 700)

The commands are then automatically recorded on the magnetic tape in the form required by the recorder. The information is later read from the tape into a buffer store, and after decoding electronically, the electron beam within the CRT traces out the two lines in rapid succession.

Pointing at the tube face are either a 16 mm. or 35 mm. camera and a camera containing photo-recording paper for enlarged 'hardcopy' prints. In addition to lines, characters formed by extruding the electron beam through an etched matrix can also be displayed and recorded. The aperture setting remains fixed for a particular type of film, and since the CRT and cameras are in a light-tight cabinet the shutters generally remain open during the time a job is running. The time-interval between frame advances varies depending on the information content of the frame or picture. Whilst the film is being advanced under tape command, further display instructions are held up until the film is again stationary. Typically, lines and points are plotted at the rate of several thousand per second.



To produce a cine-film, the 16mm cine camera is used with black and white negative stock in 400 foot cassettes. It is possible to use colour stock, but as the phosphor of the tube emits light mainly in the blue region of the spectrum, the colours that can be obtained are rather restricted. By making use of a form slide projector, provided for superimposing constant information on the displayed data, but using colour filters, the blue trace may be combined with a coloured background in order to provide colour variations. The addition of a second, different colour filter, replacing the shutter itself allows for further modification in the colours. Opening and closing the now translucent shutter at suitable instants during the production of a frame give two colour plots on a third background colour.

The black and white film is processed in a small 16mm/35mm table-top microfilm processor at either $3\frac{1}{2}$ or $2\frac{1}{2}$ feet a minute, but colour film, when used, is sent to a commercial film processing laboratory.

Cine-films of any length are readily produced from short sequences by printing from A and B chequerboard rolls which is a method for preventing joins on the print from showing on projection. Some difficulties have been experienced with high contrast prints made on silver stock since the line work is very fine in certain instances. Although Diazo film appears suitable for printing on, at the moment sprocketed feed printers do not seem to be available. This material is exposed to ultra-violet light and processed in ammonia vapour at a speed of approximately 20 feet a minute for this type of work.

In order to retain interest, camera effects such as zooms, wipes, mixes and fades are possible on the displayed objects using suitable computer programs provided for manipulation.

A film made to illustrate the routines available has been produced with a sound-track on magnetic stripe running at 16 frames per second. The professional who made the sound-track did so under protest as

from the computers

from the computers

the film industry standard is 24 frames per second. However, as computing costs are high, the small drop in quality in this instance with this particular sound track can probably be justified!

The film uses the forms-flash to show a background picture of the Atlas Computer Laboratory with the title of the film – 'FOCUS' – drawn by the microfilm recorder, superimposed. Various routines provided for simulated camera effects and for achieving other necessary functions, such as line-thickening, are shown. Then follows a sequence describing the method used by a contouring routine for handling randomly distributed points having known values. A dramatic view of the earth rotating produced from a program originating from the American Space project, and generated from over eight thousand pairs of numbers representing the coastlines of the world, is accompanied by suitably stirring music. This gives way to a sequence of the British Isles being rapidly drawn as if by hand. The information representing this map contains even more points or pairs of numbers than that used for the whole world in the previous example, giving much greater detail. These values were obtained using a digitiser, a machine that automatically punches out the co-ordinate as a hand-held pen traces the outline. A zoom-in settles on the Atlas Computer Laboratory again and a final 'mix' brings up the word 'END'.

Paul Nelson is a programmer with the Atlas Computer Laboratory. The film 'FOCUS' which is described here was shown at the 1970 British Industrial Film Festival, held at Brighton in June. Copies are available on loan from the ACL Library.

3. fish to watch

Adrian Buckel

I keep fish as a hobby; and when one day in February another member of our shift suggested having an aquarium in the entrance hall of the Atlas Laboratory, I agreed to help set up the tank and look after the fish. The Director and department Heads were all willing, so work was started and Mr. Roberts (Admin) and his staff were very helpful in setting up the aquarium. A poster describing fish that would live happily together in a community tank was hung on the entrance hall inviting volunteers to buy them. The response was very good – despite requests for Piranhas!

The tank measures 54 ins x 10 ins and is 15 ins high. It holds 29 gallons and has two under-gravel filters. We only have one heater as the tank stands above two radiators but usually a tank of this length needs two to keep the temperature between 78° and 80°F. The fish are fed twice a day by my wife Gaynor *(see picture)* who also switches the lights on at 8.30 a.m. and off at 5 p.m.

At the moment we have six different types of plants in the aquarium. They are Crypocoryne, Echinodorus, Vallisneria, Synnema and Micranthemum, also Aponogeton which has grown very well and has flowered many times. By this time next year the plants should be well settled and growing much thicker and faster.

After having trouble with fin nipping by Tiger Barbs, weak fish dying, and very hard water, the fish are settling down now and the guppys are breeding regularly. None of their fry have survived as there is not yet enough cover for them. A pair of Zebra Danios have spawned (the eggs being eaten), and a pair of Red Platys may soon have some young. These three types of fish are the only ones in the tank at present that will breed there: all the rest must have special conditions to breed. Except for guppys and platys, most of them are egg layers.

Below is a list of the fish we have. A little about them each is headed by the scientific and the popular name of the fish.

***Lebistes Reticulatus* or Guppy**
The Guppy is one of the best known tropical aquarium fishes. Most of the males are very colourful: no two have the same coloration. The Guppy is a live-bearing fish: it has up to 70 fry a time, and a female is fertile when only three months old.

***Xiphophorus Maculatus* or Platy**
The Platy is another live-bearing fish, having up to 70 fry a time, but not quite so colourful as the Guppy. There are red and black Platys in the tank.

***Brachydanio Rerio* or Zebra Danio**
Zebras are egg-laying fish from India, not so colourful but very active. One pair have spawned in the tank.

***Barbus Tetrazona* or Tiger Barb**
As mentioned earlier Tigers tend to nip fins; despite this drawback they are very colourful. Origin Thailand, Sumatra and Borneo.

***Rasbora Heteromorpha* or Harlequin**
These little fish look very nice in a school of a dozen or more in a well planted tank. Origin Malaya and Sumatra. Not easy to breed, but when they do they lay their eggs on the under side of leaves.

***Gymnocorymbos Ternetzi* or Black Widow**
Black Widows are found in Paraguay. They are egg layers, and very good community fish.

***Hyphessobrycon Flammeous* or Flame Tetra**
Sometimes called Rio de Janeiro Tetra as they are found in rivers in Rio de Janeiro. We have not got any Flame Tetras yet, but they have been requested.

***Hyphessobrycon Innesi* or Neon Tetra**
This very pretty little fish found in Peru and Western Brazil is seen in the community tank in many homes. The rear lower part of the body is red, the throat (as you could call it) is white and a blue/green neon line runs from the eye to the caudal peduncle (base of tail).

***Hyphessobrycon Gracilis* or Glowlight Tetra**
Coloration is the only difference between the Glowlight and the Neon: the Glowlight has an orange instead of blue/green line, and the rest of the body is silver. Origin Guiana.

***Gyprinocheilus Aymonieri* or Sucking Loach**
The worker of the tank, origin Thailand, called Sucking Loach because of the sucker around it mouth which enables it to stick to the sides of the tank or leaves of plants. Is a very good scavenger so helping with the maintenance of the tank. The Sucking Loach has not been bred in captivity.

***Corydoras Paleatus* or Mottled Catfish**
A request for a catfish was made so I chose the attractive C Paleatus which often sits at the front glass and amuses onlookers with a frequent wink of the eye. Unfortunately our little catfish died which I was on holiday.

Adrian (picture in 'newsfront') and Gaynor (seen left) are Computer Operators at the Atlas Computer Laboratory.

***Betta Splenden* or Siamese Fighting Fish**
In Siam these fish provided sport, much the same as cock-fighting did in England before it became illegal. The wild Bettas are found in Paddy Fields in Thailand, Cambodia and Indonesia. When breeding, the male Betta builds a bubble-nest at the surface and the eggs are put into this nest and cared for by him. Our Betta died from dropsy only two weeks after we bought him.

***Pterophyllum Eimekei* or Angel Fish**
Another well known tropical fish, with one drawback: they grow to 5 ins which is twice the size of any other fish in the tank, so we may have to move them and get some smaller ones later.

from the computers

4. computericks

INTRO
If FORTRAN is incomprehensible
And to speak it, you feel, indefen-
sible:
Then just read these verses
In our tongue(?) from Atlas –
And their FORTRAN seems less
reprehensible!
ED

1 There was a programmer from
Cuidad
Who made love to an engaged
card-reader; he'd
Scarcely begun
This ILLEGAL FUNCTION
When it monitored C TIME
EXCEEDED.
FRED

2 There was a nice punch girl
called Dora,
Whose dress shimmered like the
aurora,
The card reader action
Was a fatal attraction –
'Twas a difficult job to ignore
her.
APOLLO

3 There was a young coder from
Aix
Who fed the computer cream
cakes
When it started to burp
They gave it some turp –
Entine and ran the LOG.
FRED

4 One Supervisor was a woman,
The other wasn't quite human,
When they ran off together,
SHE was as light as a feather,
But IT had to come in the van.
APOLLO

5 *(Written on discovering the perpetrator of some unrepeatable doggerel about 'Fred' and 'bed' chalked on the author's blotter).*
There is a Yank student called
Rosenthal
Whose dog-ends on my floor
are oft squozen. Till
He happens to light
Some old gelignite,
We shall have to endure his vile
prose and all.
FRED

why bother with contracts?

The following letter has been drawn to our attention by the Contracts Section at London Office and is reprinted, by courtesy, from 'Purchasing Journal', the official publication of the Institute of Purchasing and Supply:-

The Amateur Buyer
To the Editor of *Purchasing Journal*.
For more years than I care to remember, I have had trouble with the Amateur Buyer. Following a recent brush with one of our more senior AB's it occurred to me that young purchasing men, new at the game, might be glad of a viewpoint against which to examine their own. I realise the procedure will differ with each organisation but the principle, and the effect, is exactly the same.

Amateur Buyer contacts supplier and places unofficial order. In due course supplier despatches goods – without an order number. Goods receiving department has no record so when consignment is received it is placed to one side.

By and by, AB realises the goods he ordered have not been received so he asks purchasing department to find out where they are. When he has calmed down buyer rings supplier who says – 'What the hell, they were despatched two weeks ago'. Again, buyer loses his cool and forcibly points out that supplier had no right to accept without an official order – and he had better not do it again. Buyer checks with goods receiving department – consignment has been there for some time. You say buyer should have done this before ringing supplier. He, naturally, thought AB had done it. And AB? It would not occur to him.

Buyer contacts AB and tells him goods in stores. Asks for purchase requisition to cover.

AB goes round to stores and persuades storekeeper to release consignment. Promises to have official order raised at once so that delivery may be recorded. Alas, like mortal man the world over, AB having got the goods forgets to buy the mink coat, or in this case raise a purchase requisition.

Invoice section now ring buyer and want to know what to do with this invoice about which they know naught. Buyer calling upon gentlemanly instincts almost forgotten, restrains himself. Tells them AB has promised paper work but failed to keep word and would they please remind him.

A member of invoice section now contacts AB who says he will deal with it at once, which is quite funny, really. Supplier now rings buyer and asks why his invoice is being held up. Buyer, adrenalin surging through his veins, marches off to see AB. Raises hell and gets requisition made out there and then. But only after both have had such a row that they are capable of little productive thought for the rest of the day.

I realise I have exaggerated. Even so, the above is much too close to the truth for comfort. Something like it happens in most factories every day.

It creates an enormous amount of unnecessary work and wastes a lot of money. Breeds dislike and distrust between departments. Strains relations between buyer and supplier. Not to mention that no attempt has been made at price negotiation or cost saving and AB places no restrictions on the extent of his wheeling and dealing.

In my opinion, no company, regardless of size, can afford even one Amateur Buyer. That, of course, is a dream. He will always be with us. He is tough and resilient and when he cannot pull rank he will use charm, guile, bluster, or any other means at his disposal. And, as you may have gathered, I dislike him intensely.

You can't join him – not and run an efficient department – so you have no choice, have you?

H. SALLABANKS,
Purchasing and raw materials control manager.
Jas. A. Jobling & Co. Ltd.

It couldn't happen here? – well just read on.

Seen in a recent RL bulletin :

'UNDELIVERABLE GOODS. Will the person who ordered 6 single Welders Gauntlets from 'Greenham Tool Co.' by phone in May 1970 please contact Mr. D. B. Howe, Ext. 580 as soon as possible'.
Incidentally, who ordered the 3' x 2' x 4' Hopper currently awaiting collection in Offices Services Section at London Office?

perhaps that's why !

nutcracker no. 1 – studentships

The day after the committee meeting, five professors descended on the secretary. 'It's an outrage!' cried Professor Battie, 'I hear that I have 10 studentships, while Hazelnut has 6, Greenstick 7, Danton 8, and that rogue Ravage 11.' 'According to my sources,' said Danton, 'Ravage has only 7, while Battie has 8, Hazelnut has 9, Greenstick 11, and myself a paltry 10.' 'I wish that were true,' said Greenstick, 'but I hear I have only 10, Battie has 11, Ravage 12, Hazelnut 14, and Danton only 6.' 'My sources give Danton 7,' said Hazelnut, 'while I have 8, Ravage has 9, Battie 10, and Greenstick 6.' 'No, no!' exclaimed Ravage, 'As I hear it, Battie has 6, Hazelnut has 7, Danton 10, myself 11, and Greenstick 12.'

'We protest!' they cried in unison.

'It seems there are more false rumours than usual this year,' said the wise, honest and magnanimous committee secretary, 'in fact, each of you has given exactly one professor the correct number, and put precisely one professor in his correct place in the order. Needless to say, I can't divulge the actual numbers, but no two of you have the same number, and if you're worth your chairs, you should now be able to work out how many each of you has.'

How many studentships did each professor have?

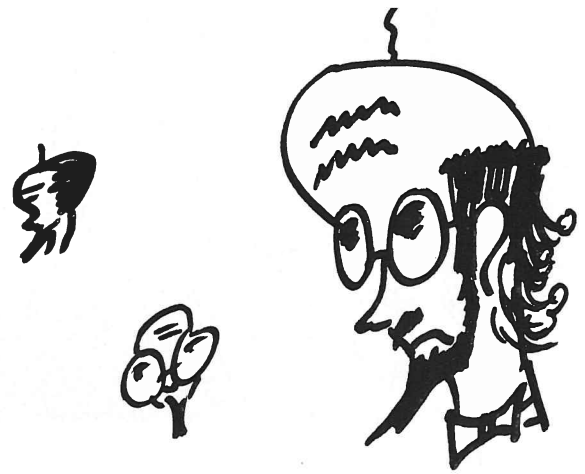
Hint: Work out the order first. There are two possibilities. Solution on page 28.

(This is the first of a series of problems devised by Peter Casey, an SO at London Office on the Chemistry Committee. In certain quarters the various anagrams, puns and, in this case, personal references will no doubt strike a response of their own.)

anglo-australian meeting

from the record
On 3-5 August 1970 the Anglo-Australian Telescope Joint Policy Committee met in State House. The Committee comprises Professor Fred Hoyle (Chairman on this occasion), the Astronomer Royal and Mr. Hosie for the UK and Dr. Bowen (Chief of Radiophysics, CSIRO), Professor Olin Eggen (Director, Mount Stromlo and Siding Spring Observatory) and Mr. K. N. Jones (Department of Education and Science, Canberra), for Australia. The meetings were also attended by Mr. W. Goodsell, the newly appointed Project Manager (formerly of MPBW) and Mr. H. Minnett, the retiring acting Project Manager (of CSIRO, Sydney). The secretariat was provided by Mr. D. Cunliffe, the AAT Executive Officer, assisted by SRC staff. Various consultants, including Professor Redman from Cambridge and Professor Gascoigne from Australia attended some of the sessions.

from the unofficial record
'Great hairy jumping roos!' Australians don't really talk like this, but you try to write in strine. It was the Wednesday before the Anglo-Australian Telescope Joint Policy Meeting. The occasion was a visit to Freeman Fox Partners (consulting engineers). A taxi laden with the AAT project team threaded its way through tourist London to Alliance House. ('This is *not* the entrance to the Caxton Hall. Freeman Fox, second



floor'). 'Great hairy roos!' for it was still the good old days and it was very hot and the mini skirts varied between micro and nano and the Australians were exceedingly impressed with London.

For about three weeks, the thirteenth floor of State House became travel bureau, post office, hotel booking service and general nursemaid service. At least five lots of visitors of different status were staying for different periods, all needing a private room, with bath, next door to State House as well as a large office with shapely secretary and good view.

Most of them had to settle for just the view . . .

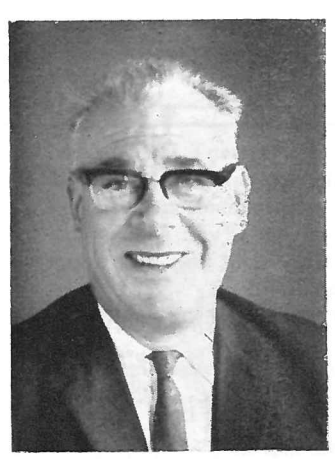
The day of the meeting came: 09.55, five minutes to go – Could we have a shorthand typist to do just a little letter? (actually 4 pages, and, being Australian, having to be typed upside down). Could we have 7 copies of this by ten minutes ago? I don't seem to have brought my cigars. Has anybody seen Professor Hoyle? Will Dr. Bowen take a call from Sydney?

'Good morning gentlemen, shall we begin? I should like to start by welcoming to the meeting . . .'

It is always a good thing with all-day meetings for the members to be offered beer with their lunch. This ensures that the afternoon session proceeds at a pace more suited to the needs of the Secretariat (who, incidentally, should partake sparingly of the ale). At the end of the three days which the meetings occupied I had 28 pages of notes, including three attempts at a caricature of Professor X (enclosed), a very fine sketch of an air balloon and a drawing which would be of great interest to my psychiatrist. My Australian colleague had pages of notes including lots of clever points which I missed while drawing Professor X.

So there we were, four days to write the minutes – or else! – and they had better not be as long as the last lot. (I was already quite clear on that point anyway, for it is difficult to produce 50 odd pages of beautifully typed minutes out of 28 pages of scribble, including the Mongolfier plans). Well we did it and the Secretary has flown back to Australia – though why one *flies* to *down under* I don't know. *Secretary*

the mayor of wallingford



Alec Goode (left) and above the Mayors' Party in the stainless steel car on their way to the Saluting Base.

Wallingford, Berkshire, population 6,000, a small but thriving market town on the banks of the Thames, is of great historic interest. Its origins go back to the Saxon times and in fact the early fortifications in the form of earth mounds are still standing. The Danish King Sweyn destroyed the town in 1006, but by 1066 when William the Conqueror arrived on his way to capture London, it was a busy and prosperous place. The sensible folk of Wallingford threw open the gates of the town as William approached and thereby gained a unique right to extend its curfew until 9.00 p.m. each day – an hour later than any other part of the country. The curfew bell still rings every evening as it always has since that time.

The castle was built in 1071 and Henry II held a Parliament there in 1154 and gave the town a charter in 1155. In 1349 the plague disrupted life leaving only 44 houses standing and further destruction followed during the Civil War when fighting raged through the town and the castle was demolished. A disastrous fire occurred in 1675 which destroyed many of the medieval houses.

The office of Mayor dates back to the 13th century and has been continuous except for a few years during the Civil War. On 21st May this year Alec Goode, Head of the Building and Mechanical Services Group at the Rutherford Laboratory was installed as Mayor of the Ancient Borough of Wallingford. Alec joined the Laboratory from the Capenhurst Works of the UKAEA and took up residence in January 1958. He was elected to the Borough Council in May 1963 and also represented Wallingford on the Berkshire County Council from 1967 to 1970.

In June, very early in his term of office, Alec and his wife visited the USA to take part in the Tercentenary Celebrations of the foundation of the town of Wallingford, Connecticut. The invitation for the Mayor and Mayoress to attend this function had been received in 1969. By the time the visit took place it had become necessary to charter a Boeing 707 at a cost of £9,500 to carry everyone.

On 26 June, 153 people travelled to the States, half the Council went, husbands left wives behind and wives left husbands behind – even the Mace was taken. Free accommodation was generously provided by the people of Wallingford, Connecticut. The party was met at Kennedy Airport by coaches and taken to their destination, 90 miles away, through a part of the States where the towns have such familiar names as Oxford, Plymouth, Bristol, Durham, Manchester, etc.

The celebrations started on the next day, Saturday, and lasted for a week. During this time Alec and his wife were kept very busy and in fact only managed one break, of only three or four hours, to themselves. The opening ceremony on Saturday afternoon commenced with a procession to the saluting base, led by the Mayors of Wallingford England and Wallingford Connecticut and their wives. The body of the car in which they travelled was made entirely of stainless steel and was valued at 58,000 dollars. Wallingford Connecticut, population 36,000, apart from being famous for its silver ware is an important centre for the production of stainless steel.

But to return to the opening ceremony – on arrival at the saluting base, the party which included the First Councillor from the British Embassy and the Deputy Governor of the State witnessed one of the largest shows ever seen in the county. There were 450 units in the procession which took 4½ hours to pass the saluting base. A barbeque followed and the first day ended with dances held all around the town – Alec and his wife visited four.

Sunday was given over to the religious aspects of life when they both attended two church services and three church receptions.

On Monday, a visit was arranged to New York for all who wished to go, and this was followed in the evening by a spectacular in which young people depicted the history of their town. The next day's events included a trip to Newhaven (now there's a familiar name) where both mayors were interviewed on the radio. Events followed so closely that Alec has some difficulty in recalling everything but he does remember the main event on Wednesday. This really was an unusual affair as a joint meeting of the councils from the two Wallingfords took place in front of a large crowd. During this meeting momentoes were exchanged, Alec Goode as Mayor of Wallingford, England presented his opposite number with an illuminated address and received in return a silver bowl.

And so the week passed with visits to fairs, theatres, Yale University and concerts. At one school Alec was presented with the Stars and Stripes which had been flying over the school. The flag will now be flown once a year at Wallingford, England on American Independence Day.

The final event, a dinner and ball was held at Choate School which is, one gathers, in the top bracket (the Eton and Harrow of the USA) and numbers amongst its former pupils John F. Kennedy and Adlai Stevenson. Here in the presence of the State Governor, local Congressmen and many other dignitories, Alec made his final speech.

The party returned home on Tuesday, 7 July having experienced hospitality that was both warm and generous.

Alec has some amusing stories to tell of this hectic visit such as the astonishment expressed that the Mayor of Wallingford, England received no pay. His opposite number serves for 4 years, is paid 11,000 dollars a year, and is head of the fire brigade and the police. This last office proved to be of great use as everywhere Alec went (with police escort) it was green lights all the way.

He got to know the police escort very well and consequently had a lot of questions to answer about the British police. Alec is still chuckling over their amazement when they learnt that their British counterparts did not carry pistols, not even when making an arrest.

All in all, a momentous start to Alec Goode's year of office; did he enjoy his visit – 'Yes, very much', was he glad to return to the ancient borough – 'Oh yes', – or was it 'OYEZ'.

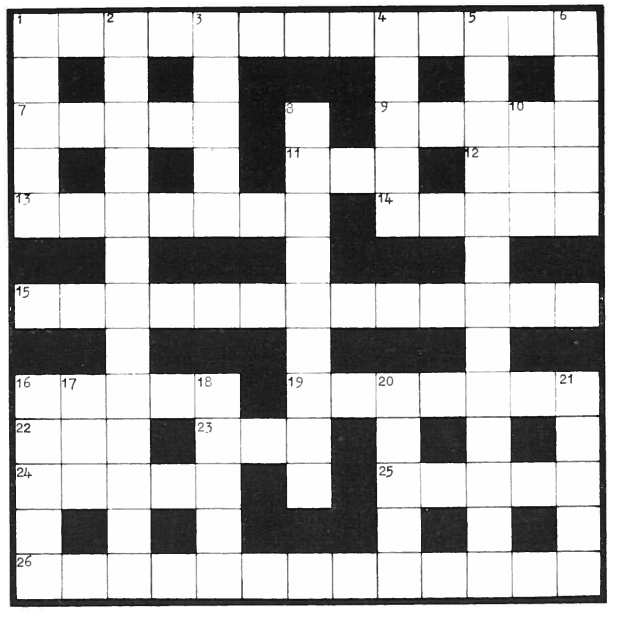
crossword

Across

1 More common but unusual (13)
7 Extend broken care followed by hard beginning (5)
9 A frontal plate far away initially followed by US intelligence (5)
11 Sappers contain nothing from the fish (3)
12 Owns a mixed ash (3)
13 Church of England following a German town to reality (7)
14 Smiling boy in a little right (5)
15 Bury the groups where they cross (13)
16 Gather one Weight (5)
19 A boy with a lob back gives a game of chance (7)
22 One of 17 down, or fifty with two points (3)
23 On foot to the east (3)
24 Bury among? (5)
25 Farewell a french god (5)
26 Inca die at pact confused and helpless (13)

Down

1 A point before a backward Ireland, strange! (5)
2 UK to USA or vice versa (13)
3 Pale like a chicken (5)
4 Deduce an inferno without negation (5)
5 Digger of the past (13)
6 As yet if mixed will rise (5)
8 Quietly felt bitter and gave (9)
10 Scot of 14 across (3)
16 Somewhere else, but I bail confused (5)
17 22 across and 10 down (3)
18 Razor sharp after its use (5)
20 Intended food containing pole (5)
21 Gauged, lost a note, became confused, and fell ill (5)



Set by Robert Marsh, RSRS (Assistant Experimental Officer in the Satellite Orbits and Predictions Group)

Solution on Page 28

London Office . . . where's that?

moving on

Having been very loth to leave the tremendous view behind, not to mention the tremendous extremes of temperature and the colossal downdraughts, some of the London Office staff in SUGA and the finance and establishment divisions have been moved down the road to 5-11 Holborn. Now that they are there, in the historic City of London, in a building ⅔ of a century old, very few would be pleased to move back again from their 'chambers' to the State House block. No regrets except that during the August downpours (and this year they seemed pretty heavy even for August) some of those back from early holidays did wish that the building had been made waterproof. The sound of tiny drops pattering into buckets made them quite homesick for the shingle of the South coast.

Old Bailey. Enterprising youngsters may be interested to note the proximity of Hatton Garden, the underground car park to hide the wagon until the bother (bovver?) has died down and it can be flogged in the Euston Road, and fifteen floors to hide the sparklers. Also, no doubt some honest citizens who would trade the chance of reward money for a share in a profitable concern. 5–11 Holborn has no place in history that we know of, unless it is as part of the trend to overthrow the four storey block in favour of the State House type of thing. But State House is quite well known round about London to people who remember when it was a rare sight, – like a lone pine amid the alien corn or perhaps, according to prejudice, a latter day Tower of Babel. Nowadays tower blocks increase and multiply (to continue in the style of the Authorised Version) at a rate that threatens afforestation on a Manhattan scale. We look for divine intervention – in 'their' direction, of course, not ours. They interrupt our uninterrupted contemplation of the panorama.

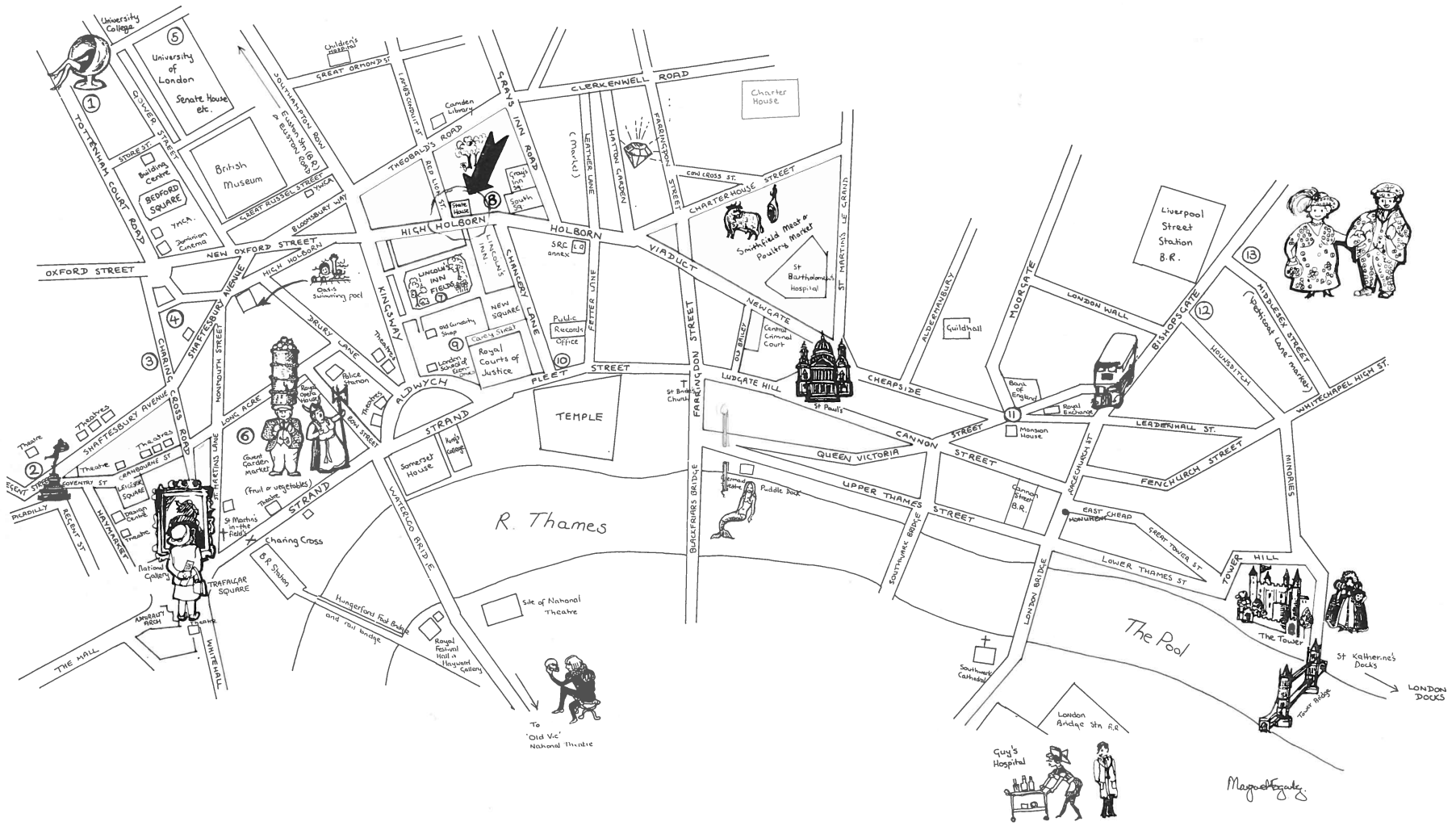
Picture on right: State House as seen by the man in the street (with a crick in his neck), the roof of which played a part in the film 'Herostratus' shown recently on TV – which was not, we thought, for the squeamish. Some think the encircling bands were a last minute save-all added by the builders, others that they are intended to spring apart when the balloon, so to speak, goes up. We wish we knew.

Picture on extreme right shows the venerable 5–11 Holborn. No, not that old! – it's the building second from right. Ye Olde Shoppes (nearest the camera) are 500 years old.

here 'tis

Being, as ever, concerned with the practical, we show the geographical position of SRC's London Offices.

The map is not so much a guide as a record for the benefit of your children to show the position of Dad's London office in relation to such historic places as the Tower of London, Piccadilly, LSE, and the



map references

1 Tottenham Court Road – *a byword in furnishing*
2 Piccadilly Circus – *where IT seems to be AT*
3 Charing Cross Road – *for the bookish or the film voyeur*
4 Denmark Street – *'tin pan alley'*
5 University of London – *seat of learning supported (partly) by SRC*
6 Covent Garden – *where prima donnas sing to rows of (sic) cabbages*
7 Lincolns Inn Fields – *the miniest minis on view in the swinging city.*
8 Inns of Court – *where suits are very expensive*
9 Carey Street – *London synonym for 'Queer Street'*
10 Fleet Street – *a dangerous place for a haircut*
11 Threadneedle Street – *a safe place*
12 Houndsditch – *wholesale warehouses*
13 Petticoat Lane – *wholesale pigs in pokery*

Map drawn by Margaret Fogarty of the Service Unit for Grants and Awards (SUGA), London office, who is by training a graphic artist.

Anyone fancy an envelope?

We recently received one of those unopenably complicated American envelopes bearing the legend

'Columbian Natural Clasp no. 90N'

Wonder what they call the other 89 positions?

(from Fred Lunnon, Atlas)

Or a politically sensitive typist?

'VISITS BY PARLIAMENTARY CANDIDATES. The three candidates for the Abingdon constituency will address members of staff in the Lecture Theatre on the following dates :-
Thursday 11 June, 1.00 p.m.
Airey Neave – Conservative
Friday 12 June, 12.45 p.m.
Normal Price – Labour
Monday 15 June, 1.00 p.m.
Caradoc Evans – Liberal'

(from RL bulletin 30/70)

Our research programme is aimed at understanding

the forces of nature

and the laws that they obey

forces - what are they?

Forces hold bodies together or apart; the forces (or interactions) between particles, atoms and molecules govern the properties and behaviour of all matter.

forces - how many?

Probably four:
Gravitational (Relative strength 10^{-40})
Electromagnetic (Relative strength 10^{-2})
Strong (Relative strength 10)
Weak (Relative strength 10^{-4})
each described on later panels (nos 2-5)

forces - how studied?

At this Laboratory, all the forces except gravitation are investigated by means of high energy physics experiments using our proton accelerator Nimrod, which, together with the techniques of high energy physics is introduced on later panels.

1

rutherford laboratory

open days july 1970

3

On 2 and 3 July 1970, some 600 visitors from Universities, Government Departments and Industry, travelled by car, train or coach to the Rutherford Laboratory. On Saturday, July 4, families of the Laboratory staff and associates had their turn and an estimated 1500 people took advantage of the opportunity to tour the many displays. The Open Days theme this year was 'The forces of Nature and the laws they obey.' The photograph (1) is of the first of a number of display panels which were set up in the reception tent as an introductory exhibition interlinking the other specialised exhibits by showing where each fitted into the Laboratory's research programme.

Amongst the many exhabits in Hall 3, the concrete insulated magnet display attracted a lot of attention (photo 2). Organic based magnet insulating materials are subject to radiation damage whereas inorganic materials are not affected. Considerable progress has been made in the use of cementaceous aggregates as an insulation binder. Labourers who were involved in some of the early work in mixing these aggregates, 'commented unfavourably' on the precision measurements of the relative quantities of materials used in these mixes. Unfortunately those comments, are, one is told, unprintable.

Another exhibit which was a must for the many visitors was the superconducting magnet display (photo 3). The technology required for the successful development of these magnets has received special attention at the Rutherford Laboratory. In collaboration with Imperial Metal Industries, the research team has developed a new type of conductor consisting of a twisted array of very fine superconducting filaments embodied in a matrix of normal metal.

The last photograph shows a small part of the new experimental hall (Hall 3) and in particular the π 8 experiment (Westfield College and RHEL) which is shown set up at the top of the photograph. The experiment will determine whether charge conjugation invariance C is violated in electromagnetic interactions. Or for those suffering from scientific indigestion – are positive and negative charges treated alike at short distances.

Space is too short to permit more than a random sample of the many exhibits on show throughout the Laboratory. To visit them all required a considerable feat of endurance and the demands for cups of tea *and* comfortable chairs grew as the hours went by.

2

4

For a last word on the Rutherford happening we include the following. The muse, unfortunately, had 'gone to lunch'.

Lochnessery at the proton laboratory

(by an arts girl in search of Science)

Now Rutherford did open doors
For everyone (n^2) to see
A 7 Ge' Synchrotron
And SUPERconductivity.

From north they came – electronwise,
From south and east with open eye,
To climb the mound, to poke around,
To follow tracks of energy.

Trails of sparks and flying spots
Were traced on cathode tubery,
By scanners scanned and fed on-line
To rapacious computery.

We felt that we had seen it all
– Real cool magnets, beam-line
benders,
Scattered pion-proton action,
The latest thing in bubble chambers.

But as we homeward read our way
Through each descriptive article
We stopped in wild surmise –
gasped – Why
We never saw the Particle!

the undiscovered particles

M. G. Albrow

Dr. Albrow wrote this article when working at the Daresbury Laboratory with a team from Manchester University. He is now a research fellow at CERN in Switzerland.

In the early 1930's it seemed to physicists that they had reached a point where the structure of matter could be understood, at least in principle, in terms of only four basically different particles. All atoms were known to consist of a tiny central nucleus composed of positively charged protons and neutral neutrons, surrounded at a relatively large distance by layers of very light, negatively charged electrons. Atoms could emit or absorb energy in packets of electro-magnetic waves, the particles of light known as photons.

Nevertheless, there were some difficulties that required clearing up, and the solution of each seemed to require additions to the initial list of four. Firstly, it appeared that in the radioactive decay of an atomic nucleus, a neutron spontaneously transforms itself into a proton and an electron, but when the process was quantitatively investigated it seemed that neither energy nor angular momentum were conserved. This uncomfortable situation was resolved by the slightly less uncomfortable hypothesis of Pauli that the energy and angular momentum that appeared to be lost were in fact taken away by a new neutral particle, later called the neutrino. This particle was finally found 25 years later.

Secondly, Paul Dirac found that when he tried to bring quantum mechanics into line with relativity theory, the equation describing the (negative-charge) electron had a second solution describing a positively charged electron. This antielectron or positron was later discovered by the tracks it made in a cloud chamber. Were there also antiprotons and antineutrons?

This question was answered in the affirmative in 1955 when the particle accelerator at Berkeley came into operation. The list grew. The third puzzle, and by far the most difficult, was that the protons in the nucleus should violently repel each other by virtue of their positive charge. Yet the nucleus was stable, so presumably there was a much stronger force than electromagnetism binding it together. As we believe that forces require some object to transmit them (electromagnetic forces are transmitted by photons), perhaps this strong force was transmitted by another particle. Yukawa correctly predicted the properties of this particle, the π meson. It was expected to exist in three charge states (positive, neutral, and negative) and to be some 250 times more massive than the electron. However, this turned out to be a gross simplification of the strong force, and many other particles were found which play a part in transmitting the force among protons and neutrons.

The preceding brief history of the rise of particle physics shows how theoretical or experimental difficulties in our understanding of matter can often be resolved by supposing the existence of new particles, the properties of which can generally be predicted in advance, and that sometimes these particles are only detected decades later. The present state of particle physics appears to be extremely complex, with over a hundred objects known. Many of these hardly deserve the name 'particle', being so unstable that they disintegrate after an extremely brief existence (about 10^{-22} seconds); but there is no sharp dividing line between these so-called 'resonances' and the relatively stable particles such as π mesons.

The undiscovered particles described below have mostly been proposed to resolve theoretical difficulties in our understanding of how the known particles interact between themselves, and if discovered would therefore enjoy a rather high status in the particle zoo. Others are 'predicted' simply because we can see no reason why they should not exist, and generally speaking anything that can happen in physics does happen. As Gell-Mann put it . . . 'That which is not forbidden is compulsory.' The list below is not exhaustive, the selection being made either on the basis of how important the particle would be in our understanding of matter, or of the faith held by physicists in their existence.

quarks

Undoubtedly the experimental discovery of the quarks q would have an enormous impact on physics. This is because it would be possible by taking various bound combinations of the three different quarks p,n,λ and their antiparticles $\bar{p},\bar{n},\bar{\lambda}$, to construct all the known particles that take part in the strong nuclear force. Thus a proton would be made of two p quarks and one n quark (ppn), a neutron would be (nnp), a negative K meson ($\lambda\bar{p}$), etc. As the known number of strongly interacting particles is of the order of one hundred, such a scheme is highly economical.

quark properties	Q	B	S
$\bar{p}$	$+\frac{2}{3}$	$+\frac{1}{3}$	0
n^-	$-\frac{1}{3}$	$+\frac{1}{3}$	0
$\bar{\lambda}$	$-\frac{1}{3}$	$+\frac{1}{3}$	-1

anti-quark properties	Q	B	S
p	$-\frac{2}{3}$	$-\frac{1}{3}$	0
n	$+\frac{1}{3}$	$-\frac{1}{3}$	0
λ	$+\frac{1}{3}$	$-\frac{1}{3}$	$+1$

The properties which the quarks would be required to have are unusual in that the charge Q and the baryon number B (B=+1 for a proton, –1 for an antiproton, 0 for a meson) would be fractional. These properties are shown in the table, along with a third property called the strangeness S; the properties of the antiquarks are identical numerically but have the opposite signs. One simply adds the Q, B, and S numbers to obtain the properties of the composite particle.

Quarks were first proposed in this form by Murray Gell-Mann in 1961, and, whether or not they really exist, the quark model has enabled many satisfactory predictions to be made concerning the behaviour of the known particles. Each quark would have a very high mass M_q at least five times the proton mass M_p, but if three came together to form (say) a proton, nearly all this mass ($3M_q - M_p$) would be released as energy according to Einstein's relation $E=mc^2$. To smash a proton into its constituent quarks we would have to provide this energy, and as yet we have no particle accelerator powerful enough.

There are, however, cosmic rays with such energy, and quite recently (September 1969) C.B.A. Mc Cusker at Sydney claimed to have observed five tracks in a cloud chamber produced by cosmic-ray particles with a charge of only $\frac{2}{3}$. However, these tracks are not sufficiently free from alternative explanations to be widely accepted as quarks. A 300 Gev accelerator would enable the search to be extended up to about eleven times the proton mass, so perhaps the next generation of big accelerators will provide a clear-cut answer one way or the other.

'exotic' particles

On the quark model, the strongly interacting particles can only be formed in the combinations $(q\bar{q})$, (qqq), or $(\bar{q}\bar{q}\bar{q})$. Any hypothetical particle formed by any other combination is called an 'exotic particle'. So far, none has been found, but the search continues as a test of the model. One such particle, the Z*, would have B=+1, S=+1, and the reader will see from the quark table (along with the antiquark table) that it would have to be exotic. The experimenters are trying to see if a K^0 or K^+ meson (B=0, S=+1) can be made to stick to a neutron or proton (B=+1, S=0) for long enough (10^{-22} seconds would be quite long enough!) for the combination to be considered as a particle in its own right. So far there have been a few indications of this happening but the interpretation of the results is frustratingly ambiguous.

intermediate vector bosons

We know that when two particles act on one another through electric or magnetic forces, photons are exchanged between them. These photons are not exactly like the photons in a beam of light or X-rays, which are called 'real photons'; they differ in that their momentum and energy are not identical in value and are called 'virtual photons'. Similarly, when particles act on one another through strong nuclear forces, π mesons and other particles are exchanged, as mentioned in the introduction.

There is a third force in nature which can act between particles. Known as the weak force, it is responsible for the decays of radioactive nuclei, π mesons and many other particles. The neutrino can feel only this weak force (and probably gravitation), which is why it is so hard to influence or detect. Is there an intermediate particle, analogous to the virtual photons and π mesons, which is exchanged between particles acting on each other with this weak force? We call it the intermediate vector boson, for want of a less clumsy name, label it W, and know that it would have to exist in three charge states W^+, W^0, and W^-. We also know that it would have to be quite massive, this being because the range of a force is inversely related to the mass of the exchanged particle.

Thus the electric and magnetic forces have an infinite range because the photon has zero mass, while the strong nuclear force has a rather short range (about 10^{-13} cm) because π mesons are quite massive. If we knew the range of the weak force we could estimate the mass of the W, but we only know that it is considerably shorter than 10^{-13} cm. This may be another particle that will require more powerful accelerators, like the 200 GeV machine being constructed in the United States, before we can produce it.

gravitons

The fourth, and by far the weakest force known to act between particles is gravitation. The gravitational force between two protons is 10^{-36} of the electrical force between them. Owing to this weakness, the force of gravity is always completely negligible in experiments with high-energy particles. Nevertheless, we believe that it does act between particles, and the intermediate exchanged particle of this force has been

the undiscovered particles continued

termed the graviton. Because the force of gravity has an infinite range, gravitons must have zero mass and therefore always travel with the velocity of light. Like the other zero mass particles, it would have an intrinsic angular momentum or 'spin' – neutrinos have ½ a spin unit, photons one unit, and gravitons two units (although gravitons with zero spin are considered possible in some theories).

At present, the possibility of ever detecting single gravitons seems hopeless – neutrinos were hard enough to detect and gravitons interact some 10^{25} times more weakly. On the other hand, the detection of gravity waves, composed of intense streams of gravitons (perhaps), is not only a possibility but may even be history. Last year (1969) Joseph Weber observed simultaneous induced vibrations in large aluminium cylinders, one in Chicago and one in Maryland, which he claims are caused by gravity waves from an astronomical object possibly situated at the galactic centre.

tachyons

These extraordinary particles have been predicted fairly recently in an attempt to make the laws of the universe more symmetrical. A tachyon (named by Feinberg in 1967) is any particle with a velocity exceeding that of light (c). Ever since Einstein formulated the Special Theory of Relativity, it was commonly accepted that no particle could have such a velocity, for to accelerate any particle up to the velocity of light would require an infinite amount of energy.

This is true, but does not prohibit the existence of a class of particles whose velocity *always* exceeds c, any more than it prohibits the existence of photons and neutrinos whose velocity always equals c. Such 'superluminal' particles would have imaginary 'rest mass', but as rest mass is hardly a meaningful concept for particles that can never be brought to rest relative to an observer, this is no problem. A tachyon would always appear to have a positive energy, but unlike the particles we know, it would accelerate as it lost energy. At zero energy it would have infinite velocity, and therefore would have a completely uncertain position in space.

Two different observers in motion relative to each other can disagree on the sense of the direction of motion of a tachyon (*ie* right to left, or left to right) and hence on whether the tachyon was absorbed or emitted at a given point. Although different observers may thus give different accounts of physical processes, they would both be equally correct and neither would see any violation of causality (the principle that 'causes' must precede 'effects').

Searches for charged tachyons have commenced, so far with no positive results, but the experimenters have very little to go on. One method is to measure simultaneously the energy E and momentum p of a particle; if p exceeds E, the particle must be a tachyon. Another method attempts to measure the velocity directly by the Čerenkov light that a charged tachyon would emit (this is analogous to the acoustic shock wave emitted by a supersonic aircraft). Neutral tachyons would be much harder to observe, but could possibly be detected from the effects of super-rigidity they could give to nuclear particles, a zero energy tachyon being able to transmit impulses instantaneously. If tachyons really exist, two-way intergalactic communication is no longer a physical impossibility, merely a practical impossibility!

magnetic monopoles

In 1931, Paul Dirac realized that the existence of particles which were isolated north or south magnetic poles was not only compatible with quantum theory but would make Maxwell's equations of electromagnetism symmetrical and explain why charge is quantized, appearing only in multiples of the electron charge. Just as a spinning electric charge (*eg* an electron) behaves as a magnet with N and S poles, so a spinning monopole would behave as an electric dipole with a positive charge on one hemisphere and a negative charge on the other.

The mass of the monopole can be estimated from theoretical arguments to be at least twice the proton mass, and presumably they could be produced in proton collisions if enough energy could be provided. Experiments at accelerators have so far produced null results, indicating with a high degree of confidence that if monopoles exist they must be at least 2.5 times as massive as protons.

Monopoles would be fairly easy to recognise from their tracks in spark chambers placed in magnetic fields; another elegant detection method is to measure the change in the electric current flowing round a superconducting torus when a monopole passes through the centre. Searches are being made for monopoles trapped in deep-sea sediment, meteorites, and lunar rocks, and several cosmic-ray experiments have been tried without success – which is a pity, because if stable monopoles could be collected in sufficient numbers they could be accelerated with simple inexpensive apparatus to energies well in excess of those now envisaged for the next generation of accelerators.

In this brief review there has been space to mention only a few of the objects which we know may exist. The search for these objects constitutes a small, but exciting, part of the work done by high-energy physicists, and intensifies their need for accelerators of higher energy.

clear for sonic run

L. Lintern

Hunter T Mk 8 of 759 Squadron Royal Navy which the author flew on his advanced flying training at RNAS Brawdy.

'Aberporth Radar – this is Brawdy 62 Overhead base at flight level 400, heading 030°, request clearance for sonic run on 240°'
'Roger 62 – wait one'

However it would take another year to achieve my first solo sonic run, breaking the sound barrier. In the meantime, the story continues (*Part 1 appeared in Quest, July 1970*) with the activities at RAF Linton-on-Ouse. As our basic flying training course proceeded the flying became more exciting with aerobatics coming into the syllabus. On the other hand there was the precise science of instrument flying which few enjoy but which is very necessary for flying in cloud or bad visibility. You may spend a whole flight of an hour under a visor so that you cannot see outside, while you fly the aircraft on the instruments from just after take off until just before landing.

The importance of good instrument flying was brought home to me at an early stage when returning to base one day and simulating a descent through cloud. I followed the normal pattern of descent and under air traffic control, although as we had done little instrument flying we were supposed to remain visual. The controller gave me the heading to steer and told me to commence fast rate descent. I then saw a large thundercloud dead ahead. I thought: 'Oh well, I won't be in it long – might as well plough on'. As soon as I entered it the aircraft buffeted violently and I did a foolish thing – I looked up from the instruments (a thing one should never do) and saw the screen covering rapidly with ice. Then I was startled back into action by the controller saying: 'Juliet 13, turn left at 8000 feet heading 280°'. I said: 'Roger, 13' and rolled left.

Then it all started happening: I became disorientated, rolled too far left and before I knew what was going on I was in what is lightly termed an 'unusual position'. I quickly tried to remember all I had been told about recovery but the air speed built up, the buffeting increased and the altimeter was unwinding rapidly. My first feeling was 'eject', so I began to reach for the bottom ejector seat handle. Then I thought, 'must call base'. With the R/T call on my lips I thought, 'No, don't panic' and hurriedly swung back to controlling the aircraft. I managed to level the wings and pull up – but too far. The next thing I knew I was below the stalling speed and probably on the way into a loop. I pushed forward and the speed crept up very slowly. Then I found that, although I appeared to be straight and level with full power, the speed was hovering just above the stall and I felt such a buffeting that I thought I must still be stalled. Then I remembered I still had the airbrakes out. A quick flick and in they came, the speed built up and in a few seconds the cloud parted. 'Phew!' I quickly called base for the inbound heading and no one was any the wiser, except me of course, and very much so!

As our course proceeded we became much more confident in handling the machine and went on to the more powerful Mk. IV Jet Provost. We did more aerobatics and intricate manoeuvres and high altitude flying. Perhaps the most exciting part of the syllabus was formation flying. It looks an impossible art when you are first given control, with another aircraft bobbing gently alongside you. The first thing that happens is that you lose him by slipping in one of the six directions you can move, or a combination of them – left, right, up, down, back and forth. After an hour

clear for sonic run continued

though, you can usually hold on to the other aircraft, in straight and level flight at least. Turning is more of a problem but is soon solved. Then comes the real ultimate in flying an aeroplane – the 'dogfight' or 'tailchase' as it is called. In learning the manoeuvres the idea is to follow the leader without hitting him or falling too far behind. Gentle manoeuvres are practised first, leading to full aerobatics. It is very satisfying to sit glued to the tail of the lead aircraft through loops, barrel rolls, and manoeuvres on the edge of the stall. Violent buffeting shakes the aircraft as you hit the leader's turbulent wake, and full control movements are required to keep up with him. This is real flying!

Flying wasn't the only thing that made life enjoyable for us. We were a close knit course, all keen on sport of any description but not particularly adept in any of it. Our keenness brought us through though, and we won most of the games we played through sheer team spirit. Then we decided to buy a course mascot and to choose something useful. As many of us were keen motorists, a vehicle of some peculiar nature was indicated and, after rejecting a suggestion of a fire engine, we chose a hearse in the form of a huge 1934 Austin 20. The engine was a large six cylinder with all six never firing: as one chap put it – 4 cylinders on main and two on standby. Now the idea was that when the course went out for a night's drinking one person would be nominated to drive and would remain sober. There was plenty of room for all in the hearse as we removed the central coffin table leaving a well so that people could sit on each side with their feet in the well. There was a black top hat for the driver to wear and a selection of bowlers for anyone else who sat in front. The picture was completed by an old horn-type gramophone playing in the back. We were amazed at the number of people who raised their hats in genuine respect as we approached.

We became accepted on the local scene and soon the local press arrived to take photographs and write an article and they were followed up by the national dailies. At Christmas time we fitted fairy lights around the inside of the hearse and went carol singing for local charities. The trouble was that at every call we were invited in for a drink, so the singing appeared to us to get better and better but maybe not to our audience.

Very soon we found our time at Linton-on-Ouse running out and we passed out as qualified pilots in January 1967. We decided that the hearse would have to fit into our Wings Parade somehow. When the day arrived it was wet and the parade was held in a hangar. The prizes and wings were duly presented by the reviewing officer in the presence of all station officers and the families of the passing out course. We all wore our best uniforms and ceremonial swords. As soon as we marched out of the hangar everyone ran to the other door where the hearse was parked. All but two scrambled in and on top of the hearse and a smoke bomb was fused on the roof. The remaining two heaved on the mighty door winding handles and as they parted the hearse roared in. Everyone was still gathered, the reviewing officer on the dais, as the hearse went past with a bang as the smoke bomb exploded and smoke began to envelop the proceedings. The senior officers all took it very well really and there was nothing but smiles and laughter.

After six weeks interspersed with leave and attendance on various courses we joined RNAS Brawdy, our first naval station, for a year where we were to do our advanced flying training on Hunter aircraft.

It was good to be on a naval station at last and very soon we were all solo on the Hunter, a beautiful aeroplane to fly. Shortly after we arrived the Torrey Canyon incident occurred and there was great excitement as the Buccaneer aircraft which did the bombing always stopped at Brawdy to refuel and 'bomb up'. The station was often called on to investigate oil slicks approaching the Bristol channel. I did a great run checking on reported positions, in the Hunter, flying low over the sea. This was not quite the aircraft for the job as it goes too fast but great fun for the pilot.

The hearse went with us to Brawdy where it again did useful service as course transport. Handling became more difficult, though, with mediocre steering and brakes, but legal of course, coupled with its width and the narrowness of the Welsh lanes. We never had an incident but many drivers were surprised to find its black shape hurtling towards them at 60 mph as they rounded a tight corner in a narrow lane. It had a hinge up door at the rear and so if you were late out of a pub you could run like hell to catch

Pictures: left 'the hearse' and company with the author, second from right (photo Yorkshire Evening Press). Below 128 Fixed Wing Course at RAF Linton on Ouse, at the presentation of wings ceremony (author nearest camera).

it and jump in the back. One night we had to leave it in a country lane as it ran out of petrol. On our return in the light of day we found we had parked it in front of a farmers milk churn stand. It wouldn't start up and when we located the fault it meant a walk to the farmhouse and considerable haggling with an irate Welsh farmer before we got our rotor arm back for ten bob.

Life wasn't all roses at Brawdy though, the flying training was still intense and a failure in one flying test usually spelt doom. This was noticeable at Brawdy: many of our friends were 'withdrawn from training' to use the official phrase, or just 'chopped'. It was disheartening really and didn't help the rest of the course. My turn came when I failed an instrument rating test, so here I am back at the Rutherford Laboratory.

Was it only 3 years ago – 'Brawdy 62, you are clear sonic run on 240°, advise complete' – '62, will advise'. Right, lower, the nose, full power, check engine instruments, speed rising 0.90 – 0.95 – 0.98 – rudder tramp, slight hesitation and through, 1.05. O.K. recover, throttle closed, airbrakes out and raise the nose and up she comes, G coming on. Level out at 25,000 ft. – 'Brawdy 62, sonic run complete, angle of dive steep, max speed 1.05 levelling at flight level 250 and manoeuvring in this area'. So my first solo sonic run was completed: the culmination of two years of intensive training and the realisation of an ambition nursed since the age of ten.

'Wake up Laurie!!! It's 6.30 a.m. we're getting the beam back, check magnet currents – counter EHT's – spark chambers on and computer ready' . . . *'Brawdy 62? . . . level out 25,000 ft?* . . . Was it all a dream?

plantophobia

How to become an expert without really trying

Florrie Bunnda

There are three essentials in gaining a reputation as a house-plant expert:

(a) A couple of good reference books,
(b) A love of all things green and beautiful,
(c) An ability to 'chat up' the plants.

If the plants don't like you then you might as well give in with a good grace. My husband is firmly convinced that, if not actually a 'nut case', I am at least teetering on the border-line – with good cause, I must admit. After all, it must be a little alarming to enter a room and overhear one's spouse addressing a bunch of leaves or a fierce-looking collection of prickles, with such words as 'And how's mummy's baby this morning then? Do you want a little drinkie then?' But as all house-plant addicts will bear witness – it works. They blossom and flourish with cossetting!

My husband long ago gave in with a good grace – in fact he now comes home on occasion with the odd pot to increase the 'family' (totalling 90 at the last count!) He's still a little wary at times though – there is one large pot of what looks like green clutching fingers which he is convinced is going to seize him one day if he doesn't maintain his guard. There is also a very large 'totem-pole', desert-type cactus, too large to stand anywhere but on the floor, which makes an excellent house-guard. Affectionately known as Old Bill, he waits beside the front door to catch the unwary, bending. Moral – never bend over too close to Old Bill – he will get you in the end!

The 'mania' began with me some years ago when a friend came to dinner and brought as a gift a pot containing four cacti and succulents. Of course, they died, I killed them with kindness by drowning. However, the seed was sown, the damage was done and I soon began collecting and propagating, learning at first by trial and error.

A good memory is an asset when acquiring one's (albeit spurious) reputation as an expert. Every time a new plant comes into the house, I consult the authority and learn the latin name. How much more impressive it is when somebody comes to you and says 'I'm having trouble with my rubber plant' and you reply 'What have you, a Ficus Decora or a Ficus Elastica?' Mind you, it does earn one the odd sidelong glance! Seriously though, part of the fascination of plant-growing for me is knowing the specimens by name. My own particular weakness is for cacti and here it is a little more difficult to classify them. There are so many specimens to a group name – I

plantaphobia continued

have a Cereus Winterianus and Cereus Peruvianus and they are not really a bit alike! Take the Opuntias also. I have an Opuntia Subulata and an Opuntia Tunicata and various odd specimens of common or garden Prickly Pears but the similarity ends with the name. And what a collection of Mammillaria there are!

If you intend to take house-plant growing as a serious hobby, the reference books are absolutely vital. Each new plant you acquire should be 'read-up' and its likes and dislikes noted. So many plants wither from under-watering, over-watering, lack of light, being placed in strong sunlight, lack of heat, too much heat, not enough humidity, draughts, *etc*, *etc*. Some plants like a daily spray with tepid (never cold) water, some must never be watered from the top because the leaves will rot (African Violets and Peperomia for instance).

Some enthusiasts prefer to prepare their own soil but I have found that the purchase of a bag of Levingtons is quite adequate. All plants appear to flourish in this soil. For propagation, Levingtons rooting compost is ideal, later moving the rooted cuttings into Levingtons potting compost (I assure you, I am not being paid commission by Levingtons for this advertisement).

As I have said, one learns by trial and error and I have discovered by bitter experience that if one owns a large collection of plants it is advisable to avoid adding plants subject to attack by aphid. I have found two such plants recently – Cinneraria and Fuschia – the little beasts seem to love them, and once well established on the plants they are almost impossible to vanquish.

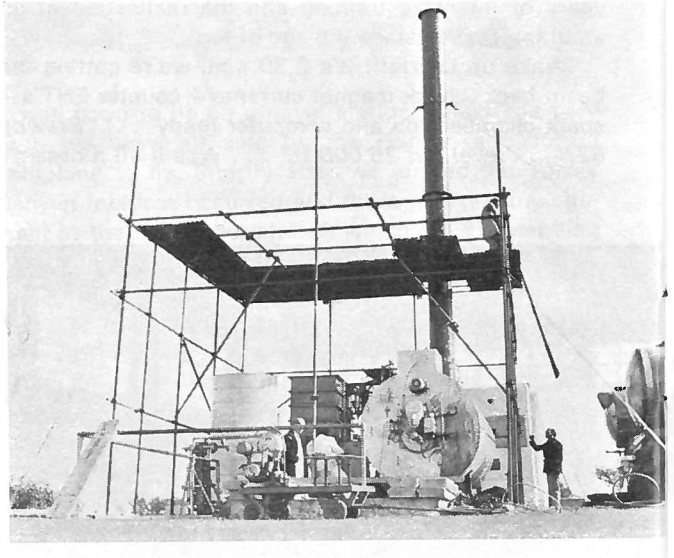
Regular feeding with a good liquid manure such as Bio is very beneficial to most succulents and flowering plants – not the cacti, it's a little rich for them. As a rule, feeding is only necessary in the growing season, as the majority of plants have a rest period during the winter months (I must remind my various ivies about this – they went mad last winter!) The plants, of course, do not always obey the rules. I have been waiting patiently for about a year now for a cutting of a 'Shrimp Plant' (Beloperone Guttata to you) and I am still waiting because the stupid plant refuses to stop flowering. 'The Book' says quite distinctly that 'the plant does not flower during the winter', but it seems that this particular Shrimp Plant has not read The Book. The circumstances however, are a little unusual because this plant is owned by a friend (in the Typing Office) who can grow flowers on plants on which nobody else has ever been able to grow flowers!! I don't know by what magic incantation she does it, but there they are, blooming away for all the world to see.

A word about pots. In my experience, clay are preferable to plastic pots. It's probably just one of my fads and fancies but the plants appear to be happier in clay pots – probably because, being porous, there is not so much chance of the roots becoming clogged if one is a little heavy-handed with watering.

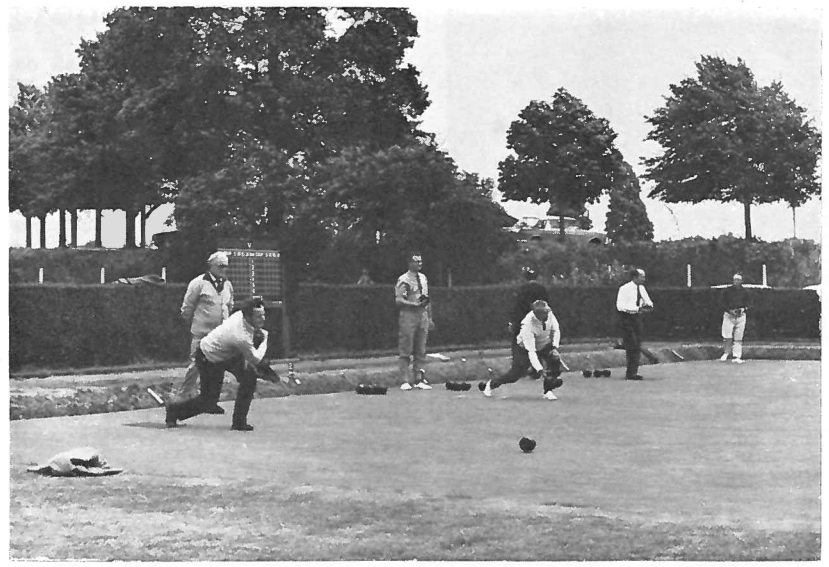
I could not, of course, complete this article without a mention of the fine display of attractive plants adorning the windowsills of our typing office. The 'green-fingered' lady who owns them, Eileen Barnes, has contributed to many a collection of plants by the cuttings which she so patiently cultivates and distributes among RSRS plant addicts.

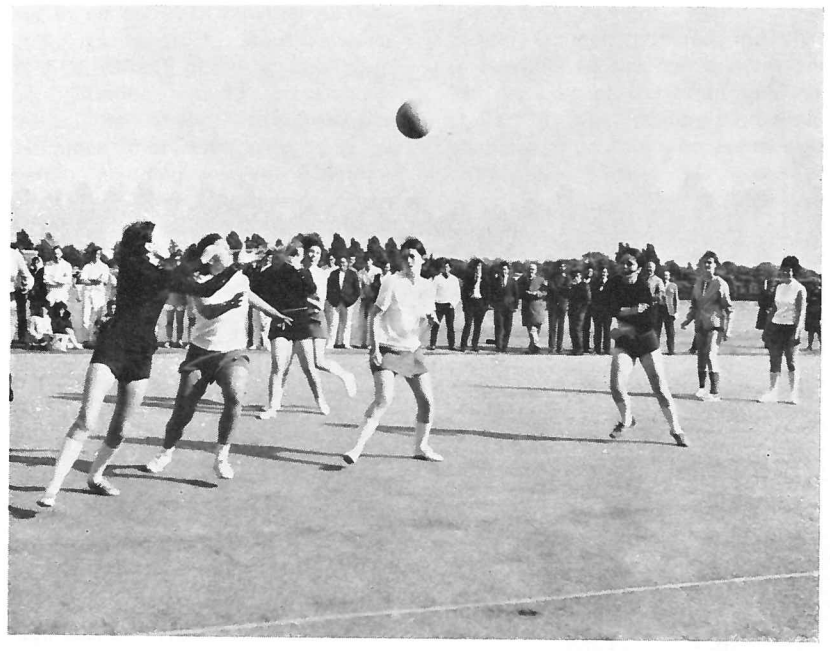
the pen name hides the identity of Patricia Elvins, Typist I at RSRS

It will never get into orbit



Many hoped that the above project would be the British candidate for the Space race but regrettably no funds for further development were forthcoming from the Science Research Council whose annual report was published on 23 September. For technical details see page 28.





sports day 1970

netball

A great deal of shouting made the netball final easy to find *(picture on left)*. The game's first appearance at Sports Day proved it a top choice. The final fought out between teams from RGO and Atlas was one of the most exciting of the day. Spectators lined the court yelling determinedly for one side or the other–or both–and the goals went 1–-0, 1—1, 2—1, 2—2 with RGO just taking the lead until Atlas broke through at 12—12 to go 13—12. With the ball whipping from end to end and the players changing direction and formation with lightning frequency, RGO held on, drew level and, in the very last seconds of the game, scored one last goal to win by 14—13. Netball is definitely here to stay!

football

'Fast and furious' would describe many of the games in the six-a-side football touraments. It was a 'knock out' tourament in more than name. There were ten teams, including one from ROE (for the first time) and three from Rutherford – who were obviously keen to win. And so they did with the C team beating their own A team in the final by 15 points (3 corners + 3 goals) to 11 (3 corners + 2 goals).

cricket

Cricket (in 15-over matches) ran well into the evening, winding up with a very good final between the Daresbury and Rutherford Laboratory elevens. Daresbury, having led off to a good start, began to lose wickets to accurate bowling from the holders of the cup (1969), but with a determined push for extra runs by their tail end, they managed to carry it off for 1970. The game with the best scores however was the Rutherford – RGO semi-final which finished at 87 for 5 to 86 for 8 – a very close result and a good match.

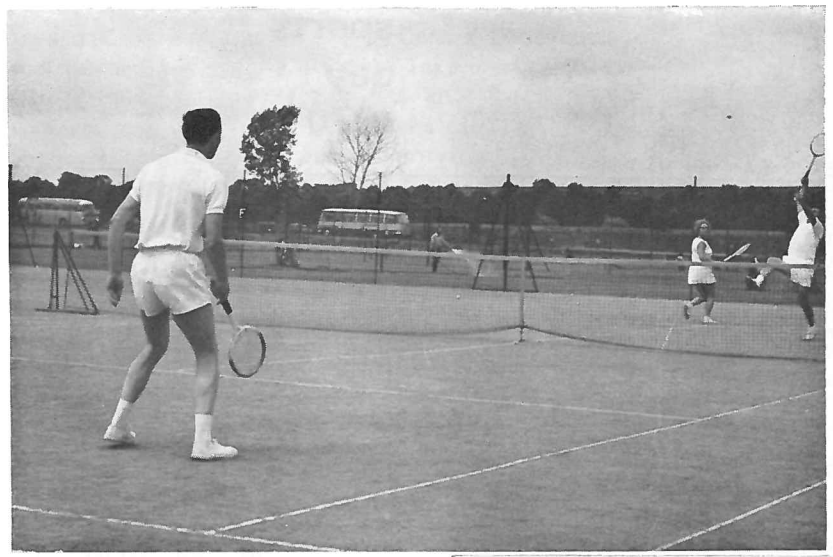
bowls

Bowls (picture above) attracted the crown greeners from Daresbury this year but the match, played as before on a flat green, was won by Mr. J. T. Pike and Mr. A. J. Johnson, both flat green experts from RGO.

Photo Peter Hicks RSRS

tennis

The strong winds kept the tennis players on their toes. In the men's doubles, played on a league system a clear win went to Mr. A. C. Gordon-Smith and Mr. A. C. Roberts of RSRS. The mixed doubles was played in two leagues with the winning couple in each meeting in a final. They turned out to be well matched – Mr. B. Yates and Mrs. Robson of Daresbury against Dr. and Mrs. Horner of RSRS (last year's winners). This time the Daresbury couple won the day.



In the picture above the Horners are countering a tricky shot from Mike Claringbold and Lorna Green of Atlas on their way to the final.
Photo P. Hicks.

Picture on right shows a goal save in one of the early football matches. The Sports Pavilion is seen in background. Photo P. Hicks.

Below some RGO supporters at the netball final, willing their side to win.

So every trophy had been well defended but each one had changed hands. Dr. W. L. Francis, Secretary of the Council (see Quest, April 1970), presided at the presentation and Mrs. Margaret Francis (known to many in the London Office) presented the prizes. A social evening followed which continued, with drinks, light refreshments and dancing until 10.30 p.m. – closing time.

In thanking all who took part in a very successful day, we should mention in particular Dr. and Mrs. Francis, the SRC Sports Association (who organised it), the protagonists (who provided the spectacle), the spectators (who gave encouragement, and even advice where they thought it was needed) and the Civil Service Sports Club (who provided the sports and catering facilities) and their catering staff. We also thank Bill Butler of Rutherford, a member of the St. John Ambulance Brigade, who rendered first aid throughout the day and treated no less than 18 victims of the sports!

Next year we hope the former champions will stage a come-back and 1970's victors will fight 'to the death' for their laurels against all comers.

properties

for sale

Upper part of prominent London office block, comprising 129 reception rooms and 57 toilets on 4 floors. Extensive panoramic views across London. To be sold lock, stock and barrel including period furniture, 17 tons of assorted paper, one Royal Charter and a unique collection of inhabitants.
Apply 01-242-1262 Extn. 60 ... ... (Accommodation)

'15th CENTURY CASTLE with outbuildings and extensive grounds – Herstmonceux 3171 . . .'

Did you make an offer for that property advertised in the Times on August 7 only to find that it was put in by an RGO vacation student doing his own thing which included a 'FOR SALE' board at the main gate. Among national press comments, the Daily Mirror reporter estimated that with everything as found, including a resident Astronomer Royal, the place would be a snip for £6M. But he quoted a Times man as saying 'I suppose you couldn't really put a price on it . . . I mean the sky's the limit for a place like that' . . .!

the trouble with students

This is not the first time a group of students at RGO have gained notoriety. Last time they renamed the roads in the grounds – using proper street signs they had acquired somehow – and people were startled to be confronted with Woolley Way and Eggen End. Professor Eggen, by the way, happened to be in England on both occasions (this time for the AAT meeting reported on page 10) so the Australians must hear some funny stories about us. Another lot used the South quadrangle to teach country dancing – to their Austin sevens!

Once the students laid an elaborate plot against one of themselves. He was rather studious and not very sociable and his main lone was to go off every evening to use the computer. He wanted above all to compute the orbit of a comet.

Getting wind of this, the others tried telephoning a comet report into the RGO using the correct IAU code but with completely fictitious figures. This fell a little flat however as he just continued to compute. So someone suggested it would be a great joke to kidnap him and turn him loose after dark in the middle of Pevensey marshes. First, however, the group insisted on holding a dummy run with the ringleader acting as victim. As he was big and strong they made a good job of the handcuffing and blindfolding before driving him by car deviously round and about by the longest way possible.

It wasn't until he was alone among the silent, dark marshes that he realised he was indeed the victim!

This wasn't the end of the story. The 'victim' capped their achievement by thumbing a lift back from the marshes at night – wearing handcuffs! He then dumped the chap responsible in the castle moat and for the rest of the night held the stairs to the student's quarters shooting at anyone who approached with a water hose.

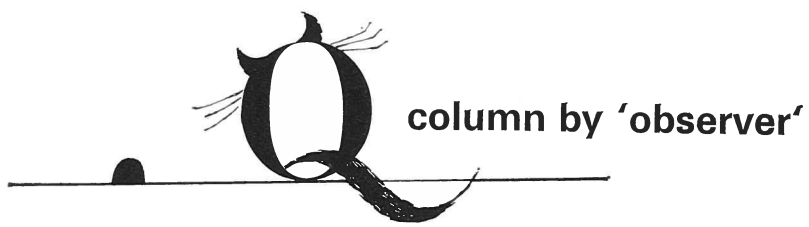
No doubt his character has been without stain ever since, likewise the driver of the car, then one of the RGO staff, now at London Office.

the loss of a best friend

Michael Reordan, LO, with Carla, until lately his guide dog.

Carla had her own ideas on many things. One winter for instance there was the usual power cut but, unusually, this one befell before the end of a dark afternoon, only 'They' forgot (or perhaps not) that in buildings like State House you need a lift to get down by. Carla took one look at the vast array of stairs stretching down into the depths and thereupon became the first member of LO to stage a sit-down strike.

Carla had to be put to sleep at last because of heart trouble, aged 12, after nearly ten years as his guide and family pet. She is also missed by many around the office who she liked to chat up on the offchance of a biscuit or a kind word – very successfully too.



If you wonder, as well you may, about some of the entries in this issue of Quest, just remember that it was put to bed during what is after all known in the trade as the silly season. Some of our chosen contributors were persuaded (with some editorial force) to wring out their copy in a highly euphoric state, not yet fully aware that they were back in a hard, cold office with their 10 sun soaked days on a foreign shore over and done with.

We also got some altogether unsolicited entries from those left behind who were only too apt – following the arrival of a postcard from some sunbaked genius –to go down to the local. At about the eighth pint they would exclaim with sudden insight – like Archimedes hopping out of the bath – 'Now why don't we write something for Quest' and then, it seems, spend the rest of the afternoon chewing the pen and bellowing at their own jokes. Have you tried (sober) to turn down an offer from a man who's had upwards of ten pints. Well we didn't.

ideas that pay

For the second time within a year an award of £100 has been made under the Rutherford Laboratory Suggestion Award Scheme. On 7 July, the Director, Dr. G. H. Stafford, presented a cheque for £100 to Mr. G. McGee, a skilled craftsman employed in the Mechanical Installation and Maintenance Group of the Nimrod Engineering Department.

Mr. McGee, who lives in Didcot, came to the Laboratory two years ago after working for a firm in the North of England. He is mainly employed on the assembly and commissioning of particle separators but when skilled assistance was required for the development work on field monitoring equipment he was appointed to assist.

A problem at the time was the encapsulation of magneto-resistors in epoxy resin. Owing to the extremely fragile construction of the magneto-resistors and the high viscosity of the resin mix, damage can occur under normal injection methods. Mr. McGee suggested a way out of the problem by making the mouldings first in two halves, each with a cavity to take the magneto-resistors and then bonding the complete assembly together. His suggestion proved to be technically sound and entirely successful in batch production; it also assists in making it suitable for sub contract production off the site.

Here then is an example of, to quote the Director 'a relatively simple suggestion' which has solved a difficult problem, has resulted in financial saving AND encouraged others to emulate George McGee and pocket a nice cheque.

George in expressing his thanks said that on behalf of himself and others he would like to thank the Director for the operation of such a scheme.

stop press

'the Cape'

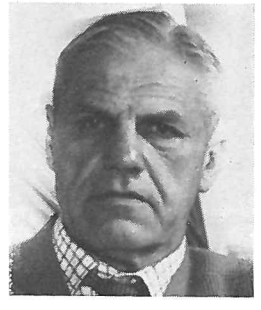
(article on page 4)

The Science Research Council and the South African Council for Scientific and Industrial Research (CSIR) have just reached agreement on a joint astronomical venture. They are to set up a new observing station in the Karroo near Sutherland which will be known as the South African Astronomical Observatory and will operate as an institute of the CSIR with an astronomical base at the present Cape Observatory.

Manpower and equipment resources will be pooled by the Cape Observatory and the Republic Observatory in Johannesburg, both of which are unsuitable for further development as observing sites because of their situation in large cities. ...

The Astronomer Royal, Sir Richard Woolley, OBE, FRS, (see picture, also 'Profile' in Quest July 1970), who will retire from that position at the end of 1971, has accepted an invitation from the CSIR to be the first director of the new observatory which will come into operation from January 1, 1972.

It is the intention to build up a facility which can make a major contribution to astronomy in the Southern Hemisphere.



Sir Richard Woolley

Solution to nutcracker on page 11

Battle had 9, Danton 10, Greenstick 7, Hazelnut 8, and Ravage 12.

Solution to crossword on page 13

Across
1—Extraordinary; 7—Reach; 9—Facia; 11—Roe; 12—Has; 13—Essence; 14—Riant; 15—Intersections; 16—Amass; 19—Tombola; 22—Len; 23—Toe; 24—Inter; 25—Adieu; 26—Incapacitated.

Down
1—Eerie; 2—Transatlantic; 3—Ashen; 4—Inter; 5—Archaeologist; 6—Yeast; 8—Presented; 10—Ian; 16—Alibi; 17—Men; 18—Strop; 20—Meant; 21—Agued.

first see foot of page 24

To tell the truth ('it will never get into orbit') we must admit that the picture shows the emergency steam supply rigged up in the car park at Rutherford Laboratory in September. It provided steam for various services for a few days while the AERE supply had a shut down to repair their chimney stack. The hopeful many were of course the onlookers.

interest in things ionospheric

Some visitors to the Radio and Space Research Station exhibit at the International Radio Enginering and Communications Exhibition which was held in London in August. The exhibit under the heading 'The influence of the earth's atmosphere on radio communications' showed displays on (l to r in the picture) Auroral Electron measurements, Rocket experiments in the D-region of the ionosphere, Application of Satellite Data to radio communication problems, Tropospheric experiments at Chilbolton and (not in picture) Radiometer studies of the sun and troposphere.

farewell to a pioneer

Harry Chandler of Rutherford Laboratory retired on 24 July for the second time in a working life spanning 50 years. However retirement in his case is a temporary phase as he will shortly be taking up a new appointment.

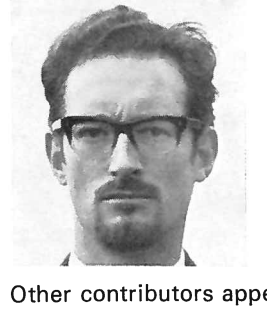
Born 26 July 1905, Harry left school at the age of 13 and in 1920, at 15, joined the Royal Navy. For the next 28 years he saw the world from above and below the oceans and his stories of life during that period are fascinating, endless and often unprintable. There is no doubt that the training and experience gained during this period proved to be of great value in his work at AERE and RHEL. His solutions to problems were often, to say the least, unorthodox, but highly successful.

Harry's first retirement came in 1948 when he left the Royal Navy with the rank of Warrant Officer. He joined AERE the same year and became a member of the EM Separator Group in Hanger 7. In 1953, with Leo Hobbis, Ted Harrison, Bob Fowler and John Brown, he moved over to what was to become the Rutherford Laboratory site, to work on the Ion Source and Injector for the PLA, so he can certainly claim to be one of the pioneers of the Laboratory. It is reported that the facilities on site consisted of one office, one laboratory and one chemical toilet! He moved on to the Nimrod Injector Group, then to the General Physics Group and finally in 1966, to the Vacuum Section of the Nimrod Engineering Department.

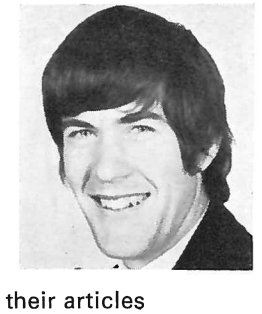
On his last day at the Laboratory, he received a presentation (see picture) from the Director, Dr. G. H. Stafford, on behalf of his friends and colleagues. We join them in wishing Harry a successful future in Part III of his career.

contributors

G. M. Harvey, Cape Observatory. See page 4.



Adrian Buckel, ACL see page 8



Other contributors appear with their articles