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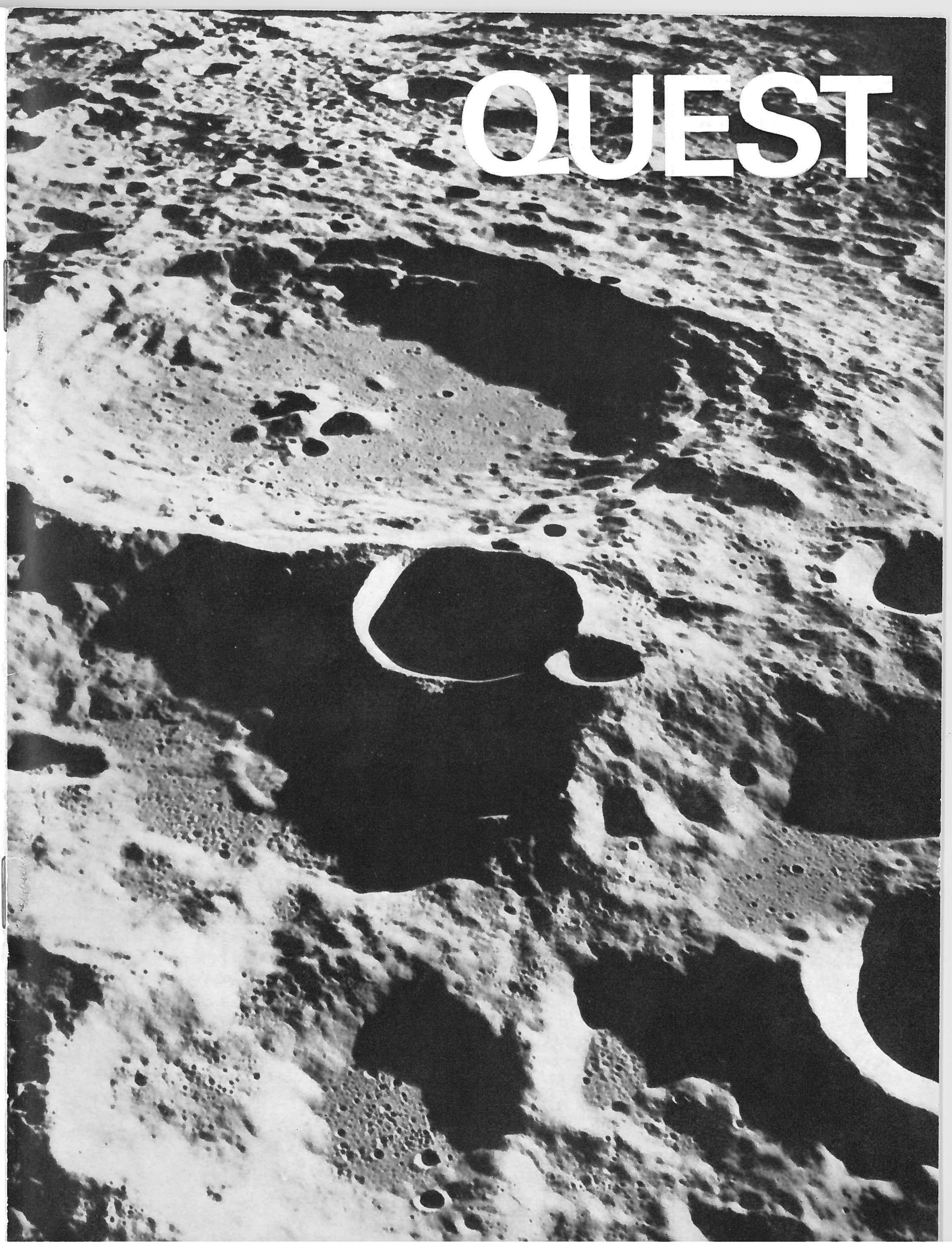
# QUEST



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# QUEST

**House Journal of the Science Research Council**



**Vol. 2 No. 4**

**October 1969**

## contents



*Cover picture of the Moon surface shows International Astronomical Union crater number 308, 80 km in diameter (location 179 degrees E long. and 5.5 degrees S lat. photographed from Apollo 11 during the ascent of the lunar module to rejoin the command ship in orbit on July 21.*

*We are grateful to the United States Information Service for providing this photograph and those on pages 11, 12 and 15.*

# profile

**Dr. J. A. Saxton, Director**

**Radio and Space Research Station**

'I stopped playing football when the bruises began to take too long to heal . . .', but Dr. Saxton had a longer run than most scientists can expect and might easily have become as well known in the field of sport as he now is in the world of radio wave research.

Born in a small Leicestershire village in 1914, he went to school in Castle Donington and at Loughborough Grammar, where he captained the soccer team and also played in Midlands' Public Schools representative football. Going up to University didn't deter him and he played at centre-forward for Imperial College, and later captained the National Physical Laboratory team, before the recalcitrant bruises persuaded him to accept first the position of Treasurer and then Chairman of the NPL Sports Club.

In 1933 Dr. Saxton went to Imperial College with a Royal Scholarship where he obtained a first-class honours degree in physics and was awarded a Governor's prize. He stayed on at Imperial until early 1938 as a Demonstrator in the Physics Department and studied artificial radio activity produced by slow neutrons. After leaving Imperial College he joined the Radio Division of NPL, where his first work was with Dr. J. S. McPetrie on the propagation of very high frequency radio waves and this kind of research work has loomed large in much of his professional career. It was thus not surprising that during the second world war he should be engaged on wave propagation work closely related to radar and microwave communication problems.

The post war years saw a wide and rapid expansion in the use of very short waves for broadcasting, including television, and point-to-point communications. This resulted in close collaboration between the Radio Division of NPL and the BBC and Post Office, involving an expansion of the propagation research under Dr. Saxton. As these studies developed, it became increasingly clear that a better understanding of the relationship between meteorology and radio wave propagation was required – the subject now known as radiometeorology – and that in particular, research on the fine-scale radio refractive index structure of the troposphere in relation to the weather was essential. Work in this field was continued at the Radio Research Station when it was established as a separate laboratory of the DSIR at Ditton Park in 1956.

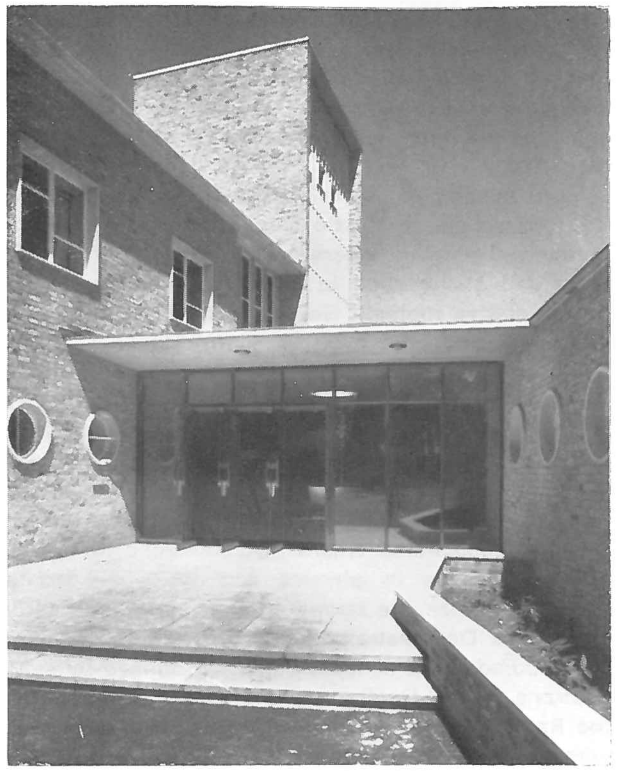
In 1954, Dr. Saxton attended a session of the Administrative Staff College at Henley-on-Thames, and in 1961, eighteen months after being appointed the first Deputy Director of RRS, he accepted an invitation to become a Visiting Professor of Electrical Engineering at the University of Texas. He spent a most enjoyable academic year in America and although the University exacted a full pound of flesh in the way of teaching assignments, he did find time to enjoy the wide open spaces and frontier life and also to return briefly to an earlier research interest in microwave di-electric studies of polar liquids.

He resumed his duties as Deputy Director at RRS but in 1964 was back once again in the United States: this time as Director of the United Kingdom Scientific Mission and Scientific Counsellor at the British Embassy in Washington. He was no stranger to UKSM, for he had been there for short periods in 1945 and 1950 as a Liaison Officer in radio physics. He found this new work a rewarding experience and he particularly appreciated the involvement in science policy; but whether to try to be a scientific diplomat or a diplomatic scientist, that was the question! History then repeated itself, for in April 1966 Dr. Saxton again returned to Ditton Park to be appointed, in succession to Mr. J. A. Ratcliffe, Director of what had in his absence become the Radio and Space Research Station.

Dr. Saxton is keenly interested in fostering collaboration between RSRS and the universities and is himself a Visiting Professor of Physics at University College, London. He is also very active in international scientific matters and is at present chairman of Commission II (on radio and the non-ionized atmosphere) of the International Union for Radio Science (URSI). His interest in promoting the effective use of the results of scientific research has sustained an association over many years, which still continues, with the work of the International Radio Consultative Committee (CCIR) of the International Telecommunications Union.

A Fellow of the Institution of Electrical Engineers, Dr. Saxton has several times been a member of Council and of specialist committees, and will be the Chairman of the Electronics Board for the 1969–70 session.

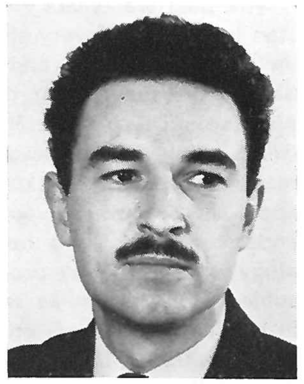
Dr. Saxton lives in a large old Victorian house in Teddington, where he indulges his interest in music through a hi-fi stereo installation. Fortunately, Mrs. Saxton is a keen gardener, so that his enjoyment of the music is not marred by a conscience over encroaching weeds. His son followed his example by going to Imperial College to study electrical engineering and his daughter, who spent some time in the UST Division of the London Office, is a graduate in languages at Exeter University and is now with the Inner London Education Authority of the GLC preparing to be a Careers Officer.



*RRS (now RSRS) main entrance in 1956.*

# guest column

***A new, regular feature written by outside contributors who have an interest in SRC affairs. Our first 'guest', Brian Southworth, is known to many readers. He is editor of 'CERN COURIER'. Previously he edited 'Orbit', former house journal of the Rutherford Laboratory.***



## down with national laboratories

Writing a Guest Column suggests that I am no longer a member of the SRC household. This I accept as only partially true because by participating in the work of CERN-Meyrin I am participating in the work of the SRC. There are obvious distinctions of course. CERN-Meyrin is not a laboratory operating under the Science Research Council in the sense of Atlas, Daresbury or Greenwich, but nevertheless it receives a sizeable proportion of its money and scientific manpower via the SRC.

CERN-Meyrin is part of the physics programme of the UK and, in a way, a very economical part in that, thanks to the financial and scientific participation of eleven other European countries, it gives British scientists access to experimental facilities which they could not otherwise have. In no way is anyone coming to CERN-Meyrin lost to British science. I certainly don't feel that I have emigrated . . . and I still have a right-hand drive car and wear Marks and Spencer's underwear like every true-born Englishman.

I have been careful to write 'CERN-Meyrin' because, from the beginning of October, there will





probably be a CERN-Doberdo or a CERN-Drensteinfurt or wherever, to house the huge 300 GeV accelerator, and there is a single exception to what I have written above. When Dr. J. B. Adams accepted the appointment as Director designate of the new Laboratory, he was, as things stand, lost to British science for, as SRC staff are well aware, the UK is the only European country to announce its intention not to participate in the 300 GeV project. J. B. Adams has gone down the drain.

This brings me to the theme, which is not original but is certainly topical, on which I am making some strictly personal comments. These comments are relevant to the particle physics laboratories, Rutherford and Daresbury, but may interest other SRC laboratories – firstly because it is the rapid development of other branches of physics (especially that concerned with seeing stars for, at present, nowhere is the fizz being put into physics quite so much) which is partly responsible for present financial problems in particle physics, and secondly because similar problems may not be all that far off for the other laboratories.

In the context of the 300 GeV project the SRC has been faced with some bitter decisions. For many years, priorities have been laid down by the UK particle physics community itself (as can be seen for example, in the Wilkinson Report of 1965 and in the statements of the UK delegation to the CERN Council) and top of the list has always been the 300 GeV project. The SRC continues to hold these priorities, despite the government decision, and in the light of foreseeable resources faces the painful prospect of reducing expenditure in the national laboratories. In particular, the possibility of running down Nimrod at Rutherford over the next five years has already been announced.

I feel sure that the priorities and the consequent decision are right, but I am not, from a temporarily safe position in Geneva, throwing my friends to the dogs. The important word in the provocative title of this column is the word 'national'. I believe that in a few years time there should be no such thing as a 'national' laboratory in particle physics. In the wake of the abolition of 'national' laboratories could come new life, though in some cases different life, to research centres – not only in the UK. My belief comes both from idealism (it is difficult not to be infected with the European ideal when living in the midst of what has been so magnificently accomplished in this direction at CERN) and from looking for a practical way out of the problems confronting laboratories such as Rutherford.

At the CERN Council meeting in December 1967, Sir Brian (then Professor) Flowers encouraged other countries to consider how all particle physics facilities could be organized on a European basis to secure the fullest use of experimental equipment in Europe. He said that the UK was ready to discuss how to open its national laboratories to full European participation. In the corridors afterwards it was obvious that the enormous practical difficulties involved drowned the general agreement that this was the ideal thing to do.

Since then things have changed considerably as the impact of the start of the 300 GeV project has become clearer. I know from my frequent contacts with all the big European laboratories that the idea of full integration in a European scheme is now much more readily talked about. It was significant that in the 'letter of intent' in which the government of the Federal Republic of Germany declared itself for the 300 GeV in September 1968, there is the statement 'The cooperation of high energy physicists in Europe, being exemplary, permits national and European accelerator projects to be considered today as a single comprehensive programme'.

I have no space to list the difficulties (and I don't want to take the edge off my case) but let me speculate on what the situation could be ten years from now. We could have the 300 GeV just starting physics in the No. 1 European Laboratory. Around it could be perhaps four major centres providing complementary facilities – say CERN-Meyrin for high energy proton-proton colliding beams in the ISR and 25 GeV protons from the PS, Daresbury with a 15–20 GeV electron machine, DESY with high energy electron-electron colliding beams . . . let's leave the fourth open so that any existing laboratory can write its own name in. Other laboratories, and perhaps Rutherford would come into this category, could be 'staging posts' for the major machines and could specialise on some relevant technologies. (Superconductivity, for example, has already a good start at Rutherford.) The important thing is that each machine would be equally accessible for experiments to any European group. Each specialized centre would be working for the total European programme. Each centre would be financed on a European scale and at the top would be a European committee.

Let me sum up the present position with two quotations. The first is from the Wilkinson report where, having recommended a 17% growth rate in expenditure on particle physics, the Committee considered in horror what could be done with only 10% or even 5% saying that they reserved the right while preparing their own gallows to protest at being hanged. The second is 'to be about to be hanged concentrates the mind wonderfully'. Given the foreseeable growth-rate in the UK of only 4% we can assume that our administrative friends have wonderfully concentrated minds to help them overcome the problems of achieving full integration of the European particle physics programme.

# council commentary

The May Council meeting formed part of a two-day visit to the Abingdon area, where members stayed at the Cosener's house and visited the Atlas and Rutherford Laboratories and the Astrophysics Unit at the Culham Laboratory. They met many of the staff, and a selection of the work was presented and discussed. Members expressed appreciation of the work, and of the arrangements made by the three Laboratories for the visit. Among the specific items approved at the May meeting were a supplementary grant of £400,000 to Professor H. H. Rosenbrock (UMIST) for researches into the design of multivariate control systems for industry, and up to £66,000 for enlargement of the core store of the computer at the Institute of Theoretical Astronomy, Cambridge.

At the June meeting the nuclear physics appointments that were announced at the time, involving Dr. Pickavance, Dr. Stafford, Professor Ashmore and Dr. Voss, were approved. The Council approved changes in the superannuation arrangements to enable the 35 locally-engaged staff in South Africa to join a new contributive scheme and asked the office to continue their efforts to improve the terms for the five members of staff with more than ten years service. Other matters included discussion of the draft of the annual report for 1968/9, and approval of a supplementary grant of £145,000 for the modifications and repairs to the Mk. I radio telescope at Jodrell Bank, and of a maintenance grant of £129,000 for the Oxford electrostatic generators.

A reorganisation, with an Engineering Board and a Science Board in place of the single UST Board, and with the Council directly undertaking rather more of the general policy-making than hitherto, had been under discussion with members of the Council and senior staff for some time. Specific proposals, still not in full detail, were put to the Council at the July meeting, and accepted, and it was decided to put them into effect on 1st October. The terms of reference and the membership of the new Boards were agreed, as were the broad outlines of the corresponding changes in the London Office.

Another item in July was the UST Board's final report for the session: now therefore the Board's last report. One point that emerged clearly was that the policy of selectivity of support is continuing to develop in the Commitees, (all of which will continue in being in the new organisation). The Council approved nine large grants recommended by the Board, the largest being a grant of up to £200,000 to Drs. Lilley and Dunnill (UCL) for the setting up of an enzyme technology unit. A visual input-output system for attachment to the computer at the Atlas Laboratory was also approved.

The Council noted the satisfactory start made by the Physico-Chemical Measurements Unit. This unit is operated by the UKAEA by arrangement with the SRC, and university workers can have samples examined by methods using the various mass spectrometers, NMR and infra-red spectrometers etc. with which the unit is equipped. Other Research Councils are also showing interest.

The Council considered a report from the ASR Board on the UK-4 satellite. A serious feature was an increase in the estimated cost, and the Board recommended that the project should only be allowed to go forward with a limit of £1.05 million on the total payments to the Ministry of Technology, which is lower than the new estimate, and subject to a scientifically worth-while programme being possible under this condition. After discussion, the Council agreed that the project could go forward on this basis. The Council also took note of the SPGC's plans for the necessary restriction of the number of space research groups that can be supported, in view of the generally reduced flight opportunities in rockets and satellites.

Domestic matters dealt with in July included the granting of increased delegated powers of approval of expenditure, to the Astronomers Royal and to the Directors of the Atlas Laboratory and the Radio and Space Research Station. The Council also noted the progress made on the possibility of an industrial productivity agreement, and the setting up of a pilot study, which, it is believed, will be the first practical study of such a scheme in a purely research organisation.

Finally the Council said goodbye with regret to the three retiring members: Lord Halsbury, Sir Ewart Jones and Dr. Mather.



# senior appointments in nuclear physics

**Dr. T. G. Pickavance,** CBE, appointed Director of Nuclear Physics with responsibilities for all the Council's nuclear physics interests, including the Rutherford and Daresbury Laboratories.

Dr. Pickavance, who lives in Oxford, is married with three children. He read Physics at Liverpool University and later did post-graduate work there under Sir James Chadwick. From 1939 to 1946 he worked in Liverpool on nuclear problems as a member of the atomic energy project ('Directorate of Tube Alloys' from 1941), and in 1943 became a lecturer in physics. He joined the AERE, Harwell, in 1946 as a leader of the Cyclotron Group, and was appointed Deputy Head of the General Physics Division in 1955. In 1957 he was appointed Director of the Rutherford High Energy Laboratory. In 1968 he was made a Fellow of St. Cross College, Oxford, by special election.

*

**Professor Alick Ashmore,** appointed Director of the Daresbury Nuclear Physics Laboratory to succeed Professor Merrison.

Professor Ashmore, who will take up the appointment in mid 1970, is married with five children. He graduated in Physics in 1941 from Kings College, London, obtaining his PhD at Liverpool in 1958 and Fellowship of the Institute of Physics in the following year. From 1947–1959 he was Lecturer and Senior Lecturer in Physics at the University of Liverpool and from 1960–1964 was Reader in Experimental Physics at Queen Mary College, University of London. He was appointed Professor of Nuclear Physics at the same College in 1964 and has been Head of the Physics Department there since 1968.

*

**Dr. G. H. Stafford,** appointed Director of the Rutherford Laboratory (where he had been Deputy Director since 1966) to suceed Dr. Pickavance.

Dr. Stafford lives in Abingdon and is married with three children. He graduated in Physics at the University of Cape Town in 1939 and obtained his PhD at Cambridge in 1950. From 1951–1954 he was Head of the Bio-physics Sub-Division at the Council for Scientific and Industrial Research, Pretoria. From 1954–1957 he worked in the Cyclotron Group of the AERE, Harwell and became Deputy Head of the Group in 1957. He subsequently transferred to the Rutherford Laboratory as Head of the PLA Group. Dr. Stafford has published over 40 papers and reports, mostly in nuclear and high energy physics.

**Dr. R. G. P. Voss** is acting Director of DNPL until Professor Ashmore takes up his appointment. Dr. Voss, MA, DPhil, B.Sc Eng, (Natal and Oxford) is head of the Experimental Physics Group at Daresbury Laboratory. A member of the Institute of Physics and of the Physical Society, his main interests lie in High Energy Physics and the equipment used and in Accelerator construction.

# recognition for research

Original research work of a very high standard has earned special promotions for three scientists and an engineer from SRC. The promotions were among twenty-six recommended by a special panel which reviews each year the work of scientists conducting research work of high calibre in Government and other public service establishments.

These promotions – to grades which are comparable to the rank of university professor or reader – will allow the scientists to continue their research work without necessarily having the administrative responsibility normally associated with their new grades.

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**Radcliffe Observatory**

**Dr. A. D. Thackeray**
is promoted to DCSO.

**Dr. M. W. Feast**
is promoted to SPSO.

Dr. Thackeray has been the Radcliffe Observer at Pretoria since 1950 and has directed the work of the Observatory from that time onwards. Under his direction the Observatory completed the survey of the velocity of southern B stars in such a way as to strengthen greatly the constants of galactic rotation. He has personally made a definitive study of the spectra of certain peculiar stars, particularly Eta Carinae, and has led important investigations on the brighter stars in the Magellanic Clouds and has discovered RR Lyrae stars in them. With Dr. Feast he determined the mass of the Magellanic Clouds ($10^{10}$ times the mass of the Sun) and made an original determination of the distance from the Sun to the centre of the galaxy.

Dr. Thackeray's article on the work of the Observatory appeared in Quest, April 1969 issue.

Dr. Feast has recently made special studies of late type variable stars, and of their kinematics, and has worked extensively on the Magallanic Clouds, making in particular a study of both planetary and diffuse nebulae in these systems. He has worked recently on the abundance of Lithium and its isotopes in stars.

**Rutherford Laboratory**

**Dr. P. K. Kabir**
is promoted to SPSO.

**Mr. J. A. Fox**
is promoted to Suptg. Grade Engineer

Dr. Kabir's main interest in high-energy physics is in the field of weak interactions. During the last few years he has studied problems arising from the discovery of $K^{o}_{2} \rightarrow 2\pi$ decays. He has published a book on the subject – 'The CP Puzzle' (Academic Press, London 1968) – and the comparison of $K\pm \rightarrow \pi\pm\pi^{o}\gamma$ decays, analysed by him in collaboration with G. Costa (in Phys. Rev. Letters 18, 429 (1967)), is being carried out by a Rutherford Laboratory team at CERN. His current work is on high-energy electron scattering; he has suggested a method of determining electromagnetic form-factors of nucleons using polarised targets, and also hopes to find tests of the high energy behaviour of weak interactions through this method.

Mr. Fox is the first professional engineer to have received a special promotion. He is studying the dynamic behaviour of European electrical power systems, in conjunction with the appropriate national agencies, to determine the acceptability of a static power supply for the proposed European 300 GeV proton accelerator. This static power supply would use a reactive compensator to eliminate the large motor-flywheel-alterator systems used at present to power proton synchrotron magnets. Similarly, he is engaged in computer studies of possible applications of this power supply system to existing accelerators, and is collaborating with the CEGB in computer studies of the behaviour of steam-turbine governors and time series analysis of CEGB operational tests.



# metamorphosis of ust

Changes in the structure of one of the Council's Boards and its supporting Division at London Office will give a number of people fresh work in different offices.

With the setting up of two new Boards, one for Science and a second for Engineering on October 1 to replace the one UST Board, the supporting Division is split into four parts 'Science', 'Engineering', a 'Service Unit for grants and awards' to provide services for all four Boards now existing, and 'Science and Industry Unit'.

Mr. C. Jolliffe formerly Director of UST Division will take over the Science Division and Dr. A. W. Lines, formerly second in command as 'Head of Division', is appointed Director of the Engineering Division. The Science Board, with Professor Kornberg as Chairman, will be responsible for the support of research and post graduate training in biology, chemistry, enzyme chemistry and technology, mathematics and physics (other than nuclear physics, astronomy, space and radio research). It will also be responsible for Atlas Laboratory and for the arrangements for university use of neutron beam facilities and of the services of the Physico-Chemical Measurements Unit. The Engineering Board will be responsible for the support of research and post graduate training in aeronautical and civil engineering, mechanical and production engineering, control engineering, metallurgy and materials, computing science and polymer science.

Policy co-ordination will be the responsibility of Dr. W. L. Francis, Secretary to the Council, assisted by a Standing Policy Co-ordination Committee drawn from all Divisions of London Office. He will have additional staff to do this and also reporting to him will be the Service Unit under Mr. J. F. Hayes and the Science and Industry Unit headed by Dr. W. G. Potter.

**Chairman of the Science Board** *(see picture on left)*

**Professor Hans Leo Kornberg,** FRS, became a member of the Council in 1967, after previous service on the Biology Committee. A graduate of the University of Sheffield, he spent two years (1953–1955) in the USA as a Commonwealth Fund Fellow. From 1955, he was a member of the scientific staff of the MRC Cell Metabolism Research Unit, and from 1958 also a Lecturer of Worcester College, at the University of Oxford.

In 1960, Hans Kornberg was appointed to the first Chair of Biochemistry at the University of Leicester and was largely responsible for setting up the School of Biology there. He is known mainly for his work on the nature and regulation of biochemical events in micro-organisms, which was recognised by the award of the first Colworth Medal of the Biochemical Society, and election to the Royal Society in 1965, and by his appointment as CIBA Lecturer for 1968 at Rutgers, NJ. He is a frequent speaker at international scientific meetings, has been a Research Associate at the University of California and at Harvard Medical School; Visiting Instructor at the Marine Biological Laboratory, Woods Hole (1964–1966); and Visiting Professor at Universities in the USA, Europe, Israel and Asia.

Professor Kornberg, who is 41 years old, is married with four children. He lists his recreations as 'cooking and conversation'.

**Chairman of the Engineering Board** *(above right)*

**Professor Hugh Ford,** FRS, DSc(Eng), FInstCE, FIMechE, FIM, FCGI became a Member of the Council in 1968. From 1951 to 1959 he was Professor of Applied Mechanics at the University of London Imperial College of Science and Technology and in 1965 was appointed Head of the Department of Mechanical Engineering at the College. He became Professor of Mechanical Engineering earlier this year. In 1963 he was President of the Institute of Metals and he is a Member of the Council of Mechanical Engineers and Technical Director of the Davy-Ashmore Group.

Professor Ford received the Thomas Hawkesly gold medal, the premier award of the Institution of Mechanical Engineers, in 1948 for researches into the rolling of metals and the Robertson medal of the Institute of Metals. His publications include 'Advanced Mechanics of Metals' (1963), papers to the Royal Society and various institutions and articles in both British and foreign journals.

Professor Ford is married with two children and his chief recreations are gardening and music.

# sports day

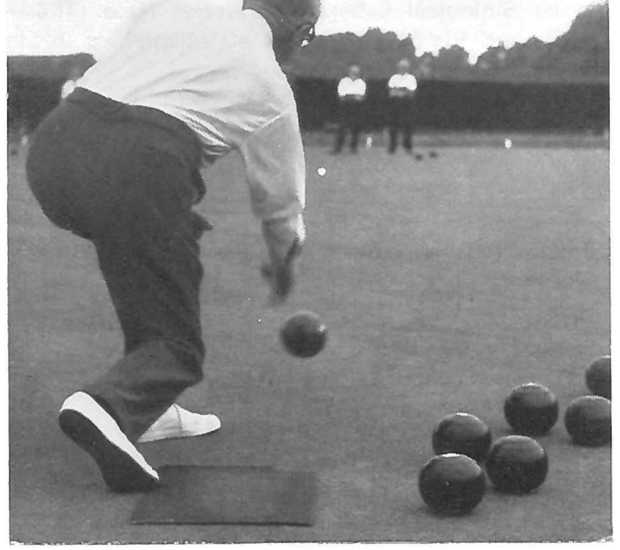


*photo R. Butler RSRS*

Players and spectators with a predilection for the macabre will recall the inclement conditions for SRC's inaugural Sports Day in 1968 (see Quest, October 1968). In contrast, the photographs this year testify to the vagaries of an English summer. This time it was a great pleasure for everyone to bask in sunshine while enjoying some very entertaining competitions.

The setting was again the Civil Service Sports Ground of thirty acres by the Thames at Chiswick where a well designed new pavilion had been opened earlier in the year to provide plenty of changing rooms and hot and cold showers. Salad lunches and other refreshments were provided unceasingly by the cafeteria, and the bar dispensed cool drinks (hard and soft) all afternoon, except of course during the dry season from 2.30 to 4.30 p.m.

The SRC Sports Association organised an interesting programme. The number of events was doubled: as well as tennis and cricket, we had six-a-side soccer and bowls and more than 160 competitors took part. A morning start ensured time to complete all events.

## bowls

The Bowls tournament turned out to be one of the best organised and most exciting events of the day. The games were all played on flat greens, but this did not deter some of our local crown green exponents from trying their hand, and all of them did very well. The organisers are hoping that support for this event will be even greater next year and include some of SRC's crown green experts from the north.

The tournament was won by Mr. Ferguson and Mr. Grindrod of RL, who beat their own colleagues from Rutherford, Mr. White and Mr. Sangster, by one shot, the last possible shot of the match!

## cricket

Cricket has always had good support in SRC and the matches drew many spectators. Their interest was well rewarded since the high standard of play made for some absorbing cricket. The tournament was run on a knock out basis and the matches allowed an innings of fifteen overs to each side. The two teams left in at the end of the day were from Rutherford and Daresbury laboratories. In a very exciting final Rutherford, batting first, scored 107 runs for the loss of 4 wickets. Despite fast and keen batting Daresbury fell short of this, scoring 91 for 7 wickets, and Rutherford became SRC cricket champions for the second successive year.

## tennis

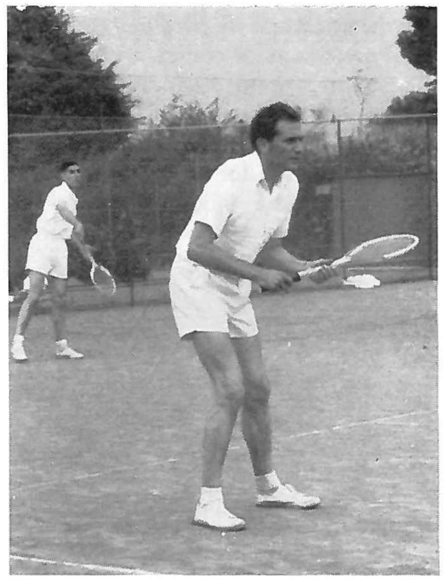
Despite that 'other tournament' on the same day at the All England Tennis Club, Chiswick attracted seventeen mixed doubles and seven men's doubles pairs who fought hard in the heat and the clouds of red dust they raised from the courts. The games were enjoyed very much by those playing and others watching from deck chairs on the lawn.

With the limited number of courts available this year, both competitions had to be played off without many rests for the players and they deserve credit for maintaining their standards through till 7 p.m.!

Last year's winners of the mixed doubles were not present to defend their title, but Dr. and Mrs. Horner were in good form beating Mr. Powell and Miss Northcott of RGO to retain the cup at RSRS. Dr. Wilkins, although minus the partner who helped him to victory in 1968, formed another unbeatable combination with Dr. Thomas and carried the men's doubles trophy back to RGO.

*(picture opposite top left)*





*photos R. Butler*

*D. Calvert RGO*

## soccer

This late addition to the programme turned out to be a well supported and successful event. Although the teams were limited to six-a-side, each seemed to have twice that number of vociferous supporters. We don't know whether their cheers and all that advice – from the professional to the merely ribald – was an indispensable contribution to the results. Obviously they thought so!

The tournament was won by a very well drilled team from Daresbury who met Rutherford's B team in the final play off, beating them by 12 goals to nil.

*(picture above (r) shows the DL team with the cup)*

Lady Flowers was present for much of the afternoon and evening. We were very grateful to her for presenting the trophies and hoped she enjoyed the day. May we also take this opportunity to thank all those anonymous organisers, without whose considerable help we would not have been able to stage such a successful Sports Day.

Sports Day is an excellent opportunity to meet people from other parts of SRC and we hope that many more will come next year. The variety of sports will be extended again; we have particularly been asked to include netball not only for its sporting value but, someone suggested, as a draw for more libidinous male spectators! After that, all there is left to say is that we look forward to seeing you in 1970.

*Mr. Ferguson and Mr. Grindrod, RL, receiving the Bowls trophy from Lady Flowers. Facing the camera (l. to r.) are Adrian McLoughlin (Secretary) and Ray Edmonds (Chairman) of SRC Sports Association.*

*More pictures in 'newsfront'*

*photo D. Calvert*

## Professor C. F. Powell

Physicists in many countries will have heard with regret of the death of Professor Powell on August 10 from a heart attack during a holiday in Italy.

Professor Powell was Chairman of the SRC Nuclear Physics Board from 1965 to 1968 towards the end of a distinguished career which started at Cambridge University in 1924 when he read Natural Sciences and spent two years on research at the Cavendish Laboratory in the great days of Rutherford. In 1928 he joined the H. H. Wills Physics Laboratory at the University of Bristol where he was to remain for the rest of his career, becoming Professor of Physics in 1948 and Director of the Laboratory in 1964. He retired from the University in the summer of 1969.

A Fellow of the Royal Society since 1949, Professor Powell was among those who helped to promote the idea of CERN in the 1950s and remained closely associated with the Laboratory. From 1961-3 he was Chairman of the CERN Scientific Policy Commitee and continued as a member until the end of his life.

*from CERN Courier, August 1969*

His career reached a peak in the 1940s when his work with nuclear emulsions investigating cosmic rays resulted in the discovery of the pion in 1947. This confirmed the Yukawa theory of the strong nuclear force, opened the door to research with pions (which are now, some twenty years later, such 'everyday' particles at accelerator Laboratories) and exposed the mystery of the muon. Around this major achievement was a mass of work on cosmic rays, atomic nuclei, particle scattering which won a world-wide reputation for his Bristol group.

In addition to the Nobel Prize, awarded in 1950 'for his development of the photographic method in the study of nuclear processes and for his discoveries concerning mesons', he received the Hughes Medal of the Royal Society in 1949, the Royal Medal of the Royal Society in 1962, the Lomonosov gold medal in 1967 (the highest award of the Soviet Academy of Sciences), and honorary doctorates at the Universities of Dublin, Bordeaux, Warsaw, Berlin and Padua.

*A personal note by Dr. T. G. Pickavance*

I became a colleague of Cecil Powell in 1939 when he brought his nuclear emulsions to the Liverpool cyclotron, at the request of Sir James Chadwick, to combine this elegant technique, which he had developed, with what was for those days a powerful accelerator. This collaboration between the Bristol and Liverpool groups was both fruitful scientifically and most enjoyable personally, and developed into a lasting association. Throughout the following years, with the rapid growth of nuclear physics and its social implications, Cecil Powell was of course an outstanding colleague who attained great distinction. He was a convinced and eloquent advocate of the relevance of scientific research to human progress and was a gifted teacher, and his concern for the wider implications of science, outside the laboratory, was expressed for example in the leading part he played in the Pugwash international meetings. But to all of us who knew him well he was above all a warm and generous friend.

## Lord Bridges

Lord Bridges, KG, PC, GCB, GCVO, MC, FRS, died on 27th August 1969 at the age of 77. One of the many public duties which he undertook, after his retirement from the Civil Service in 1956, was to be Chairman of the National Institute for Research in Nuclear Science. The Rutherford and Daresbury nuclear physics laboratories were founded and operated by the Institute until they were embodied in the Science Research Council on its foundation in April 1965.

Lord Bridges, one of the most eminent public servants of his time, had a profound influence on the successful establishment and operation of these laboratories as an integral part of British universities' resources for research.

## M. H. Jeffery

It is with great regret that we announce the sudden death of Mike Jeffery, Manager of the Anglo-Australian Telescope Project since March 1968. As leader of this great enterprise he had become known to many people in SRC, in the UK, in Australia and in North America. In a job requiring both the ability to handle complex technical matters and maintain good relations with those with whom he came into contact, Mike was an outstanding success; his technical competence and pleasant personality will be greatly missed by all those who knew him. Mike Jeffery joined the AAT Project from the consulting engineering firm of Freeman, Fox and Partners. Whilst in their service he had played a prominent part in the construction and commissioning of the 210' radio telescope at Parkes, New South Wales, and the 150' radio telescope in Ontario; experience of these two projects served him in good stead as Manager of the AAT team. His untimely death at the age of 43 is a cause of great sorrow to all his friends and acquaintances and our condolences go out to Mrs. Jeffery and her family who had recently moved from this country to Australia.



# Apollo 11's moon quest

*USIS photo*

## the launch

**J. F. Hosie**

Official SRC duties brought me an invitation to attend this historic and unforgettable occasion. When, before the event, I was cajoled into writing a piece for Quest, I overlooked how extensive would be the TV coverage. To avoid wearisome repetition I'll pick out one or two special features.

First, at a pre-launch dinner, the USA President's Scientific Adviser emphasised the international aspects of all NASA programmes and gave two instances of foreign research which had made the Apollo Missions possible. Some may say it is now somewhat old-hat but it was gratifying, before foreign potentates, that one of the two examples was the Bacon fuel cell from the UK.

Next, for the launch at 9.30 a.m., NASA, for all its incredible precision in the space mission, found it necessary to rouse their invited guests at 4 a.m. They could not guarantee timely arrival through terrestrial traffic over 12 miles even with full police escort.

At the scene three memories stand out. First, at lift off, to spectators three and a half miles away in the shadow of the fantastic Vehicle Assembly Building (525 ft. high compared with the GPO tower of 580 ft.), the silent burst of flame started an utterly majestic rise of the 364 ft. rocket.

There followed from the assembled tens of thousands of Americans a spontaneous thunder of cheers. Their relief, pride, sense of accomplishment and much else impressed even a dour Scot.

Next the noise of the blast off reached us. It shook 45 ton door segments of the VAB as if they had been tin foil. Saturn was indeed large and violent.

Almost before one had grasped that the initial steps had been taken successfully the first stage separated, the flame dwindled from a cigarette smoke ring to extinction leaving a dense local cloud. The bald headed eagles resumed their effortless circling.

# tracking east and west

R. N. Stanbury

**Jodrell Bank, Tuesday, July 22, 6.30 p.m.** I am waiting in my office for the arrival of five Russian scientists and their Interpreter. The top of my desk is inches deep in the debris of the past ten days – notes, statements, data, diagrams. The 'phone is surprisingly silent. I ring the Mark I Controller. 'No, there have been no calls in the last hour.' So it really is over!

**July 13.** That unforgettable Sunday afternoon (unlucky thirteenth!), lazy, sultry, with a threat of things to come. Luna 15 has been launched. Are the Russians attempting to recover samples of lunar rock, only hours before the Americans? I join the BBC Television team at Professor Lovell's house, The Quinta. Tea on the terrace and a Soviet spaceship on its way to the Moon!

After that, only a flood of impressions projected onto the screen of memory.

Sir Bernard seated on a rustic bench in the cloistral calm of The Quinta's lawn, interviewed by Tom Heaney against a back-drop of fragrant shrub-roses and cascading *philadelphus virginal.* The illusion of calm is short-lived. Back home, the 'phone starts ringing: it is 11 p.m. before it stops. Australia, America, Canada . . . 'What does Professor Lovell think the Russians are intending to do? Will this steal the limelight from Apollo 11?' Etc. etc.

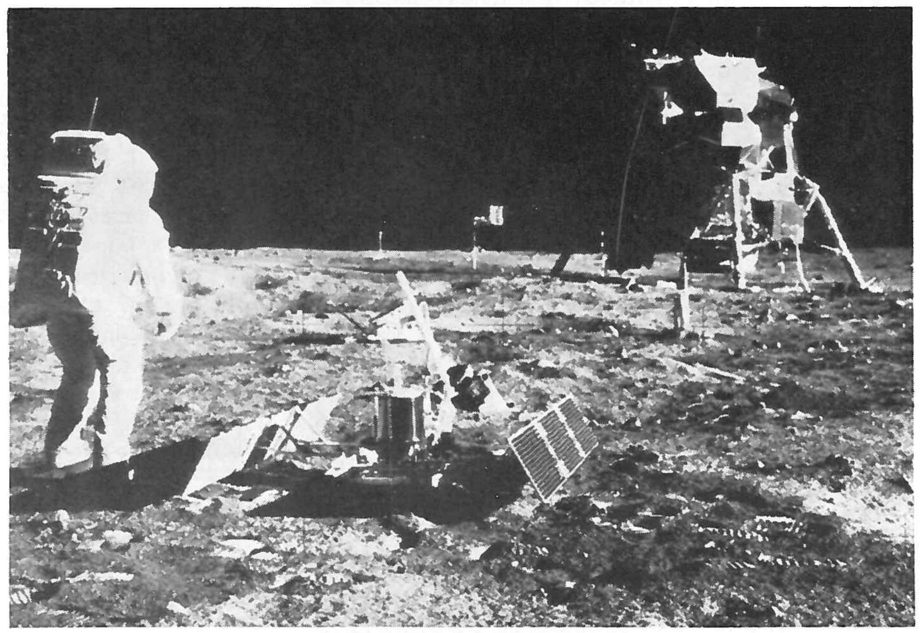
Next morning the Press arrive – a trickle at first, then a flood. You round a corner and they materialize in your path as if Hydra's teeth had been sown overnight. Luna 15 has been picked up by Jodrell Bank: its trajectory is very different from all previous Luniks. Much speculation. The Press redoubles its questions; the telephone rings incessantly; time ceases to have any meaning.

The Moon is new, a few degrees only from the Sun. The apparatus at the focus of the 50 foot Finder telescope overheats, tracking temporarily ceases. The Press are on to it – more questions.

**July 16.** Suddenly it is Wednesday and Apollo 11 is launched, the start of an epic voyage. A snatched moment to watch the Lift-off on the Conference Room television. A curious sense of anti-climax: you *expected* it to go smoothly. Luna 15 remains a puzzle. Jodrell Bank has calculated it will reach the vicinity of the Moon between 10.30 and 12 noon tomorrow. More speculation. The Russians, like Br'er Rabbit, say nothing.

**July 17.** Pick up transmissions from Luna 15 at 8.31 a.m., just after moonrise. Now one scene predominates: Lab. 5, the banks of instruments, the rhythmic click of electronic counters. Professor Lovell, eyes fastened on the dials and meters alert for any changes; Professor J. G. Davies, brows knit, making mental calculations of frightening complexity; Bob Pritchard, twiddling one knob, adjusting another, eyes darting here, there, everywhere.

Signals from Luna 15 showing the familar doppler shift as it accelerates near the Moon. 10.49 – signals suddenly stop – Lunar 15 is behind the Moon! A flurry of press and radio men as Professor Lovell announces this. 11.10 – Luna 15 re-appears, in orbit and transmitting a torrent of telemetry. Further statement to the Press. Now the telephone swamps all other thoughts: inquiries from every corner of the world – even Apollo Control at Houston wanting details of the orbit.



*Edwin Aldrin at Tranquillity Base on the Moon. Beside him is the deployed passive seismic experiments package. Beyond is the Laser ranging retro reflector and, at the back (l to r) the TV camera, US flag and Lunar Module.*

*USIS photo*

**July 18–19.** The tension and the excitement increase as Luna 15 continues to orbit and Apollo 11 approaches the Moon. So do the telephone calls. For the first time Jodrell Bank is tracking an American *and* a Russian Moon rocket simultaneously: Mark I, Luna 15; 50 foot Alt/Az, Apollo 11. Columbia Broadcasting System arrive and set up TV cameras.

**July 20 – Sunday.** The pace quickens. Professor Lovell seated under the huge, floodlit dish of the Mark I giving interview after interview – CBS, BBC, ITN. Fears that he may get sandwiched between Lulu and some other non-celestial star on the David Frost Programme! A Vicar from Doncaster 'phones to inquire the time of touch-down by the Apollo 11 Lunar Module on the Moon – afraid it may conflict with Evensong. Begin to get 'telephone elbow' from lifting the receiver! 'Commander Stanbury? This is the XYZ Broadcasting Corporation, New York (Los Angeles, Sydney, Melbourne, Timbuctoo). You are on the air . . .' In twenty minutes I make seven live broadcasts over the telephone to the other side of the world – four to America, three to Australia. (Is this a record?) As Apollo 11 Lunar Module descends, our instruments faithfully register the action taken by Armstrong and Aldrin to avoid landing in a crater 'the size of a football pitch'.

**July 21 – Sunday night and Monday.** Fantastic, unbelievable, like something out of Jules Verne! Not just those first halting footsteps on the Moon, but the calm, matter-of-fact voice of Neil Armstrong. My eyes will scarcely stay open, but I wouldn't miss it for the world. Excitement is high all day, reaches fever pitch by 4.30 p.m., with the Lunar Module due to lift off at 6.50 and Luna 15 still orbiting – but now the orbit has been changed and it will pass right over the Sea of Tranquility only 10 minutes ahead of the CSM. Then suddenly, dramatically, after 50 orbits, the doppler shift indicates Lunar 15 is landing in the Sea of Crises. Its rate of descent is 300 mph when the signals cease. A three-hour, non-stop bombardment on the telephone: Where? When? Why? What now?

**July 22.** The Russians have announced that Luna 15 has completed its mission; Apollo 11 is on its way back to Earth. A triumph and an enigma. The final Press Conference is held at 3 p.m. The Control Building grows strangely silent.

**Postscript** As always, the visiting Russian Scientists are charming, inquiring, appreciative. Before they leave I cannot resist saying: 'We should be very interested to know whether Luna 15 was intended to bring back samples of lunar rock.' The interpreter translates; they all laugh – 'So would we!.'



# no small part for SRC

W. D. B. Greening

. . . well, how do you import a piece of the Moon? and how do you obtain it in the first place?

For over three years now the Astronomy Space and Radio Division of SRC has been organising UK participation in the Apollo mission, through a Working Group of the Space Policy and Grants Committee, whose Chairman is Professor S. K. Runcorn, FRS, of the University of Newcastle upon Tyne.

This unique opportunity for UK scientists to 'reach for the moon' was taken up in earnest in May 1966 when a telegram arrived from NASA extending the deadline for the submission of proposals for analysing lunar samples to June 15 – just thirty-five days off! Although no British scientist had made any application so far, it was known that interest was high and the challenge was therefore taken up. In a remarkably short space of time the Working Group had met and had considered in detail a set of proposals which were then revised, co-ordinated, printed and bound, and finally shipped to Washington one Saturday morning by air freight with just three days to spare.

Altogether nineteen British universities and other institutions submitted proposals for a wide range of experiments which were combined into an eighty-page booklet, together with an 'operational flow-sheet' for the whole UK project. This formidable document was sent to NASA on June 10, 1966 and suspense mounted until almost a year later when NASA announced the acceptance of a total of 135 proposals of which thirteen were of UK origin. Two more have since been accepted and there are now fifteen principal investigators from the UK. Thus, this country, and SRC in particular, became part of the Apollo programme.

The principal role of the SRC has been to co-ordinate the British effort. We are the UK agency which deals with NASA over scientific matters in Space and, in collaboration with the Natural Environment Research Council, we have undertaken the planning of this work. Fortunately our existing machinery could be used without change, so you will look in vain for any specially created committees.

Most of the activity here during the intervening two years was routine and attracted relatively little public attention, but the scientists directly concerned naturally showed increasing interest with the successful completion of each stage of the Apollo programme. Continuous contact with their colleagues on the other side of the Atlantic and visits to the Lunar Receiving Laboratory at Houston convinced them of the realism behind the Apollo planning. Other people, however, saw things in a different light and in the beginning there was a certain incredulity surrounding our activities. This continued until last Christmas when Apollo 8 commanded by Colonel Frank Borman made its wonderful flight round the Moon. It then became clear to all that we were no longer dealing with Science Fiction but with real life, and that within a matter of months there would be pieces of Moon rock in London.

There have been several published accounts of the analyses which will be carried out in British laboratories and there is no need to repeat them here in detail. They include most of the standard geological studies which are applied to ordinary rocks and in addition several major investigations into the physical aspects. For instance, Harwell will irradiate a small sample in one of its nuclear reactors, and other laboratories will look at the chemical composition, magnetic properties, crystal structure and so on, of the various pieces which will be allocated to our scientists.

A NASA representative attended the annual NATO Advanced Study Institute at Newcastle during Easter 1967 at the invitation of Professor Runcorn, and a Working Group meeting was held shortly afterwards to which Principal Investigators were invited and at which Mr. Verl R. Wilmarth explained the Apollo programme and discussed the role of the UK investigators in more detail. The following September NASA held the first Conference of Principal Investigators at Houston with four representatives attending from the UK, and in April 1968 three attended a NASA Conference at Baltimore convened for scientists concerned with mineralogy and petrology.

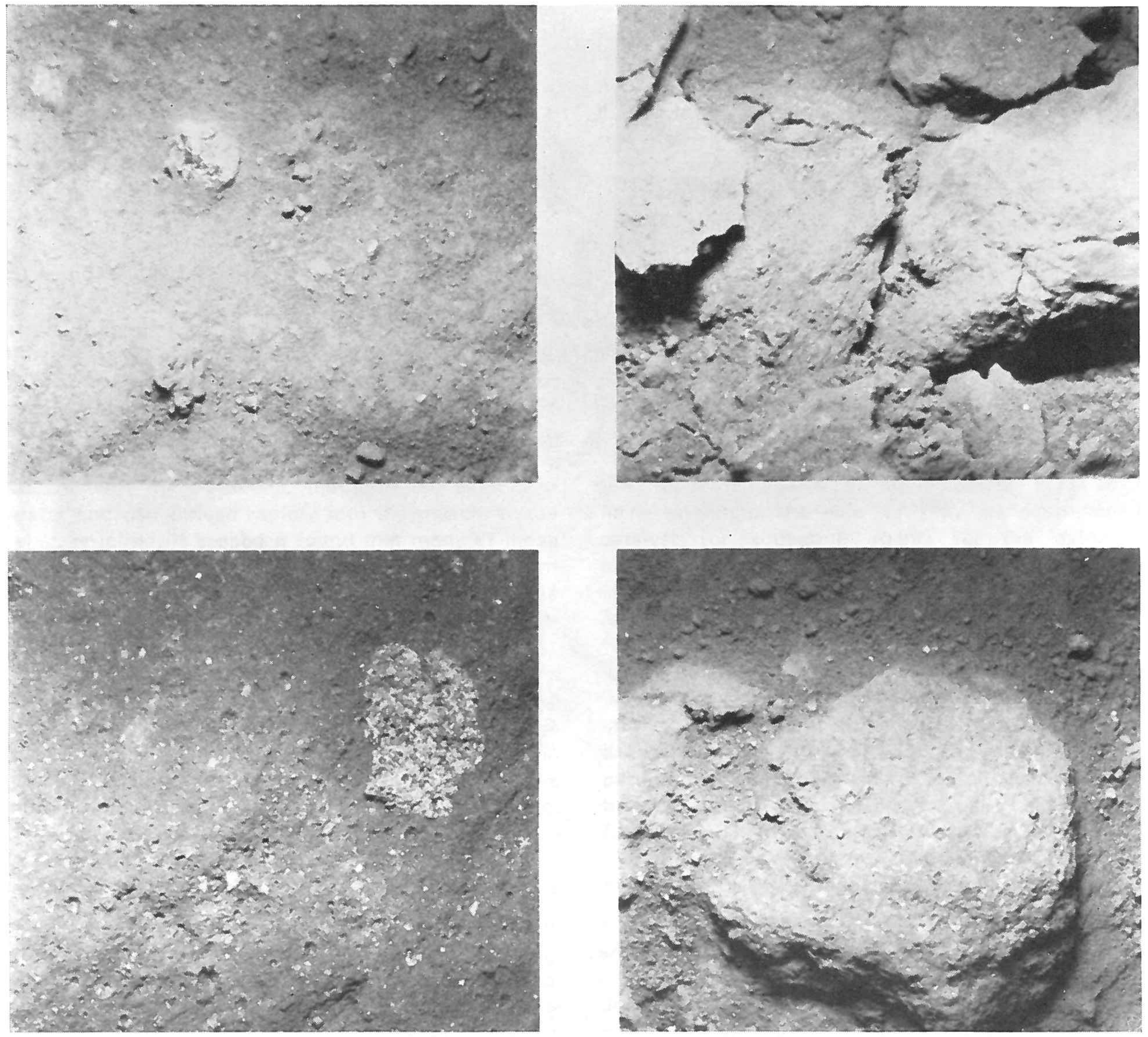
At about this time, mainly due to a strong recommendation from the Working Group, plans were made for a joint 'Lunar Symposium' with the Royal Astronomical Society at Burlington House, and a highly successful meeting took place in November last year, attended by a NASA official, scientists from the Continent, as well as representatives from all the participating UK laboratories. An account of the meeting by Ian Ridpath was published in the New Scientist of 5th December, 1968, under the title 'Britain's Part in Apollo'.

Public interest in the Apollo programme increased enormously with the spectacular successes of Apollo 9 and 10 missions and the realisation that *the* achievement of landing a man on the moon was at last no longer a pipe-dream. With this realisation came a number of problems for the SRC, not least the method of importation of an entirely novel material – lunar samples – into the UK. Nobody knew for certain whether there would be any danger to man, animals or agriculture: would they carry deadly micro-organisms? Visions of epidemics provoked by alien life could not be dismissed as rubbish but had to be taken very seriously indeed, even though it was known that the probability was low. Fortunately NASA had published its plans for quarantining the astronauts and their samples, and these plans could be referred to the various UK Ministries concerned. But then there arose a new problem: who in each Ministry should one approach? There was one memorable day towards the end of last year when first enquiries were made with the Board of Trade, HM Customs & Excise, the Home Office, and the Ministries of Health and Agriculture in an attempt to find the right contacts. The results were hilarious. Try and imagine what your own feelings would be if quite unexpectedly someone telephoned you and asked if your Ministry had any objection to importing a piece of the Moon. Your first reaction would be to ask yourself whether the enquiry was serious or whether there was a crank at the other end of the line. Once the individual had recovered from his surprise, however, we received the maximum of assistance and were referred to the experts in each Ministry who examined the problem from their point of view, and passed their advice to the Board of Trade who in turn advised HM Customs. In this way official clearance was obtained.

The main concern of the SRC has been to secure the maximum scientific return from the opportunities offered by the Apollo programme. So far we have been remarkably successful, thanks to the excellence of the proposals made by our scientists and above all to the generosity of the Americans – for without the expenditure of American resources and the risking of American lives there would be no pieces of the Moon in Britain this autumn. It is our hope that the investigations, which will start shortly with the samples just brought back in triumph by Armstrong, Aldrin and Collins in Apollo 11, will continue with future lunar missions and may even be extended to new fields. The geologists would certainly like to have samples from different areas of the Moon and also cores from below the lunar surface.

All this implies a continuing effort over the next few years – and who can tell what the outcome will be! Did the Earth and the Moon have a common origin? Has the moon a magnetic field? Has there ever been life on the Moon? What, in fact, is the Moon made of? One day these and many other questions will be answered, and our scientists will have made their own unique contributions to these investigations.





*USIS photo*

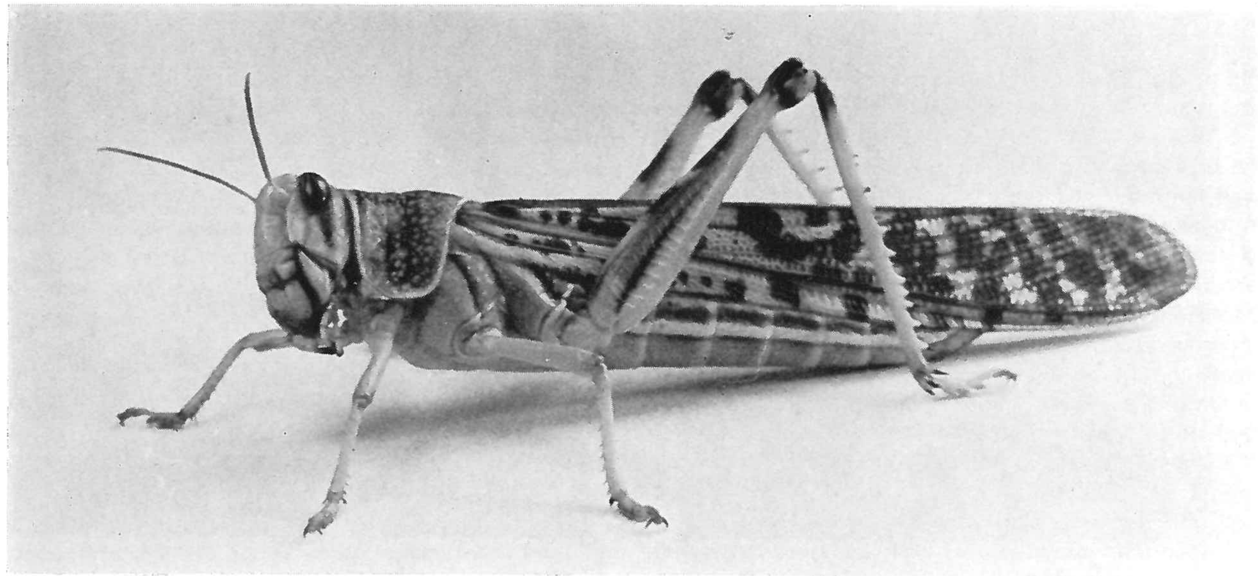
*Moon Rock on the Moon* as photographed by the Apollo 11 astronauts with a 35 mm stereo camera. Area covered in each picture is about 75 millimetres square.

*at upper left* is a small lump of lunar surface powder about 12 mm across, with a splash of a glassy material over it. Scientists surmise that a drop of molten material fell on it, splashed and froze.

*at lower left* is a lunar rock showing an embedded fragment, about 19 mm across, of a different colour. On the surface several small pits are seen, mostly less than 3 mm in size, and with a glazed surface.

*at upper right* is a clump of lunar surface powder, with small pieces of different colour. Many small, shiny spherical particles are visible.

*at lower right* is a rock about 64 mm long embedded in the powdery lunar surface material. The little pieces closely around it suggest to scientists that it has suffered some erosion. On the surface are several small pits mostly less than 3 mm in size with a glazed surface. They have a raised rim, characteristic of pits made by high-velocity micrometeorite impacts.



Locust

# fuels, energy and insect flight

*This 'Grant' article is by Dr. D. J. Candy of the University of Birmingham who holds an SRC grant worth £4,256 (over 5 years) for research into control of fuel utilisation during insect flight.*

Flight is the most energetic activity which animals perform. In insects the work of flight is done by the large flight muscles of the thorax which may thus be considered as the 'engines'. These muscles are found to have the greatest capacity for energy conversion of any known animal tissue and are capable of producing about twenty times as much power as the equivalent weight of mammalian muscle.

The energy for muscular work is provided by metabolism of fuels; that is by processes which oxidize fuels derived from food and make available the energy released for muscle contraction. It has been found that the high capacity for power output of insect flight muscle is matched by a high rate of metabolism.

The oxidation of fuels with oxygen of the air is the basic process by which both insect flight muscles and the internal combustion engines of aircraft derive energy for flight, although the detailed mechanisms for achieving this are considerably different in the two types of engine.

Figure 1 summarizes the processes in flight muscle whereby energy is released by fuel oxidation and used for work. Two main processes can be distinguished. The first step (a) is the oxidation of fuel to carbon dioxide and water. This process has the same *overall* result as burning the fuel, but there is the important difference that in simply burning the fuel all the energy would be released as heat, whereas in the metabolic oxidation of the fuel some of the energy is collected as chemical energy in the form of ATP (adenosine triphosphate). In the second process (b) the chemical energy of ATP is used to perform work in the muscle by a reaction in which ATP breakdown releases energy for muscle contraction.

## fuels for flight

The fuels required for flight muscle activity are ultimately derived from the food. Food is digested by the insect's gut and the products are absorbed into the body. Some of the products may be used for growth and maintenance processes in the body, but any surplus is transported in the blood to an organ known as the fat body where it is stored and is sometimes chemicaly modified. These stored food products represent the main source of fuel for flight. During flight the stored fuels in the fat body are gradually released into the blood where they are transported to their site of utilization, the flight muscles. In addition to the fuels stored in the fat body, smaller quantities may be stored in the flight muscles themselves.

A number of different chemicals may be used as fuels by insect flight muscles. These include carbohydrates, fats and, to a smaller extent, amino acids (from protein). The type of fuel used by the flight muscle varies with different species of insects, although some insects (including the locust) use all of these fuels.

The carbohydrates are supplied to the muscles in the form of the sugars glucose and trehalose. These sugars have the advantage that they are soluble in water and can diffuse rapidly into the muscle tissue when required. It has been found that many of those insects such as houseflies which carry out frequent and fairly short bursts of flight use carbohydrates as fuel, and this fact may be related to the rapid availability of these fuels to the muscles.

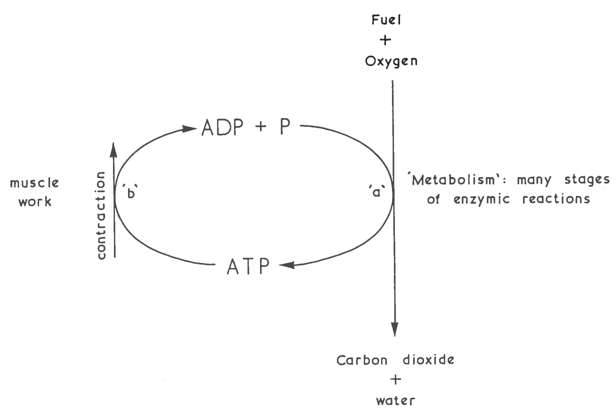
The fats, on the other hand, are not water-soluble and may thus be less rapidly available to the muscle tissue than sugars. However, fats have the advantage that they are more 'compact' than carbohydrates in the sense that much more potential energy can be stored per gram of fat than per gram of carbohydrate. This feature has particular advantages for those insects which undergo extended migratory flights of several hours. It is interesting to find that such insects (for example locusts, aphids and monarch butterflies) use fat as their main fuel for extended flights. Indeed, it can be calculated that it would be virtually impossible for such insects to store sufficient fuel in the form of carbohydrate to last for more than one or two hours flight.

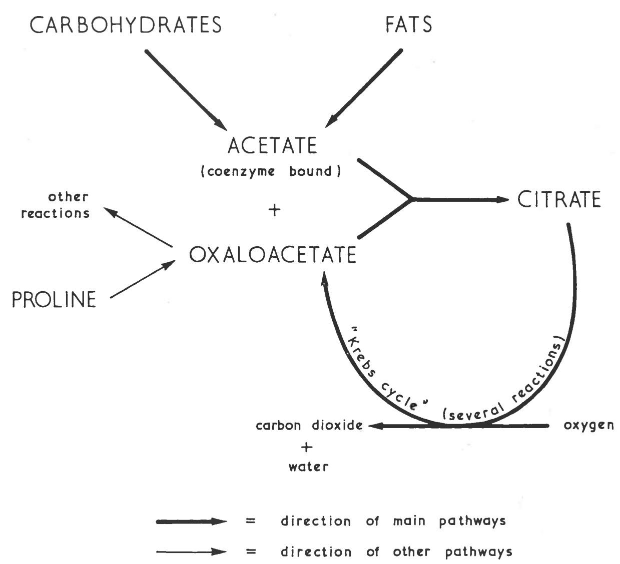
Another group of insects which use fat as the main fuel are the butterflies and moths where in some species the adult stage cannot feed. Here all of the fuel used for flight must be derived from food eaten by the insect during its earlier larval stage – with no possibility of any replacements! In these insects economy of fuel storage is essential and fat is again found to be the main fuel used for flight.

Amino acids can also be used as fuels for flight, but in most insects amino acids are quantitatively less important as fuels than carbohydrate or fat. However, it seems likely that the amino acid proline, and perhaps some other amino acids may have an important role to play in supplying a catalyst (or activating agent) for the oxidation of carbohydrates and fats. Carbohydrates and fats are converted by separate series of enzymic reactions to give coenzyme-bound acetate (Figure 2). Further oxidation of acetate to carbon dioxide and water occurs by the Krebs cycle, the first step of which is a combination of the acetate with oxaloacetate to give citrate. Subsequent reactions of the Krebs cycle in effect result in oxidation of the acetate part of the citrate to carbon dioxide in such a way that the energy released can be used to form ATP from ADP. The rest of the citrate molecule is eventually converted back to oxaloacetate so that for each molecule of acetate oxidized one molecule of oxalo-

*Figure 1 (below) Biochemical relationship between fuel oxidation and work in muscle.*

*Figure 2 (on right) Scheme to show the role of proline in supplying oxaloacetate catalyst for the Krebs cycle.*



acetate is used and one molecule of oxaloacetate is regenerated. In other words oxaloacetate acts as a catalyst for acetate oxidation. This system works perfectly well provided there is no loss of oxaloacetate, but in the cell other reactions occur which remove some oxaloacetate from the system. If this loss were not replaced acetate could not be oxidized and ATP synthesis would be reduced. The role of proline in flight muscle seems to act as a source of oxaloacetate, and thus to maintain the oxaloacetate levels at a sufficiently high concentration to ensure maximum oxidation of acetate.

Our main interest in Birmingham has centred around the locust because it uses all of the possible types of fuel (carbohydrates, fats and amino acids) for flight. One particularly interesting feature of the locust is that the proportions of the different fuels used varies during the course of flight. During the early stages when the locust first begins to fly carbohydrate is an important fuel, but as flight continues there is a gradual change in emphasis as fat forms a higher and higher proportion of the fuel used. This pattern of fuel utilization fits in well with the idea of carbohydrate as a readily available fuel suitable for the rapid initiation of flight, and fat as the main economically stored fuel for long term flight. One of the questions we are attempting to answer is how the insect controls this change in proportion of the type of fuel utilized.

### experimental study of locust flight

A number of different experimental approaches may be used to study the biochemistry of locust flight. For example, some experiments may be carried out using the intact flying locust. Locusts can be induced to fly in the laboratory by suspending them by a wire to face a stream of warm air. Professor T. Weis-Fogh has used such insects to measure oxygen uptake, carbon dioxide output and overall changes in fuel reserves during flight. He was able to show that the proportions of carbohydrate and fat used as fuel changed during the course of flight. We have carried out experiments in which radioactive fuels were used by flying locusts and the radioactive carbon dioxide produced was measured. Such experiments have confirmed the change in emphasis from carbohydrate to fat during flight. Other experiments with flying locusts have been carried out by Dr. A. M. Th. Beenakkers who found that the concentrations of fat in the blood increased by about four times during flight. We have been able to confirm this observation and have found that at the same time as fat increases the carbohydrate concentration of the blood decreases.

Such experiments using flying locusts yield considerable information about the overall processes of flight. However, a number of important questions remain unanswered if this approach alone is used. For example, the increases and decreases in fuel concentrations of the blood during flight are a result of two conflicting processes: the removal of fuel from the blood by the flight muscle and the release of fuels into the blood by the fat body. In order to obtain more information about these processes it is necessary to study the individual flight muscle and fat body tissues in isolation.

Another aspect which it is not possible to study using living insects is the actual chemical pathways by which the fuels are oxidized in the flight muscle. To answer such questions it is usually necessary to experiment with tissues which have broken down (homogenized) to give subcellular fractions capable of catalysing the chemical reactions of fuel oxidation. Finally, it is sometimes necessary to isolate and purify the individual enzymes which induce changes at single stages of the overall metabolic process. To obtain a complete account of the biochemistry of locust flight all of these different approaches at different levels of organization are used.

Many of our experiments have been carried out using isolated fat body or isolated flight muscle and it is convenient to consider these two tissues separately.

### the fat body

The locust fat body is a rather diffuse organ which stretches throughout most of the thorax and abdomen. The main role of the fat body in flight is to release stored fuels into the blood for transport to the flight muscles. Since the rate of fuel oxidation by flight muscle may increase by as much as one hundred times in going from rest to full activity, the rate of fuel release by the fat body must increase by a similar factor to keep pace with the fuel demands of flight.

Carbohydrate is stored in the fat body in the form of glycogen (a large polymer consisting of numerous glucose molecules joined together) but is released into the blood in the form of the sugars glucose and trehalose, of which trehalose is quantitatively the most important. (Trehalose consists of two glucose molecules joined together). Glucose and trehalose are more useful transport forms of carbohydrate than glycogen because they are much smaller and more soluble than glycogen and can thus diffuse rapidly into muscle tissue.

The initial step for carbohydrate release from fat body into the blood must be the conversion of stored



glycogen into sugars. This process seems to be a target for the control of carbohydrate release since two different mechanisms have been found in insects for control of the conversion of glycogen into trehalose.

In at least one insect species high concentrations of trehalose have been found to slow down (inhibit) the trehalose-synthesizing process. This effect may operate to control trehalose release during flight; at rest the flight muscles use little trehalose so that trehalose formed by the fat body accumulates in the blood until the concentration becomes high enough to inhibit trehalose synthesis. This situation represents the stable state in the resting animal with only small quantities of trehalose being utilized or formed. When the insect starts to fly trehalose is rapidly removed from the blood by the flight muscles, so the concentration of trehalose falls and inhibition of trehalose synthesis from glycogen in the fat body no longer occurs. The overall result is that trehalose release is able to take place at a more rapid rate during flight than at rest, and this increased rate is useful in maintaining the supply of carbohydrate to the muscles.

For some insect species a hormonal mechanism has been found to control trehalose release from fat body: a hormone ('hyperglycaemic hormone') from a small gland (the corpus cardiacum) in the head causes an increase in blood trehalose levels by stimulating the enzymic process of trehalose synthesis in the fat body. No correlation between release of this hormone and flight has yet been established experimentally, but it seems possible that the hyperglycaemic hormone could be released during flight to stimulate trehalose release from the fat body.

It should be emphasized that the above mechanisms for control of carbohydrate release from fat body have only been shown to occur in insects other than the locust. However, it seems reasonable to speculate that at least one such mechanism does operate in the locust, although proof of this awaits further experiments.

Fat is the other main fuel for flight, and this too is stored mainly in the fat body. It is released into the blood as a complex with protein (i.e. as lipoprotein), which is necessary to maintain the fat in a more soluble form. The concentration of fat in locust blood during flight increases to three or four times the resting level, although at the same time the rate of removal of fat by flight muscles must increase considerably. This means that the rate of release of fat body must also increase to maintain the high level of lipid in the blood, and the question arises of how this increased rate of lipid release is initiated.

We have recently carried out some experiments which throw some light on this problem. The corpora cardiaca of the locust were found to contain a hormone ('adipokinetic hormone') which, when injected into a living locust, would produce an increase in the fat concentration of the blood. In other experiments with isolated fat body tissues the hormone was found to stimulate the release of fat from the fat body into a medium containing haemolymph. This showed that the hormone could cause an increase in blood fat by acting directly on the fat body. Evidence that this hormone is actually involved during flight was obtained when it was found that the amount of adipokinetic hormone in the blood increases considerably when a locust is flown. It therefore seems likely that the increase in fat concentration in blood which occurs during flight is initiated by release of adipokinetic hormone from the corpora cardiaca, and this hormone then acts on the fat body to stimulate fat release.

### the flight muscles

The main requirements of active flight muscles are fuel and oxygen. Oxygen (in the air) reaches the muscle fibres via the tracheal system. This consists of branching tubules which lead from spiracles (holes) in the cuticle directly to the tissues. Such tubules are particularly numerous in flight muscle tissues. During flight air is pumped in and out of the tracheal system by the normal working of the flight muscles which, as they contract and relax, cause changes in the volume of the thorax which creates a tidal flow of air in and out of the tubules. In this way flight automatically improves ventilation of the tracheal system and therefore improves oxygen supply to the tissues when it is most required. Similarly, repeated contractions of muscles during flight improves the rate of blood movement between muscle fibres and therefore speeds fuel delivery.

Some biochemical experiments can only be answered by experiments using isolated flight muscle. For example, although it is well established that the trehalose concentration in locust blood falls during flight, this does not necessarily mean that trehalose is actually used by flight muscles. (An alternative explanation would be that the trehalose was being converted to glucose by some other tissue, and that this glucose was the true fuel for flight muscle). Such problems can be resolved by experiments on isolated flight muscle. In other experiments mixtures of two or more fuels can be tested to determine which fuels are preferentially utilized by flight muscle. Isolated flight muscles can also be used to study possible hormonal actions on fuel utilization.

In order to carry out such experiments it was first necessary for us to develop new experimental methods. The requirements were for an isolated flight

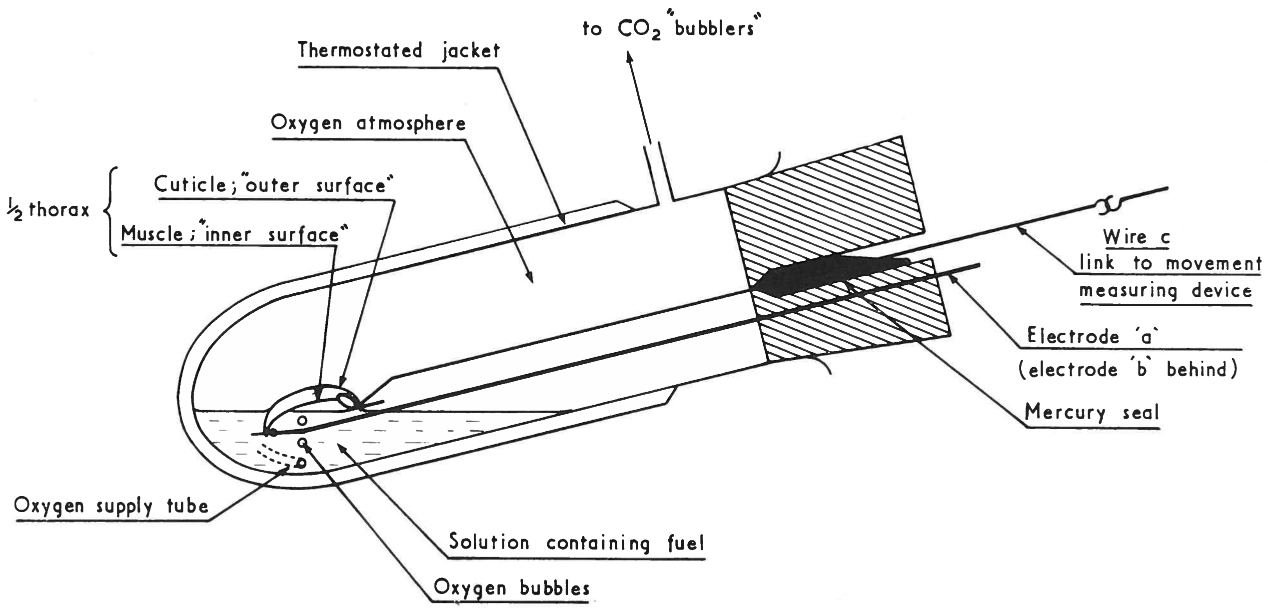



*Figure 3 Diagramatic cross-section of muscle incubation bath*

**Insect Flight** continued

muscle preparation which could be made to contract repeatedly and thus perform work (as occurs during flight). This could then be supplied with oxygen and suitable fuel. The utilization of the fuel could be best followed by labelling it with radioactive carbon so that the production of radioactive carbon dioxide and other products could be followed by radioactivity measurements.

Such requirements led to the development of a technique which employs the apparatus shown in Figure 3. The muscle preparation consists of half a thorax from a locust which has the fat body and gut removed to expose the flight muscles. The tracheal system is left intact to carry oxygen to the muscles, and the cuticle also remains as a support for the muscles and to retain the spiracles by which the tracheal system maintains continuity with the external atmosphere. In addition the main ventral nerve with its subsidiary nerves are left intact so that all of the muscles can be made to contract simultaneously by electrical stimulation of the ventral nerve via two electrodes (a) and (b). When the muscles contract they cause a movement in the flexible cuticle which then pulls down on the wire (c). This movement is measured by connecting (c) to an electronic device for recording the amount of movement. The muscle tissues are bathed in solution which contains fuel and inorganic ions at concentrations similar to those of locust blood. The 'outer surface' (cuticle side) of the preparation remains in the atmosphere since wetting of the spiracles blocks them and prevents oxygen transfer to the tracheal system. Fresh oxygen is continually bubbled into the solution underneath the preparation, and as it escapes it carries any radioactive carbon dioxide formed in the muscle to the 'bubblers'. The bubblers absorb the carbon dioxide so that its radioactivity can be measured.

Using this technique we have been able to show that a number of different fuels can be oxidized by the flight muscles. Such fuels are able to provide the energy for repeated contractions (usually at the rate of two per second) for periods of more than three hours. In the absence of any suitable fuel the mechanical response of the muscle gradually becomes weaker and weaker until after an hour or so it is only a small fraction of the original response. The results presented in figure 4 show that the fuel (glucose) oxidation rate is proportional to the frequency of contraction i.e. to the amount of work done by the muscle. The oxidation rate in unstimulated preparations is only about 10% of the rate during stimulation at two per second. This shows that in our isolated muscle preparations fuel oxidation processes and the contraction processes are 'coupled', that is they are interdependent as would be expected from a consideration of Figure 1. This gives us some confidence that our muscle preparations are functioning as they do in the flying locust.

Suitable fuels for such flight muscle preparations include glucose, trehalose, various fats and proline. When two suitable fuels are added in mixture, the contribution of each is depressed, although the total fuel used remains about the same. Increasing the concentration of one of the fuels relative to the other increases the proportional contribution of that fuel



to the total fuel oxidized.

In some experiments we have looked for possible hormonal effects on flight muscle fuel utilization. In these experiments we added extracts of hormone producing organs to the solution bathing the muscles, but so far no significant effects have been detected. This could mean either that hormones do not affect fuel metabolism by the flight muscle, or that our experiments were insufficiently sensitive to detect such effects. It is always more difficult to be convinced by negative results than by positive ones!

To summarize, the main controls of fuel utilization *at the muscle* seem to be:

(a) The amount of work done. This controls the total amount of fuel oxidized.

(b) The relative concentrations of different fuels in the solution supplying fuel to the muscles. This affects the proportional contribution of each individual fuel to the total.

**an overall picture of fuel utilization**

Our present working hypothesis on the control of fuel utilization during locust flight is as follows: At the beginning of flight the nervous system of the insect stimulates the flight muscles to contract, and the energy for such contractions is derived by oxidation of available fuels from the blood. At the same time the corpus cardiacum is stimulated to secrete hormone(s) into the blood stream: Adipokinetic hormone which stimulates fat release from the fat body, and perhaps other hormones which may stimulate trehalose synthesis by the fat body. Simultaneously, the trehalose concentration of the blood is reduced as a result of its utilization by the flight muscles, and this may relieve inhibition of trehalose synthesis in the fat body and thus reinforce any hormonal stimulation of trehalose release. For carbohydrate the initial rate of utilization by muscle is greater than the rate of release from the fat body, so that the concentration in the blood decreases. For fat, on the other hand, the stimulation of release from the fat body is so effective that the fat concentration of the blood actually increases despite an increased rate of removal by the flight muscles. The overall result is that there is a change in the relative proportions of carbohydrate and fat in the blood during flight (a decrease in carbohydrate and an increase in fat), and according to our experiments with isolated flight muscle, this should affect the relative proportions of fuels actually oxidized. Thus changes in blood fuel concentrations can explain the change in emphasis of fuel from carbohydrate to fat which has actually been observed during the flight of locusts.

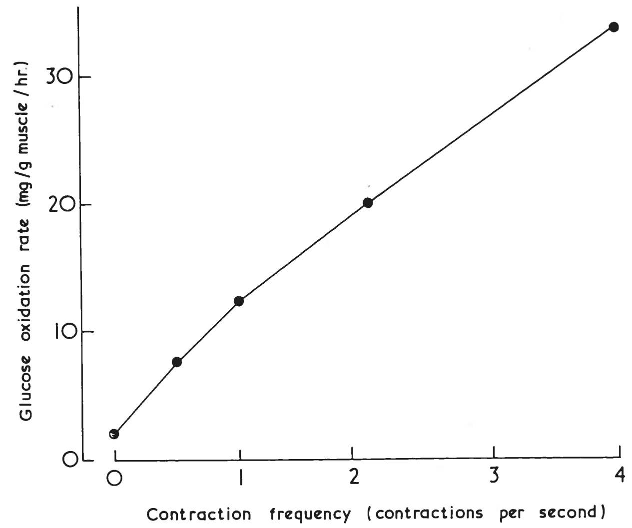
**future problems**

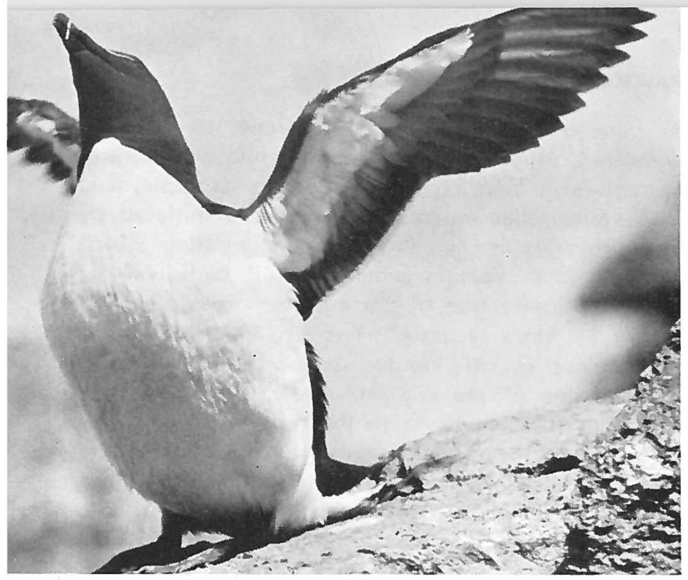
A number of interesting questions remain unanswered. Most of these are concerned with control systems at a more chemical level. For example, it is well known that muscle contraction is initiated by local changes in calcium ion concentration which activates the reaction whereby ATP hydrolysis is linked to contraction of the muscle fibres (step (a), Figure 1). More recently it has also been found that an increase in calcium ion concentration activates at least one of the key enzymes of fuel oxidation (i.e. step (b), Figure 1) in the muscle. In this way calcium ions may simultaneously activate both of the main processes in flight muscle. Further research is needed to discover the relative importance of this calcium effect, and to look for additional mechanisms for control of fuel oxidative metabolism.

The question of how trehalose enters the muscle cells is a problem which is specific to insect muscle. It has not been established whether trehalose is converted to glucose inside the cell, outside the cell, or during its passage through the cell membrane. Moreover, the rate of such processes must be controlled in some way, and linked to the rate of muscle contraction, since otherwise much of the trehalose in the blood of locusts at rest would quickly be converted to glucose.

At the present time the known effects of hormones on fuel utilization affect the fat body rather than the flight muscles. This key role of the fat body as a target site for hormonal control of flight biochemistry merits further investigation. Of particular interest is the question of exactly how the hormones act on fat body cells to stimulate the release of fuels.

*Figure 4 Effect of contraction frequency on glucose oxidation rate. (Each point represents an average of several experimental results).*





# people and their pastimes

## the birds

**Mrs. U. F. Black**
LO

Interesting facts about the habits and habitats of wild birds are collected by natural history societies. Originally intended for study of the mysteries in the bird world, of which there are many still to be solved, the collection became so comprehensive as to show where bird species were in danger of becoming extinct or how they might become threatened by changes in the environment, whether caused by nature or by man. In the interests of preservation, the wild life and bird protection societies were formed and they also discovered that unless the natural countryside was looked after it might become a barren desert, of no benefit to people in need of a resort from urban life.

Details of bird life come from amateur bird watchers as well as expert ornithologists and among the former are Una Black and her husband Pete, who belong to the London Natural History Society, the Royal Society for the Protection of Birds and are supporters of the World Wildlife Fund. Una has been a member of the group in Establishment Division, London Office that produces SRC Conditions of Employment Memoranda, and the related general notices, for the past three years. Welfare is another of her responsibilities: this covers any personal problem from finding hostel accommodation for young newcomers to providing a general advice and information service on quite a variety of questions.

Una and Pete have made many observations both of birds near their home in the west of London and at bird study centres on remote coasts and moorlands. It is important when studying birds not to disturb them. Rare birds in particular, often the most shy, may be upset by a careless intrusion, and frightened away from their breeding grounds.

There are only twenty species which breed regularly in the Central London area, as many more that breed there from time to time but over a hundred more fly over or through it. The green squares, parks and private gardens attract hardy woodland birds although great and blue tits, chaffinches, greenfinches and songthrushes prefer woodland undergrowth or, instead, tangled shrubberies in unkempt gardens. Here too will be wrens, hedge sparrows, tawny owls and, more rarely, black caps, swifts and hawfinches. In late autumn migrating flocks of redwings pass over in great numbers and may alight for a rest or to feed.

The development of London has made it uncongenial to certain birds but others have returned to changed surroundings. Marsh birds, like little ringed plovers, reed warblers, yellow wagtails and great crested grebes, have accepted the gravel pits created by the concrete age and reservoirs are the winter homes of 10,000 ducks and 100,000 gulls. Redshanks and other waders are content to live on sewage farms, which are often close to the site of former marshes and swamps, while the City of London is a series of cliff faces to feral pigeons and starlings, the counterparts of the starlings and rock doves on the rocky coast of northern Scotland. Pigeons have come to accept breadcrumbs, varied with scraps from street markets as their staple diet, their ability to make a rapid and almost vertical take-off keeping them safe from traffic. Starlings feed on insects in lawns, rubbish dumps and sewage farms, where they travel round on the rotary filter arms; but hunting on the ground brings them into danger from domestic cats – there are about five cats to every starling.

Many of the bird species found in London appear in the glens at the foot of the Grampians, as well as many others. Una and Pete have spent holidays there at the house of the Bird Recorder for Angus. Dippers, which can walk under water, push food into the red gapes of their young, open like so many letter boxes in the river bank;



woodcocks parade their square of territory every evening 'roding' just above the treetops, uttering a call at exact intervals; and the sound of a rusty hinge creaking in the wood may be the cry of hungry long eared owlets. The most exciting sounds are the weird crowing of grouse, drumming of snipe and the mournful cry of curlews or an oyster-catcher hunting in the estuary, its long legs and bill a brilliant red. Una has also heard an icterine warbler in Glen Esk and was once lucky enough to see a dotterell on its breeding ground; this handsome bird of the high moorlands is rare in Britain and very seldom seen.

Off the nearby coast are colonies of sea birds. Arctic terns dive at intruders like small white darts; but gentle faced kittiwakes sit wing to wing on the cliff face murmuring soothing calls in answer to the discordant cries of 'kittiwake' from their noisier partners.

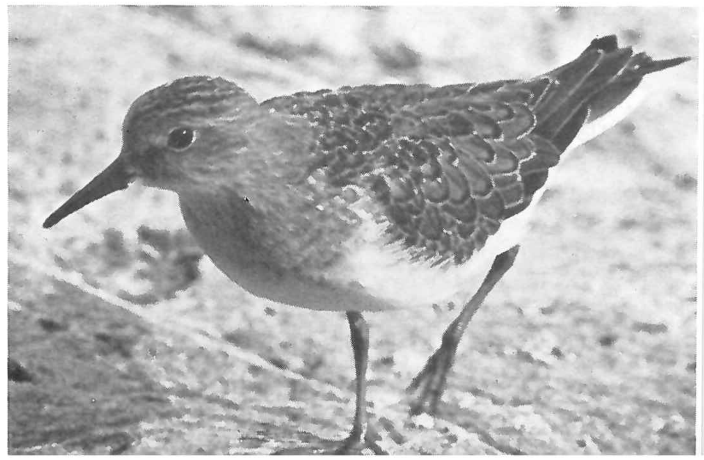
Skokholm Island off the coast of Wales is a more specialised sea bird observatory, well known for its colony of manx shearwaters. The island lies in the path of a fierce tidal stream and is swept by heavy westerly and southerly gales so that, apart from the lighthouse keepers and hardier bird watchers, it is secure from human intrusion. This is fortunate, for many shearwaters and puffins nest in rabbits' burrows, honeycombed in the soft peat under a thin crust. Storm petrels use rock crevices but all have to hide during daylight and on moonlit nights from voracious great black-backed gulls, which turn their prey inside out to leave only wings and feet. Parent shearwaters take turns to hatch and feed their young chick while their partner spends a week or so feeding at sea. When they change over the noisy meetings underground on dark nights sound like ghostly wailings from the island itself. Both parents leave the chick alone ten days before it is ready to fly, to be nourished by its own body fat until it is light enough to move. During the last few nights the young bird comes out of the burrow to exercise its wings on the ground before its final take off, either by a run down to the sea if the night is calm or, more successfully, on windy nights to be lifted by the wind by facing into it. The rest of a shearwater's life is spent at sea, except during the breeding season, and young birds will be found in South America within six weeks.

Una has also watched birds in Austria, while skiing, and in the west of Ireland, where she saw large numbers of newly arrived cuckoos (a bird more usually heard than seen at such close quarters) and some mobbed by meadow pipits, whether before or after laying in the pipits' nests it was hard to tell. Meanwhile Una and Pete are saving up for an excursion further afield to the Ngorongoro crater in Africa, where they are keen to go soon before some bird and wild life species, already rare, become altogether extinct.



The photographs shown were taken by Laurie Roberts, a friend of Una's who works in State House for the Ministry of Health and Social Security. He is both a bird watcher and photographer in his spare time and has provided pictures for natural history journals on several occasions.

*opposite page* — *Razorbill*
*below* *1* — *Bird survey*
*2* — *Shearwater*
*3* — *Temminks Stint*



## Q column by 'observer'

The temperature was well into the eighties in Holborn on Wednesday July 16 as Apollo 11 was launched and we would be less than human if we said our thoughts were entirely on work. Quite a lot of people were thinking about the astronauts; a few were considering strawberry prices and a lot more were wanting to get back to a deck-chair, a shower, or anywhere but Central London.

The Press Office tells us that they did a brisk trade in enquiries from newspapers and journals concerning the lunar samples for British universities and research teams throughout the world which the Apollo astronauts were bringing back. Would our man collect them from Houston or would all the experimenters go over and receive their samples individually? What would the security precautions be? What about clearance with Customs and Excise? There were dozens of obvious and sensible questions asked.

The article on Page 13 by Dr. Greening gives valuable 'background' to an interesting administrative chore for what must surely be the most unique scientific exercise ever undertaken.

The last word must, however, be with the Office Wag who stopped us to say 'when the courier gets off the plane at Heathrow it's more than likely he will have a Little Green Man in tow rather than a piece of lunar rock'.

Well, we know now it's rock. Personally, I would love to have met a Little Green Man.

**parts of the past**

Nowadays, it seems, you have to go all the way to the moon for souvenirs of a bygone age, Archaeologists, or mere keen diggers, aren't allowed to carry off pieces of Fishbourne Palace or newly uncovered Egyptian mummies.

A hundred years ago, lumps of ancient Rome, Greece and anywhere else were a favourite ornament for the home and inspired classical themes in buildings, paintings, furniture and women's dresses. If you visit London Office, you can see how they used to look at No. 13 Lincolns Inn Fields (opposite State House). From 1811 until his death in 1837 (aged 84) this was the home of Sir John Soane, an architect of the classical revival. Parts of ancient and contemporary buildings, models and statues were brought in to show himself and his pupils how it was done. The passageways are narrow and massive blocks from stone columns hang, breathtakingly, just above head level.

The museum gained attention at Easter when a painting by Watteau was stolen. Apparently the work of a specialised 'collector' since the dozen by Hogarth were left alone. The famous 'Rake's Progress' set of eight, now priceless treasures, were bought by Mrs. Soane at Christie's in 1802 for only £570, the lot.

The house is full of deception – decoratively speaking – to suggest to the eye that it is larger and lighter than possible in a London terrace. The ideas are worth trying at home. When the house next door is opened at the end of the year there should be more to see as the interior and furniture will have been restored from engravings made during the architect's lifetime.

**. . . and present**

If the Sir John Soane's Museum is too intellectual a refreshment in a busy day's routine perhaps the netball teams on the other side of Lincolns Inn Fields will provide greater stimulus. Followers of this very persuasive sport tell us the standard of play is quite high (we wouldn't know of course) and the participants are sometimes quite spectacular. If these diversions are not enough there's usually a brass band on Tuesdays, speakers of a variety of persuasions at the Great Turnstile corner, and if all else fails, Henekey's Long Bar. You can always persuade yourself that this deserves a visit for its architectural merit alone. It is mentioned in 'Nairn's London'.



### *Quest Quarterly Quote*

*'Two students who have completed their year of general observations are now working on their own projects. One is working towards a PhD on reproductive behaviour at Cambridge University . . .'* from Quest, April 1969.

● You may notice a number of small changes in the format and content of your Favourite Journal. All are designed to make it more readable? loveable? homely? or simply to bring about togetherness (or the opposite!) The Guest Column will we hope be a popular innovation bringing an outside viewpoint to bear on our affairs (we have some very interesting contributors in mind for future issues). The Quest Quarterly Quote will depend a lot for its success on getting a good, relevant contribution each issue and this column will depend even more on either the existence of a quiet corner in the office or else a strike by the GPO engineers. Seriously though, we do need more reader participation. We can't guarantee to run a 'personal problems' column by Aunt Joan (*in* joke) but we will do all we can to print all reasonably acceptable contributions especially cartoons, light verse and articles.

● Here is an open secret. Most Monday mornings the London Office Directors hold a meeting with the Chairman and Secretary to discuss routine administrative business. It is known throughout the office as a 'Q' meeting. Why? There are several suggested answers ranging from 'Questions' meeting to 'Quintet' (originally five attended). We have yet to hear an authoratative answer. Please Dr. Francis put us out of our misery.

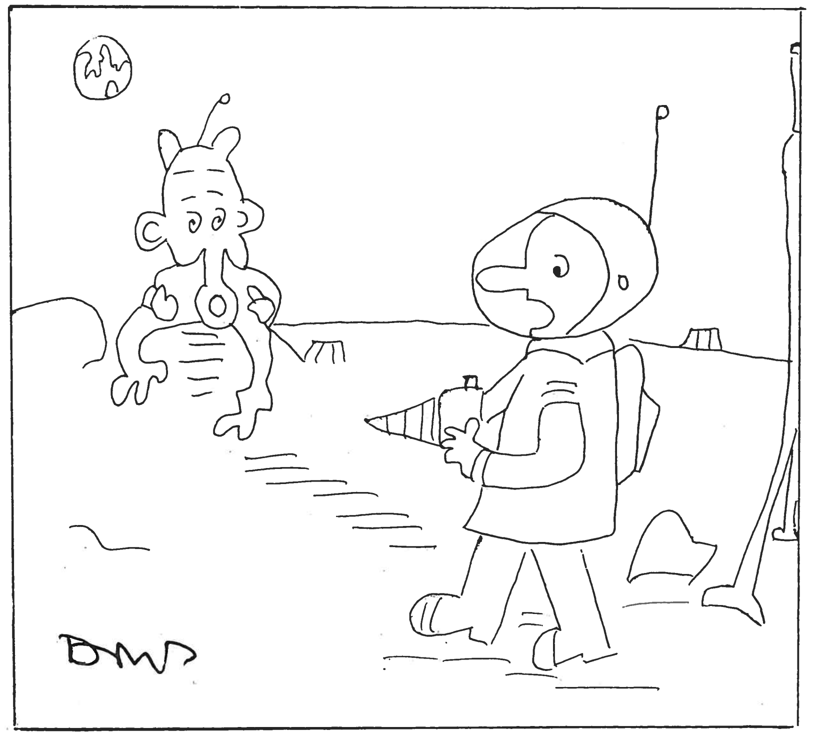
### *a word in time . . .*

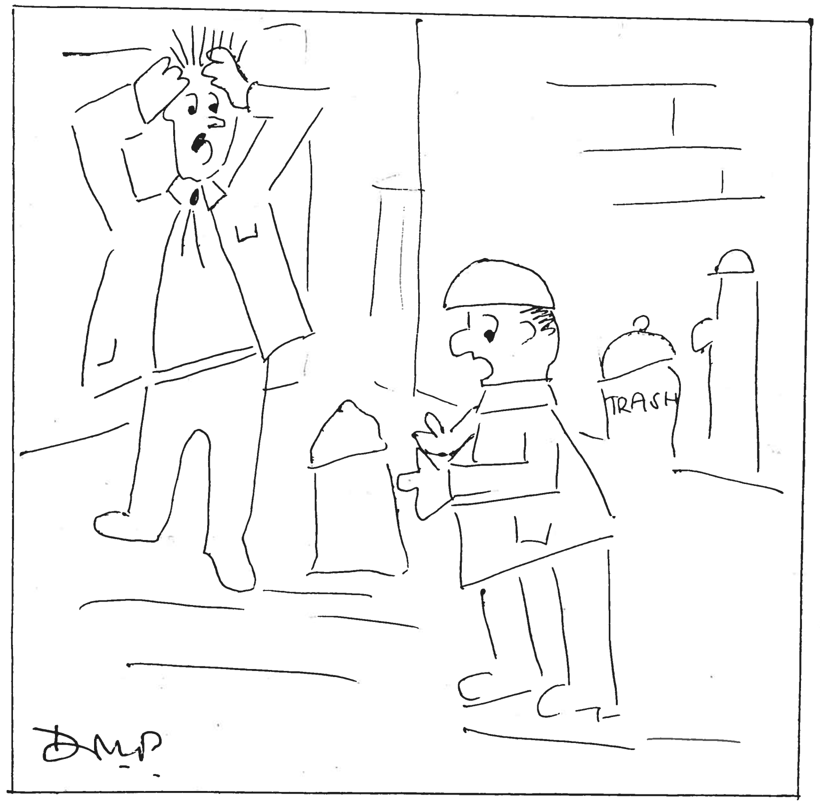
*The Director of a Laboratory, not far from SRC, arriving about ten o'clock, overtook one of his draughtsmen.*

*'Good morning, Blankson', he called. 'Late again!'*

*Said the draughtsman, with a look of concern 'Are you, Sir? – so am I.'*

***Gee! I must have a snap to take to the folks back home.'***






*'A bag marked moondust, you say?'*

● We have heard it rumoured around that far reaching decisions are being taken with regard to titles in the London Office. We shall have 'Director, Nuclear Physics', instead of 'Director of Nuclear Physics Division', 'Director, Astronomy, Space and Radio', etc. Each will continue to have a deputy as at present but he will no longer be called 'Head of Division'. All of this makes sense and up-dates us in more ways than one. Mr. Walker we gather will be 'Director, Administration' and under him will be deputies dealing with 'Establishment' and 'Finance'. In addition it is proposed that 'Establishment Officer' as a title should be dropped but the problem is to find an equally descriptive alternative. We are not sure why the title is going except perhaps that 'establishment' may have a slightly undemocratic ring about it in the setting of swinging Holborn, and perhaps it would establish us as leaders in the field of post-Fulton developments.

Anyway all this may be conjecture. We have to await an official announcement. Let us suppose however that 'Establishment Division' goes. Can you suggest an alternative? Decent suggestions on a postcard please to PO Box EST. Room 1517, State House, London WC1 by October 31 please. No prizes offered but the sporting chance of a mention in our next edition.

To help would-be contributors may we add that 'Personnel and Organisation' is an unlikely starter (after all, we might think of cruises every time we 'phone the P and O) and 'Staff, Organisation and Discipline' seems a little doubtful (no prizes for guessing why).

Our own suggestion is Staff, Welfare, Employment and Leave Section known throughout SRC as the SWELS (ugh).

● *'Quest' was abashed to find – and we do not abash easily – that among new staff appointments announced recently were two colleagues described individually in the official notice as 'Woman Computer'. 'Woman Computer' indeed! Has the age of chivalry shed its last garment? Surely 'Computeress' as with 'Shepherdess' would be more elegant or else Computer Lady, Lady Fortran, or any expression that avoids such language.*

*Beware official draughtsmen! We are following your announcements closely.*



# newsfront

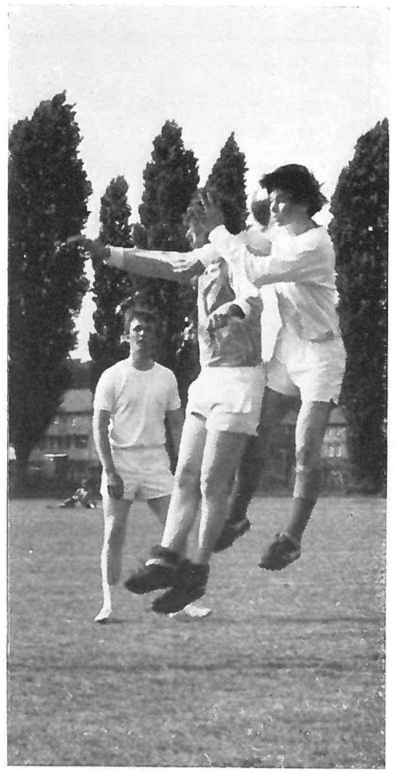
## july 28
## Minister of State's visit to Daresbury

*(l to r) the Chairman with Mrs. Shirley Williams, MP, Minister of State for Education and Science, and Professor Merrison Director of DNPL.*

## september 1
## Professor Merrison appointed Vice-Chancellor

*Professor A. W. Merrison, FRS, thanking Mr. M. J. Moore (head of Engineering Services Group) and the staff of DNPL who presented him with two prints of Liverpool and an autographed album when he resigned as Director to take up his new appointment as Vice-Chancellor of the University of Bristol.*

## july 2
## sports day



*near right* Summit Meeting in a six a side football match.

*far right* Miss Alison Astbury granddaughter of Mrs. O. J. Kirby RGO wearing 'Supporter's Hat' created by Brian Jones, Computer Engineer at RGO. The 'ribbons' bear slogans for RGO.

## june 13
## Site opened for 5 km Radio Telescope

*Professor Sir Martin Ryle FRS starting off the work to open site of the new telescope for the University of Cambridge Mullard Radio Astronomy Observatory at Lords Bridge.*



## quest loses

Len Jenkins (editor) who is now Books Editor (on promotion to Senior Information Officer) in the Department of Employment and Productivity. This involves publishing the many leaflets issued at Labour Exchanges and his particular job is to redesign the literature to match the changing image of the Department.

Dr. John Baldwin local correspondent from ACL who is to spend a year at the University of Maryland under Professor Jim Stewart to assist in implementing crystallographic programming package Xray-70 on the University Computer. Then he will work on its conversion for use at ACL. Dr. Baldwin adapted the Xray-63 package now in use from the US programme. His bellringing interests were featured in Quest (in January 1969).

Dr. John Ireland from ROE whose destination is still unknown at the time of going to press.

Quest's thanks and best wishes go with them.

## quest gains

Miss Anne Smith as Editor

F. Lunnon as ACL correspondent

Dr. W. M. Napier from ROE

The cartoons in this issue are by Miss Daphne Playford from LO.

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## contributors

**J. F. Hosie**

*'the launch'*

*Director, Astronomy, Space and Radio (LO)*

**Commander R.N. Stanbury**

*'tracking east and west'*

*Personal Assistant to Sir Bernard Lovell at Jodrell Bank, University of Manchester.*

**Dr. W. D. B. Greening**

*'no small part for SRC'*

*PSO in ASR Space (International) Section (LO)*