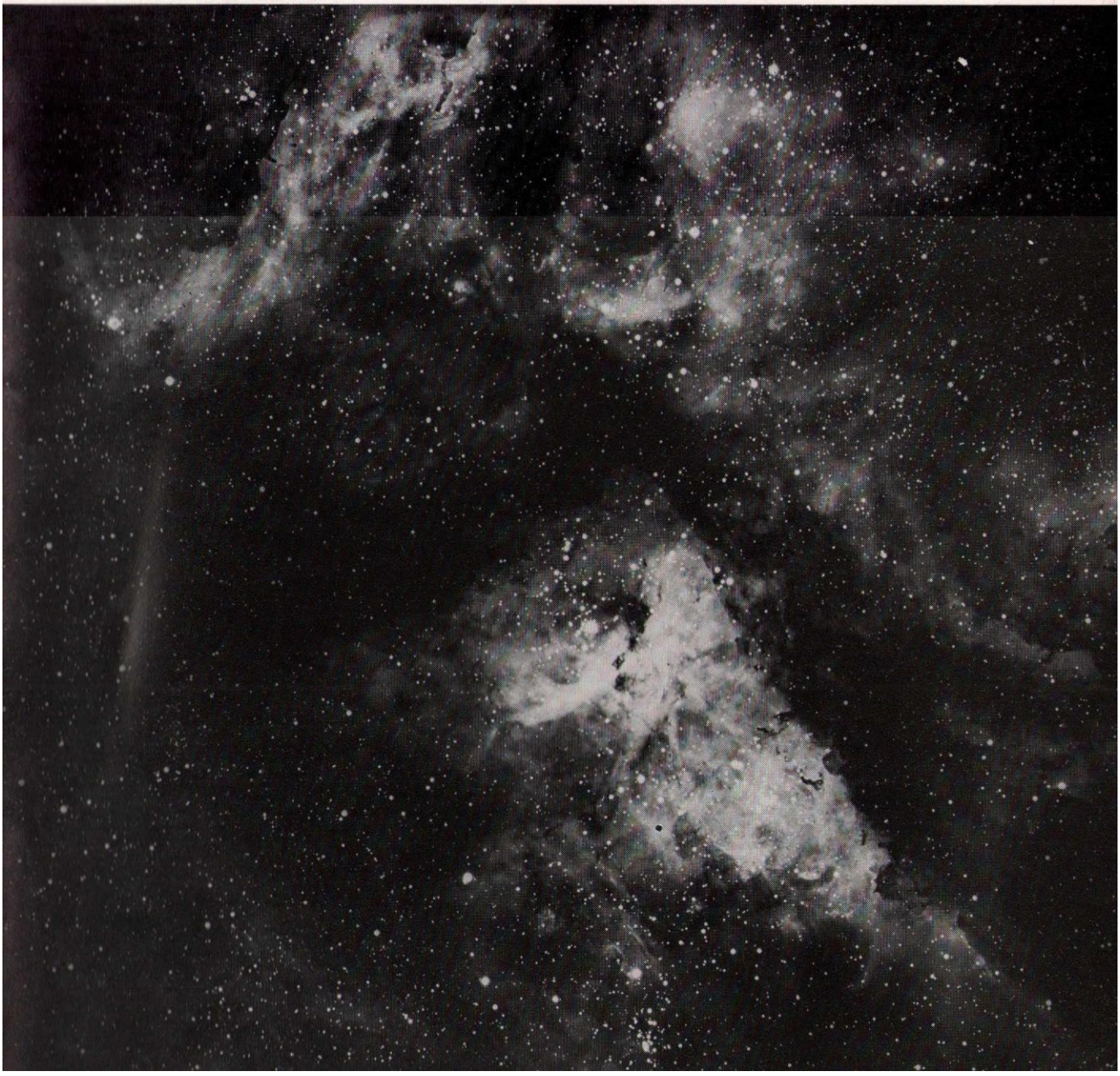
QUEST

Vol. 8 No. 1

The planning game
Sir James Chadwick
Eighth wonder of the world?



QUEST

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Cover

This issue's cover picture is one of the many spectacular photographs taken recently by astronomers who are now using the Anglo-Australian Telescope (see *Quest* vol 7 no 3). They show southern objects with a clarity never before obtained.

Our picture shows Eta Carinae which is a large hydrogen emission nebula in the far southern sky with wide superimposed dust lanes. The narrow twisted lanes in the picture (known as elephant trunks) show where cold interstellar matter is forcing its way into hot gas. The central star is unique, exceedingly variable with an array of remarkable properties. It is thought that it may be a newly formed star settling down to a stable state.

Although much work still remains to be done in commissioning the scientific instruments to be used with the telescope, teams of British and Australian astronomers are already using the prime focus camera of the 3·9 m telescope for serious scientific research. The scientific programmes of the AAT include the study of X-ray stars, quasars, stellar dynamics, the birth of stars and their death in violent supernova explosions.

Dr Paul Murdin of the Royal Greenwich Observatory, working with a consortium of British X-ray and optical astronomers, is studying star systems which produce X-rays. The enthusiastic collaboration of the X-ray side of the group now that they have access to a large southern telescope is, it is felt, an indication of how well such joint projects should go in the future.

Contents

The Planning Game

H ROTHWELL

"We have in this country a system of planning that would have made the Ottoman Empire drool with envy"
(Lord Goodman from the 1974 Richard Dimbleby Lecture)

In 1971 the Science Research Council agreed to build a national Nuclear Structure Facility (NSF) at the Daresbury Laboratory. It was realised that there could be problems because the Facility required a tower of some two hundred feet in height and it was necessary to obtain planning permission from the local authority.

Those of us who become involved in seeking approval for new projects soon realise that the obstacles to be overcome are likely to break the hearts of the most resolute men. Progress is rather like reaching the winning post in a game of snakes and ladders, except that in the commercial product of this game there is a fair distribution of ladders to snakes. In real life, the snakes predominate. The story of the NSF is an excellent example of this philosophy.

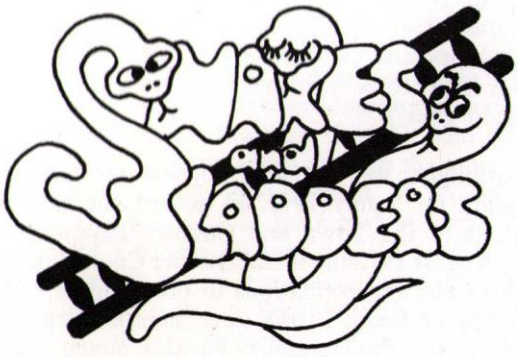
To understand the problem of obtaining planning approval for the NSF it is necessary to look briefly at the history of the Laboratory which came into being in 1963. Prior to this time the land was used for agriculture although it was owned by ICI Limited. The site requirements for the Laboratory were very restrictive and included a very stable rock foundation. When application was made to the planning authority in 1962 it was considered by the Cheshire County Council to be a substantial departure from the Development Plan. Daresbury is a white area, ie an area where the existing use should remain undisturbed. Nevertheless, planning permission was granted on that occasion without recourse to a public inquiry but that was in 1963. Since that time there has been an increasing awareness of environmental considerations and we realised that the extension of the Laboratory to include the NSF was likely to meet with some opposition.

We have always tried to maintain good relations with the local authorities and from time to time meetings have been held with representatives of the local Councils, and in September 1970 possible developments (including the Nuclear Structure Facility) were discussed with the Daresbury and Moore Parish Councils; discussions were reported in the local press without raising adverse comment.

In March 1971 the Science Research Council received approval from the Department of Education and Science to undertake a design study for the proposed Nuclear Structure Facility to be sited at Daresbury. Whilst the design study was proceeding, informal discussions were taking place with the County Planning Director and his staff and the Parish Councils of Daresbury and Moore were also kept informed.

A number of modifications to our proposals were suggested by the County Planning Director and these have been incorporated in the present design. During 1972 further discussions took place and in order to present a picture of the impact of the tower associated with the Nuclear Structure Facility, a mobile crane was hired with the gib raised to the height of the proposed tower (see p. 4). This exercise was witnessed by representatives of the Rural District Council and the Cheshire County Council. Photographs were taken in the locality and we superimposed scale drawings of the tower.

As the design study progressed so did our relations with the County Planning Director to the point that when we were eventually ready to proceed with our



application it appeared to us that there was every likelihood of obtaining the ultimate approval to our scheme. The first stage in the formal acceptance of our proposal rested with the Runcorn Rural District Council under power delegated to it by the County Council, but it was decided that prior to submitting a formal application there would be an advantage in having informal discussions giving information about the proposal and answering questions at a meeting of the Rural District Council's Housing and Building Committee. This was held in June 1972 and there was a clear impression that our scheme was well received and was likely to be accepted (clearly a ladder in our childhood game).

Accordingly, we formally applied for planning permission on 3 July 1972. In accordance with the provisions of the Town and Country Planning Act 1962 in August 1972 the Rural District Council invited objections and representations to the building of the NSF (a snake here). In the same month discussions took place with the Daresbury Parish Council who at that time decided not to raise any objection in principle to the proposal, although there were detailed points about which Councillors were concerned (a small ladder). The invitation in the press for objections to be received triggered off a demand for public meetings in the parishes of Moore and Daresbury. It is always difficult to determine who fanned the flames or precisely what motivated the objectors. Daresbury is in the Mersey valley - hardly a tourist attraction - and some two miles from the Laboratory is a power station with eight large cooling towers and a chimney higher than Blackpool Tower (these public meetings turned out to be very large snakes in our game). The press started a hue and cry too (more snakes) and the illustration above gives some examples of the publicity we attracted.

Consequently, when the proposal was formally discussed by the Runcorn Rural District Council on 5 and 20 December 1972 it was resolved "that in view of strong local objection that this be referred to the County Council with an emphatic recommendation

that when the application is considered by the County Council a decision should only be made following a public inquiry" (yet another snake). On 18 January 1973 the application was discussed by the Cheshire County Council Development Sub-Committee and further discussed by them on 9 February 1973, when they visited the Laboratory, when it was decided to grant conditional planning permission in respect of the proposed development (a ladder here - hooray!). In accordance with the prescribed procedure the County Council forwarded our application to the Department of the Environment for the Minister's decision and in April he determined that there would be a public inquiry which was subsequently arranged for 10/12 July (another snake which took us virtually back to square one).

There was little first hand experience of public inquiries in the SRC but the obvious first step was to obtain the best possible counsel to represent us. Through the Treasury Solicitor, an eminent counsel, Mr Ian Glidewell QC, assisted by Mr Burke-Gaffney was instructed to act on behalf of the Science Research Council. Discussions followed between senior staff at Daresbury, counsel acting on our behalf and the Cheshire County Planning Authority who supported our application. It was judged that the following points were those which could cause special attention:

(a) The relationship of the proposed structure to the Daresbury Laboratory's present work, and to the work of other nuclear research centres; and in the light of that, the need for the NSF to be built at Daresbury.

(b) The future scale of operations envisaged for the Daresbury Laboratory; in particular, the possibility of the need for their expansion following the construction of the accelerator.

(c) The need for the structure to be built vertically above ground and to the height proposed.

(d) The proposed siting and design of the tower, and its likely visual impact on Daresbury and surrounding areas, particularly the countryside between Runcorn and Warrington.

Although we were fortunate to have a relatively modest delay between the decision to hold an inquiry and the dates chosen for it to be heard, this meant a great deal of devilling and preparation in a comparatively short time. We at Daresbury realised that no effort must be spared to produce evidence and exhibits for the inquiry as it is no exaggeration to say that the future of the Laboratory was at stake. It was already known that NINA would have a limited life. We obtained a good deal of help from the UKAEA and from neighbouring universities. The Trades Union Side and Staff Side were keen to help and they did so most effectively in presenting evidence at the inquiry.

The opposition to the application came primarily from three sources - the Runcorn Urban District Council and the Parish Councils of Daresbury and Moore. These two Parish Councils formed a local action committee although a suggestion that a representation at the inquiry should be paid for out of a rate to be levied ran into strong opposition. There were only twenty-one letters received objecting to the proposal, but as Lord Goodman said in the Richard Dimbleby Lecture "In England, we love appeals. We have decided that the right way to conduct any jurisprudential process is to have an infinite number of appeals on the basis that the last man appealed to must be the rightest man - so that the more appeals you have the righter you are likely to be".

The inquiry took three days and was conducted by Mr J B S Dahl assisted by Professor George Bishop who had been asked by the Department of the Environment to assist the Inspector with technical and scientific advice. With counsel acting on our behalf and also on behalf of the appellants, the inquiry took on a very formal and judicial tone - quite nerve-wracking for those called upon to give evidence - but we had prepared our ground very well and no effort was spared in the production of photographs, models and other relevant information. The inquiry concluded with the Inspector touring the area to obtain some impression of the impact of the proposed tower on the locality.

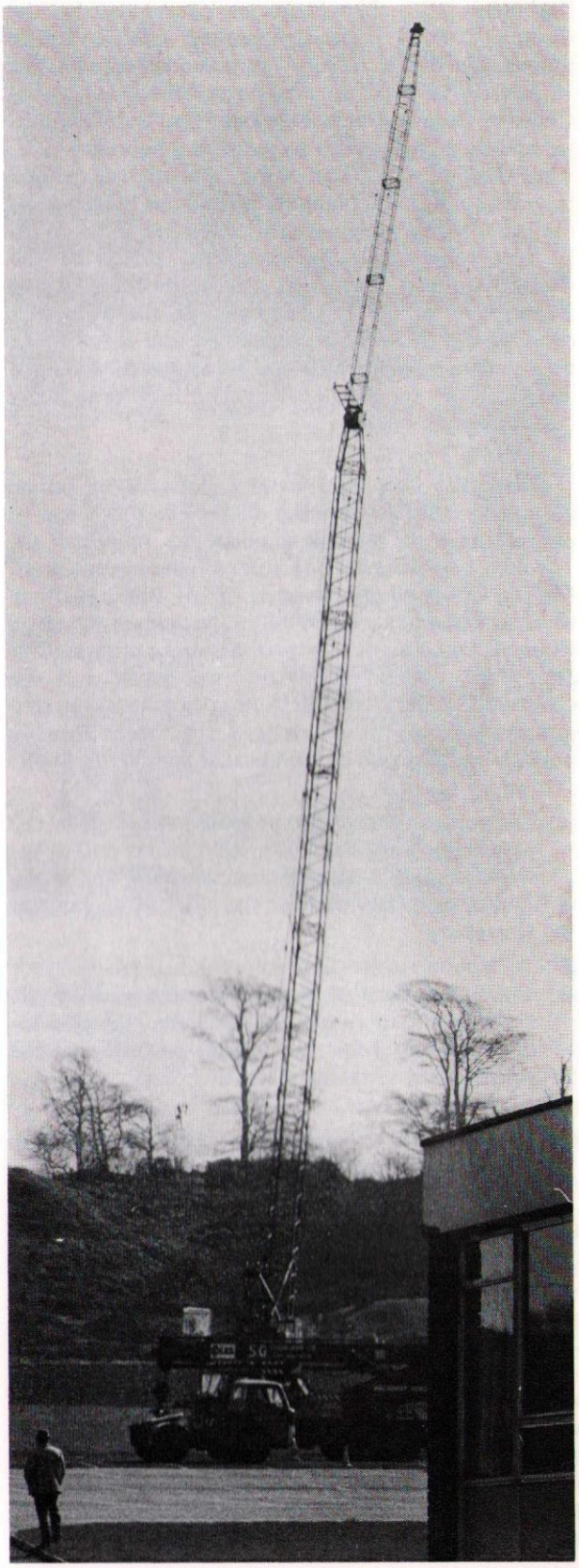
It was 19 December 1973 before we heard the result of the inquiry and as we all know this was found to be in our favour. In his conclusions the Inspector stated:

"The research and development of techniques has been pursued at Daresbury in order to break new ground in the design and construction of a static accelerator of far greater power than any in existence in order to develop a new tool to extend the depth of human knowledge of the basic structure of matter. To this end the Science Research Council, who have the duty to select projects which promise the most worthwhile return in the advancement of science, have adopted this proposal as their next principal project in this field. I therefore accept that the construction of this new facility has an importance in the international field of nuclear research. Because the construction and operation of the accelerator requires engineering

expertise, staff, computer and other supporting services I accept that its only practical location is either at Daresbury or Rutherford. Because of the proposed phasing out of NINA and because of Daresbury's location in relation to a number of universities in the north and west midlands where no static accelerator of the kind exists, I agree that the better of the two sites is Daresbury. I accept my assessor's advice that the solution to the technical problems posed by the design require the structure to be vertical, above ground and to the height proposed.

Given the exacting requirements of the apparatus, the design of the tower is along simple lines and the solution put forward is probably as good as it is possible to obtain within the very narrow design constraints. The countryside is almost entirely rural. To the north west lies the wide expanse of the Mersey Valley from which the tower will be seen from afar, partly against the background of the hill behind and in part against the sky. Whilst I would not consider the tower an asset to the landscape, it will provide a vertical feature which can be accepted in the wider view, a view which will become less rural as the industrial area of the new town develops. From Daresbury the height of the tower will appear much reduced but the top of the tower with the ion implantation room will appear very large in scale from some house windows and gardens and from a short length of Daresbury Lane. However the public viewpoints are very limited. On balance the provision of the accelerator must be regarded as of greatly more importance than limited damage done to the view by its erection". (The ladder which took us to the winning post).

Perhaps the nicest moment in the inquiry was when an architect of the County Planning Department who was supporting our application contended that the developments at Daresbury would counter the "brain drain" to the South. The examining Inspector interjected that the performance of witnesses at the inquiry did not support that there was any evidence of such a drain. Applause is not permitted on these occasions but there were distinct nods of approval from the Daresbury contingent.



Mr H Rothwell OBE joined the Daresbury Laboratory in 1964 as Laboratory Secretary. Previously he was technical secretary at the Dounreay Experimental Establishment of the UKAEA.

Council Commentary

December 1974 to February 1975

Forward Look 1976/7–1980/1

As the first part of the Council's 1975 Forward Look exercise, it noted at its February meeting the Policy and Programmes Reviews of the Nuclear Physics and Science Board respectively, which included their Forward Look bids for the period 1976/7–1980/81. Reviews from the ASR and Engineering Boards were considered at the March meeting and the Council's Forward Look will be finalised at the April Council meeting.

Regrouping of activities in the Atlas, Daresbury and Rutherford Laboratories

Council considered in February, Reports from the Computing Resources Panel and the High Energy Physics Panel concerning possible regrouping of activities at certain SRC Establishments. It decided that High Energy Physics will be concentrated at the Rutherford Laboratory and that there will be transferred to Daresbury a substantial part of the computing support for the Science Board which is at present the responsibility of the Atlas Laboratory. Council also agreed that the new interactive computing facility (see below) should be established at Chilton. The precise phasing of these operations and the detailed staffing implications remain to be determined but it is the aim that all these developments should be substantially complete by the end of 1978.

Information on SRC affairs

In order to give better public information on the work of the SRC Boards and Committees, the Council agreed that in addition to existing published SRC reports there should be available, for an initial experimental period of two years, an annual statement from each Committee making research grants. The Boards would also prepare for publication a review statement as and when appropriate.

Sub-Committee of the Select Committee on Science and Technology

The Council noted that a Science Sub-Committee has been established by the Select Committee on Science and Technology to enquire into the financing of scientific research in British universities, now under the chairmanship of Mr I Lloyd (MP Havant and Waterlooville). The Sub-Committee intends to concentrate initially on the financial situation of universities in the light of the cutback in UGC finances. Subsequently the Sub-Committee proposes to examine the dual support system coupled with a detailed examination of SRC and other Research Councils.

The Council has been invited to submit a memorandum to the Sub-Committee and formal evidence will be taken from the Council on 30 April. Council has asked Boards if there are any issues which they wish to bring to the notice of the Sub-Committee.

Energy Research Grants

Council has established an Energy Proposals Panel to examine research grant applications and to develop an overall policy for the Council's support of the energy policy field. On the recommendation of the Panel, Council has approved a grant up to £22K to Dr I Fells, Newcastle University, for study of total energy schemes and the public supply and a grant of up to £42K to Dr I Boustead, Dr P F Chapman, Professor C W A Newey and Professor M H Hussey, Open University, for the evaluation of physical resource implications of technical developments in the UK.

Science

(i) *Central Laser Facility*

In July 1974, Council approved in principle the establishment of a central facility for high powered laser research to be used by university research workers subject to the availability of funds. It was hoped that an SRC/UK Atomic Energy Authority collaborative programme might be developed. Council agreed that the Rutherford Laboratory should undertake a preliminary appraisal of the resources required for the project.

In December Council considered the Rutherford appraisal of the project and approved a joint SRC/UKAEA collaborative research programme for the development and use of high power lasers in a joint laser centre at Rutherford/AERE Harwell. The principal scientific objectives of the SRC part of the programme based on the Rutherford Laboratory would be (a) to create and study in the laboratory superdense plasma generated by the laser compression of matter (b) to study non-linear interactions of intense laser radiation with matter and (c) to develop more efficient new high power lasers for future experiments in laser compression and other fields. Capital expenditure of up to £1·9M (at November 1974 prices) on the

provision of the glass lasers, experimental equipment, an electron beam generator and the buildings required to set up the facility was approved by Council. Discussions are continuing on the collaborative programme but DES approval has been sought for the SRC part. Over 30 Council staff would be required for the project.

(ii) *Research Grants*

Council at its December meeting approved the following research grant recommendations from the Science Board:

(1) a grant not exceeding £235K to Dr R E Richards, Oxford University, for studies of structural mobility of enzyme groups and sub-units in catalysis. This grant will allow continued support for the Oxford Enzyme Group which had been established with SRC support five years ago;

(2) a supplementary grant not exceeding £45K to Professor A J Forty, Warwick University, in association with Professor A Ashmore, Director Daresbury Laboratory, for photoelectron spectroscopy of solids using synchrotron radiation.

Astronomy, Space and Radio

(i) *Research Grants*

Council approved a consolidated grant to Professor Sir Bernard Lovell, Manchester University, for radio astronomy of £160K for the calendar year 1975.

(ii) *Enhancement of Appleton Computer*

Council approved upgrading of the ICL 1904A computer at the Appleton Laboratory at a cost of £130·5K. This will allow the existing storage system EDS–8 to be replaced by a higher capacity system EDS-60 having lower operating costs. Also included is provision for a further backing store for the George 3 operating system.

(iii) *3·8m Infra-Red Flux Collector (IFRC)*

Council approved an increase of £310K to £1·53M for the 3·8m IFRC which will be built on Mauna Kea Hawaii. The increases have been caused by inflation and by more detailed costing of the project. DES approval to the increases has been obtained.

Nuclear Physics

(i) *EPIC*

Following its decision in November 1974, Council has approved a programme of preliminary work on EPIC for financial year 1975/76.

(ii) *Upgrading of Computer Facilities*

Council has approved upgrading of four of the tape drives of the IBM 370/195 at the Rutherford Laboratory at a cost of £60K. Council has also approved proposals to enhance the direct access storage facilities on the Daresbury 370/165 by purchase of a control unit and three disk drives at a cost not exceeding £54K.

(iii) *Upgrading of the Oxford Electrostatic Generators*

Council has approved proposals to convert the Oxford Electrostatic Generators into a folded tandem at a cost not exceeding £70K.

Engineering

(i) *Interactive Computing Facility*

The Report of a Working Group on Engineering Computing Requirements (Chairman Professor H H Rosenbrock) which had been endorsed by the Engineering Board was considered at Council's February meeting. The report said that facilities for interactive computing available to engineering faculties in universities and polytechnics were inadequate and proposed that the Council should establish a centre specialising in interactive computing for engineering based at an SRC Establishment. The centre in addition to operating a central facility for users via remote stations should provide a wider service in the development of applications software. Council warmly welcomed the Working Group's report, supported in principle its recommendations and agreed that the report should be discussed with the UGC and the Computer Board. It considered that the case for interactive facilities was broader than Engineering and that the proposed SRC centre should be regarded as a national facility. Council invited the Engineering Board to arrange preparation of detailed proposals.

(ii) *Research Grants*

Council approved a grant of up to £121K for an initial period of 3 years to Professor B L Clarkson, Southampton University, to allow the establishment of a unit to study industrial machinery noise. The unit, to be established within the Institute of Sound and Vibration Research, would be headed by Professor E J Richards. Council also approved a supplementary grant of up to £209K to Professor J H Westcott, Imperial College, London, for research on adaptive control of industrial processes.

Sir James Chadwick CH FRS

An appreciation by M J MOORE

The recent death in Cambridge at the age of 82 of Sir James Chadwick CH FRS was a sad loss to the scientific community.

In 1935 Sir James was awarded the Nobel Prize in Physics for the discovery of the neutron, and in the same year he was offered the Lyon-Jones Chair of Physics at Liverpool, a post which he accepted and filled with distinction until 1948 when he retired and returned to Cambridge to become Master of Caius College.

He resigned the Mastership in 1958 and went to live in North Wales for several years until he returned to Cambridge in 1969.

His self-effacing but dynamic leadership at Liverpool demonstrated one of his greater qualities. Staff and student alike worked with Chadwick—never for him. It was a unique partnership. Within a few years a new type of accelerator—a cyclotron—was designed, constructed and put into operation by July 1939. The total cost excluding salaries was £5,184, the largest single item being the 37 in diameter 50 ton electromagnet which cost £3,132. (My salary in 1938 was 250 guineas per annum and Gerry Pickavance and "George" Holt, both post graduate students at that time, received £120 each per annum from the D.S.I.R.)

At the outbreak of the war Chadwick was on holiday in Sweden and on his return to England in October he immediately started work on the physics of the "atom bomb". By this time some of the laboratory staff had departed to work on radar and other war time activities and as a result only a handful of workers remained.

This did not deter Chadwick and his team, and using the cyclotron as a source of neutrons they set out to establish the properties of the fission of uranium.

The years 1939–1943 were exciting and the laboratory became a sort of cross-roads for those working on the bomb project in other Universities such as Birmingham, Cambridge and Oxford.

In October 1941 H C Urey and G B Pegram for the US Atomic Energy Commission spent some time at Liverpool, and their report back on the work done by Chadwick's team and others contributed in no small way to changes in work then being carried out in the United States.

The separation of U235 by the gaseous diffusion method was strongly advocated by Simon of Oxford and Peierls of Birmingham and eventually two prototype models were built by Metropolitan Vickers and installed at Rhydymwyn, North Wales by ICI Limited under the supervision of C F Kearton.

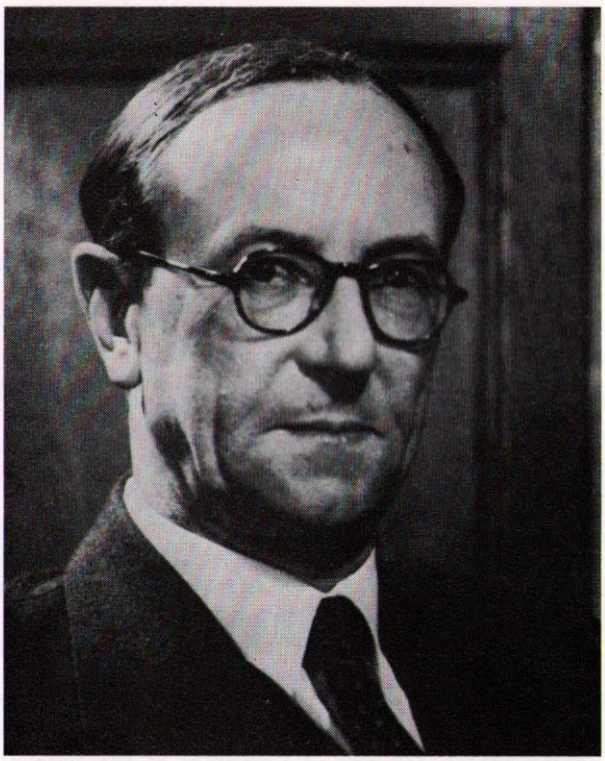
Chadwick and some of his staff were involved in the project and, in spite of delays, considerable work was carried out on various techniques; corrosion, lubrication, and of course membrane development which was crucial to the gaseous diffusion problem.

Chadwick made his first visit to the United States in the summer of 1943 and quickly established excellent relations with General L R Groves, who had been appointed by President Roosevelt to head the U.S. bomb project, the "Manhattan Project", as it was named.

Chadwick returned in September 1943 to Liverpool and was able to reveal the status of the work in the United States. He was in Liverpool at the time of Neils Bohr's flight from Sweden. Denmark was occupied by the Germans in 1940 and Bohr remained in Copenhagen where his Institute had been a haven for refugees from Fascist countries. By autumn 1943 Bohr and his family were in danger of arrest, but the Danish underground got him away by boat to Sweden. On 6th October, 1943, a Mosquito bomber, completely stripped of its armaments, landed in Sweden and Bohr was hastily packed into the bomb rack of the plane which took off at once for Scotland. Shortly afterwards Bohr came to Liverpool as Chadwick's guest and visited the Laboratory and was introduced to the handful of workers as Mr Baker. To the end of the "bomb" project no matter where one met Neils Bohr he was always referred to as Mr Nicholas Baker.

From the winter of 1943 Chadwick spent most of his time in the United States where as head of the British Mission, he had great demands made on him. He divided his time between Washington DC which could hardly be called a pleasant place in summer, and the Los Alamos Laboratory in New Mexico. His health was never too good and he suffered the after effects of four years internment at Ruhleben in Germany during the First World War.

By 1944 a British team was well distributed throughout the United States. His friendship with Groves was of the utmost importance and was reflected in the excellent relationship that existed between the British workers and their American colleagues. Chadwick



had arranged by the early part of 1944 for the majority of the workers at Liverpool, Birmingham, Cambridge and Oxford to be brought over to various American Laboratories and of course to Montreal where Cockcroft was in charge of the work.

The work in the United Kingdom was virtually closed down, and the British team supported the Manhattan Project in developing the device that was tested on July 16th, 1945, at Almagordo, New Mexico.

The devastation of Hiroshima and Nagasaki ended the war in the Far East and Chadwick and the British team returned home.

After the war Chadwick lost no time in starting to build up the department at Liverpool. The 37 in cyclotron was rebuilt with various improvements and new staff were engaged.

In the meantime a new principle of accelerating particles, the Synchrocyclotron, had been developed and Chadwick decided that such an accelerator should be built at Liverpool. By the time he returned to Cambridge, as Master of Caius College, his old college, funds were available from the DSIR and a building site procured.

The new machine was ready for use in 1954 and Liverpool, with its 400 MeV synchrocyclotron, had the most powerful accelerator in Europe.

What a contrast with 1939—the new accelerator cost £562,000 (excluding salaries), the 156 in diameter magnet weighed 1517 tons compared with the 50 ton 37 in diameter magnet of 1939. The new buildings, including the substantial shielding for the accelerator, cost £235,000.

After resigning from Caius College in 1958 he and his wife returned to Denbigh, North Wales. They loved Wales and enjoyed the fishing and meeting the old friends they had there, and were able to renew old established connections with Merseyside. Lady Chadwick came from a well known Liverpool family and Chadwick, the somewhat dour looking Mancunian, made many deep friendships. As much as anything, he wanted to be near to the Laboratory that he loved so much. Very near to his heart were the young men, the "boys" as he called them, with whom he had worked so happily in the past.

Chadwick took a great interest in the proposal to establish a new Laboratory in the North West and he was always eager to have the latest news on progress and problems.

He was invited to be Chairman of the Daresbury Advisory Committee in 1963, an invitation he was delighted to accept. The membership included Brian Flowers, Gerry Pickavance, Alec Merrison, Jim Cassels and Philip Dee with Harold Rothwell as secretary.

Daresbury were hosts on 20th October, 1966, when James Chadwick was seventy five. It was a rare occasion, with Chadwick at his best, His dry humour was perhaps not to everyone's liking, but those who were closely associated with him could penertrate that rather austere veneer and appreciate the real man.

At that luncheon party John Cockcroft presented Chadwick with a substantial volume containing messages of goodwill from all over the world.

He returned to Cambridge in 1969 to a peaceful life with his wife Aileen. It was a great pleasure for them to be near their twin daughters who had settled down in Cambridge and to be amongst close friends such as Lord McNair, a one time Vice-Chancellor of Liverpool University.

On the occasion of his eightieth birthday in 1971 he was guest of the Daresbury Laboratory and the University of Liverpool, at Liverpool. He had changed little over the years, tall, wiry and energetic; still with the same sideways glance, the same twinkle in his eyes, and the same ability to speak to the point with never a wasted word. His address on that evening was very moving—he knew he was among friends and this he valued highly.

No monument is needed to James Chadwick. The work he inspired stands as a continuing reminder of a great physicist and a fine teacher.

M J Moore, OBE JP, joined the Daresbury Laboratory in 1963 as Head of Engineering Division. Previously he was a Senior Lecturer in Physics at Liverpool University and Research Assistant to Sir James Chadwick.

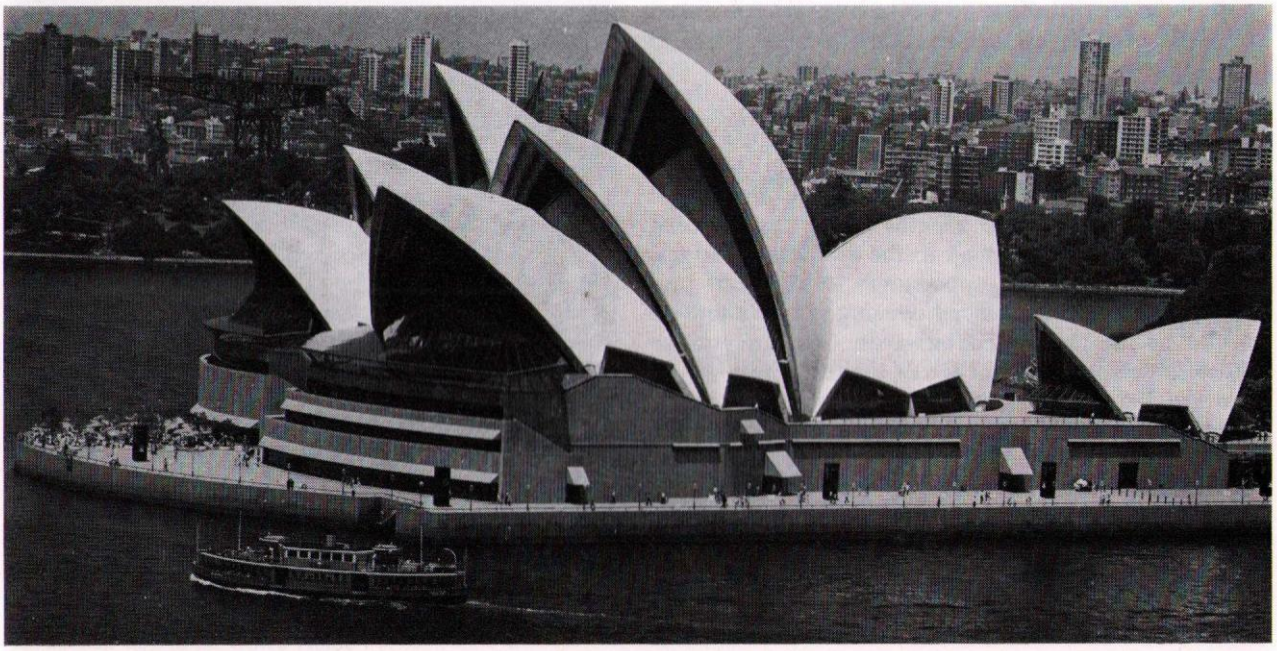
Eighth wonder of the world?

G TIDMARSH

White elephant or the eighth wonder of the world? Controversy has raged around the Sydney Opera House ever since architect Joern Utzon's design was selected in January 1957. The project has taken such a long time to complete, that it is just possible that a person, taken as a baby to see the design competition entries could have taken their own baby to see the Opera House opening on 20 October 1973!

The design is certainly impressive and though dwarfed by the harbour bridge, Sydney's other landmark, when viewed from most other angles it stands out against the background emphasizing the exciting architectural concept. The final version is not quite the same as that originally conceived by Utzon since for structural reasons, the shells or sails are in parallel rather than at random around a centre. The building shell proved difficult to construct, requiring new techniques in the use of concrete and support for the vast areas of glass. When the exterior was completed, fitting the planned, large, multi-purpose concert hall/opera and drama theatre inside the shell was the next problem and resulted in Utzon resigning from the project. The concept of the single auditorium was abandoned and the purpose-built stage machinery (purchased at a cost of over £500,000 from Britain) was abandoned to rust in a field. Instead, four main performing areas were fitted into the shell—a concert hall (2,700 seats), and opera theatre (1,530 seats), a drama theatre (500 seats) and a music room (420 seats). By international standards the audience capacities are on the small side but to some extent, seating capacity has been sacrificed for comfort as the seats are the most comfortable I have ever experienced and enough room is allowed between rows to minimise the inconvenience caused by late comers! The interior finishings display the contrasting colours and textures of various Australian woods, tinted glass and concrete, while the exteriors of the shells are covered with tiles showing an elegant pattern in close-up and, from a distance reflect a sheen rather than the dullness of bare concrete.

We were in Sydney for four weeks after completing a two-and-a-half year stay in Fiji. During that time, the first South Pacific Festival of Arts had taken place in Suva. My wife and I both became involved in the festival; she was secretary to the festival director and I operated the stage lighting at various venues during the fortnight of the festival. Out of this



event came an invitation to the festival director to present a South Pacific programme at the Sydney Opera House as part of the fortnight of celebrations for its opening by Her Majesty, The Queen. Invitations were issued to the various Governments to send groups from New Zealand (the winners of the national Maori competition); the Cooks Islands (national dance theatre group); the Solomon Islands (a group mainly made up of students from the teacher training college); Papua New Guinea (members of the PNG defence force and thus male only); and Fiji (the new Dance Theatre of Fiji, the Royal Fiji Police Band and the Banaban dancers who originally came from Ocean Island); and naturally Aboriginal dancers (from the Northern Territory of Queensland) made up the programme.

One of the festival dancers

These groups, totalling about 350 performers combined to give two performances at the Opera House only three days after the opening and gave two other combined performances in Sydney. The groups then divided into five smaller groups who each gave eight separate performances around Sydney and I was detailed to look after the Fiji and Banaban groups. After Sydney we took the groups from Australia, New Zealand, Papua and New Guinea and the Solomons to Canberra for two performances and then while they all returned home we went down to Melbourne for performances by the Cook Island national dance theatre and the Royal Fiji police band. Incidentally, while the world hears of labour disputes and strikes in Britain, labour problems elsewhere do not feature so prominently. While we were in Sydney, due to strikes, the airport was closed, the railway service was disrupted, power was restricted and no garbage was collected, and in Melbourne we had to cancel performances due to the power workers' strike!

Although the Opera House was officially opened by Her Majesty The Queen on 20 October 1973, as is customary the Opera House had been giving public performances for some months while the finishing touches were being applied to the fabric and fittings. We therefore took the opportunity to visit four performances before the official opening for we knew we would be far too busy afterwards. Our aim was to attend a performance in each of the four areas so we saw the Verdi Opera "Nabucco", which was magnificently staged with rich and vivid costumes which were matched by the scenery—our only criticisms were that the house management would not let us find our seats during the overture and that the famous tapestry curtains with the sun motif were not drawn across—due possibly to the strong criticism that had been levelled at them! For the performance in the concert hall we listened to the Moscow Chamber Orchestra and we were impressed with their playing and not least with the precision with which each violin bow movement was in conformity with its fellows. The acoustics, from where we sat at least, were excellent with even the quietest notes clearly audible. The drama theatre was to me the least satisfactory with a performance of Shakespeare's Richard II marred by the staging limitations caused by the wide, low proscenium arch so that for example, Richard's speech from the castle battlements meant that he stood on a level with a stage light that shone brightly at the audience. The final curtain calls were a little bizarre with the technical refinements of the stage with its counter-rotating turntables employed like two merry-go-rounds. Finally, the music room (much like the Purcell Room on the South Bank) provided a suitable venue to display the virtuosity of the Bartok Quartet. The main event was, of course, the opening itself and as swarms of workmen busied themselves with laying large pavement slabs, cleaning all possible surfaces and putting up all the trappings essential to such an affair, we were aware of the excitement and sense of achievement which was felt by those involved and by the people of Sydney who now had a monument of which to boast.

The Opera House is built on a spit of land called Bennelong Point which is the site of the first building constructed for Aboriginees by the European settlers at the close of the eighteenth century, and Bennelong himself was a noted Aboriginee with a long and intimate association with the settlers at that time. The association of Aboriginals with the site, so difficult to get to now amidst the concrete jungle while most of the remaining Aboriginals have retreated Northwards,

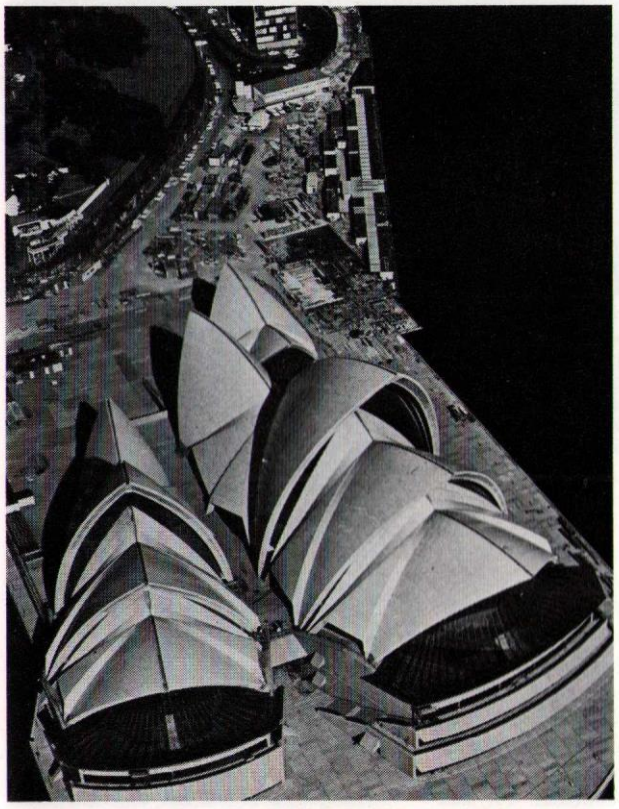
was commemorated by a speech given from the top of the highest shelf by an Aboriginal actor representing the spirit of Bennelong—"Here my people danced and sang, portraying their customs and legends.....".

After a dull and damp week, Saturday 20 October was fine but with a strong wind. Each of our Pacific groups, said that it was due to their particular spirits that it was fine and sunny but none of them took responsibility for the wind! The opening itself was arranged by the New South Wales Government not by the National Government in Canberra, so that the Australian Prime Minister sat among the guests and the Premier of New South Wales sat on the dais with the Queen.

During the morning the crowds gathered and then the guests took their seats on the steps leading up to the Opera House (specially padded for the occasion!). The military bands played and led in two colourful processions. These were the Pacific Islanders in costume and what was called the National Folkloric Group, representing the many European nations that now make up the Australian people from Armenians to Ukrainians each in their national costume. Then, as the groups settled down in their seats at the side of the dais, a fanfare of trumpets heralded the Queen. The official party took their seats on the windswept dais and heard the speech by the "Spirit of Bennelong" before the speeches of the Premier of New South Wales and the Queen. Her Majesty had momentary difficulty in controlling her hat and the papers of her speech which were threatened by a gust of wind.

As her speech ended, a flypast by the Royal Australian Airforce heralded the inspection of the interior of the Opera House where among the many sights she was shown the unusual mural specially designed by John Olsen who said on television "I like to feel that having studied my mural no-one can look at Sydney Harbour in the same way again." When the royal party were inside, guests outside were entertained by the Maori and Cook Island groups.

Meanwhile, out in the harbour, the crowds of boats ranging from the aircraft carrier and other ships from the Australian and other navies down to the smaller private fishing boats waited to play their part in "launching" the Opera House. As the royal party emerged into the open, balloons were released and the boats pulled on symbolic streamers to "tow" the Opera House into the harbour. The design inspired by the sails of yachts demanded to be represented by a nautical aspect. Then, just as a cloud of pigeons released at the same time as the balloons, was swept rapidly down wind, so the crowds swiftly dispersed leaving the Opera House officially open and waiting for the seal of the royal concert and the fireworks display scheduled for the cool, clear evening.



An unusual view of the Opera House

Graham Tidmarsh is currently in the Accounts Section at London Office. In order to gain experience he was seconded to the Fiji Government as a Senior Organisation and Methods Officer from 1971 to 1973. As a result of his spare time theatrical activities in Fiji, he was invited to help in Sydney with the Pacific Island and Folkloric performances at the Opera House opening and Waratah festival.

Newsfront

Daresbury study weekend

A Daresbury Study Weekend on "Three Particle Phase Shift Analysis and Meson Resonance Production" took place at the Laboratory over the weekend of 1st and 2nd February. Delegates, both expert and layman, attended from laboratories throughout Europe. Sessions revolved around talks given by both experimentalists and theoreticians, and, despite the subject's reputed technicality, much excitement, enthusiasm and interest seems to have been generated.

Accounts were given of the original pioneering work in the US and the alarming implications it had for meson spectroscopy. These were followed by discussions of both the theoretical doubts of such approaches, and the methods and techniques now being employed in experimental analysis.

Much motivation for the immense experimental effort required in such analyses was provided by the exciting ideas and, perhaps forlorn, expectations of many theoreticians! It was clear that much would be learnt from results of such analyses when applied to the immense amounts of data emerging from large multiparticle spectrometers. Good examples of such systems are the LAMP 2 apparatus now at Daresbury and the $\bar{\Omega}$ spectrometers at CERN.

Our thanks to J Dainton who contributed this item.

The Daresbury Chess team are proud holders of the Warrington & District's First Division Championship for the 1973–74 Season. Pictured from left to right are: (front row) John Bailey, John Storrow (Captain) and Cliff Evans, and back row: Ian Barker, Brian Trickett, Graham Winbow and Trevor Daniels. The top players in the team have a grade near 180 on the English Grading Scale, with John Bailey the strongest player currently rated at 186.

New Year Honours

Our congratulations to Dr I Maddock FRS and Professor H Ford FRS who were made Knight Bachelor; Professor P T Matthews who received the CBE; Mr J F Hayes who received an OBE; Mr P M Telling who was awarded an MBE and Mrs E M Marples who was awarded the BEM.

Dr I Maddock FRS is a member of Council.

Professor H Ford FRS is a former member of Council and former Chairman of the Engineering Board.

Professor P T Mathews is a former member of Council and former Chairman of the Nuclear Physics Board.

Mr Hayes is a Principal at London Office.

Mr P M Telling is a Professional and Technology Officer 1 at the Rutherford Laboratory.

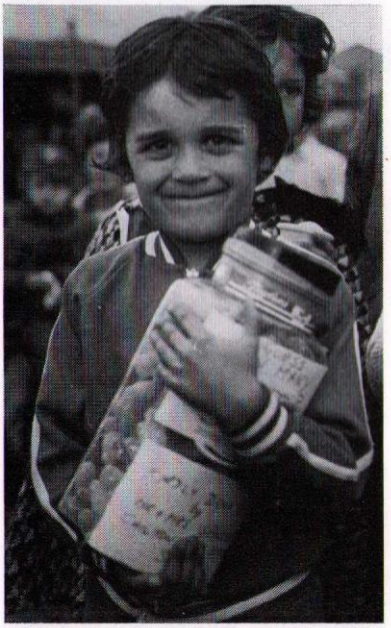
Mrs E M Marples is the Canteen Manageress at the Royal Greenwich Observatory.

Village life in Chilton

Chilton is a small downland village, containing the remains of at least one ancient road, the Bargeway, leading up to the better known Ridgeway along the crest of the Downs. In the closely knit old village all the inhabitants knew one another. Their religious needs were served by 'All Saints' Church at one end of the Main Street while some of their more secular needs were catered for by the 'Rose and Crown' at the other end, with in between the communal pump on the village green in the shade of the old sycamore tree.

When AERE came to the area all of this began to change, mains water came to the village and the pump on the green fell into disuse. New faces were seen in the village, they worked at AERE and sent their children to the village school, which rapildy became over-crowded, resulting in the building of a fine new school. The older inhabitants had earned their living by agriculture, but the newer ones knew nothing of pig farming, racehorse training or the more recently set up orchid growing.

Village children dancing round the Maypole



Winner of the "Guess-how-many sweets-in-the-jar competition."

When the SRC establishments came, the village expanded still further and with the development of several new housing estates, the old inhabitants found that they hardly knew anyone they passed in the Main Street. Many of these new inhabitants were far from their families, and came from the town rather than the country and so were not used to the more gregarious 'village' atmosphere. A few of the 'old' and 'new' residents, who daringly spoke to one another, formed the 'Chilton Association' to raise funds to promote village activities to try to hasten the process of integration of the new residents in the old village. This years officers include two SRC employees, K R Paler of Rutherford Laboratory (Chairman) and K M Crennell of Atlas Laboratory (Treasurer). The summer's fund raising activity was the 'Chilton Fete', which was held on Saturday 13 July. During glorious weather in early summer we planned a traditional Fete with a brass band, maypole dancing, a fancy dress competition, traction engines to marvel at, and many stalls where you could try your skill, such as bowling (first prize a ham).

After weeks of dry weather, dawn on the 13 July was grey and damp, and rain hampered the setting up of the marquee; just as the committee members were beginning to wonder how they would pay for the band and the prize ham, ten minutes before opening time at 2.30 pm the rain mercifully stopped. We rushed to get chairs for the band and everything rearranged, and the crowd started trickling in. There was a nasty moment when the steam roller almost stuck in the mud of the gateway, but otherwise there were no major disasters. We didn't make the hoped-for profit to provide funds for Christmas parties for the old age pensioners and the children, but we did succeed in getting a lot of the villagers to talk to each other. The noise during the tug-of-war was positively deafening!

K. M. Crennell

An honourable retirement

On Monday, 17 February 1975, a 26 ton load left the Laboratory en route to Edinburgh. Under the tarpaulin was a unique piece of physics apparatus, the 1·5 metre British National Hydrogen Bubble Chamber which has been given to the Royal Scottish Museum by the Science Research Council. The gift consists of the bubble chamber, in which a perspex target has been installed, large vacuum tank, valve box and associated pipe work. The magnet, some 300 tons, will be used for the Rutherford Mass Spectrometer (π 13 experiment) and the generators (four-1 MW sets used to supply the magnet) are now to be used to power another large magnet, the rapid cycling vertex detector.

The bubble chamber project originated back in May 1957 when a meeting of physicists from several institutions was convened in London by Professor C C Butler to consider the desirability of constructing a large hydrogen/deuterium bubble chamber for use at CERN with the 25 GeV proton synchrotron and later, at the Rutherford Laboratory with Nimrod. As a result a working party consisting of members of the physics departments at Birmingham University, Imperial College, Liverpool University, Oxford University and Rutherford Laboratory staff was formed to prepare basic designs. By 1961 a construction team, led by Wyn Evans, was assembled at the Rutherford Laboratory.

The project was completed and tested by early 1963, then dismantled and moved to CERN where it was reassembled. During its stay at CERN some 1·5 million physics pictures were taken. It returned to the Lab, and following modifications, was scheduled for data taking at the beginning of 1968. During the following 2½ years about 2·5 million pictures were taken.

During this period a collaboration programme with CERN was concerned with the development of what was to become a unique feature of the 1·5 metre chamber. This was the Track Sensitive Target (TST) which came into operation in 1971 and was the first in the world to carry out a full physics programme using the new technique of a hydrogen target operating in a neon/hydrogen mixture. From then until its closure in November 1973 it produced 2·7 million pictures and remained unique in its Track Sensitive Target operating capability. It seems very appropriate indeed that its final resting place should be the Royal Scottish Museum, Edinburgh, in a road called 'Chamber Street'.

A watery departure

Coffee break

Coffee break

Since September, staff at the Rutherford Laboratory have been able to enjoy genuine espresso coffee in the new lounge. This is open for six hours each day for all members of the Lab. It has been provided for staff to discuss work with colleagues or visitors over a cup of coffee away from the distractions of the office.

Extract from the Minutes of the Dispersal Committee?

When we mean to build, we first
survey the plot then draw the
model;
And when we see the figures of the
house,
Then must we rate the cost of the
erection;
Which, if we find outweighs
ability,
What do we then but draw anew
the model
In fewer offices, or at least desist
To build at all?

Shakespeare
King Henry IV Part II Act i
Scene iii.

Superconducting magnet for use with PT55 Polarised Target

Tests on the superconducting magnet coils for the PT55 Polarised Target have been completed successfully at the Rutherford Laboratory.

The magnet is specified to give a central field of 2·5 T with a homogeneity of $\pm$ 2 parts in 10^4 over a region 30 mm diameter and 50 mm long occupied by the target itself and to maintain a magnetic field stability of 2 parts in 10^5 over a period of eight hours.

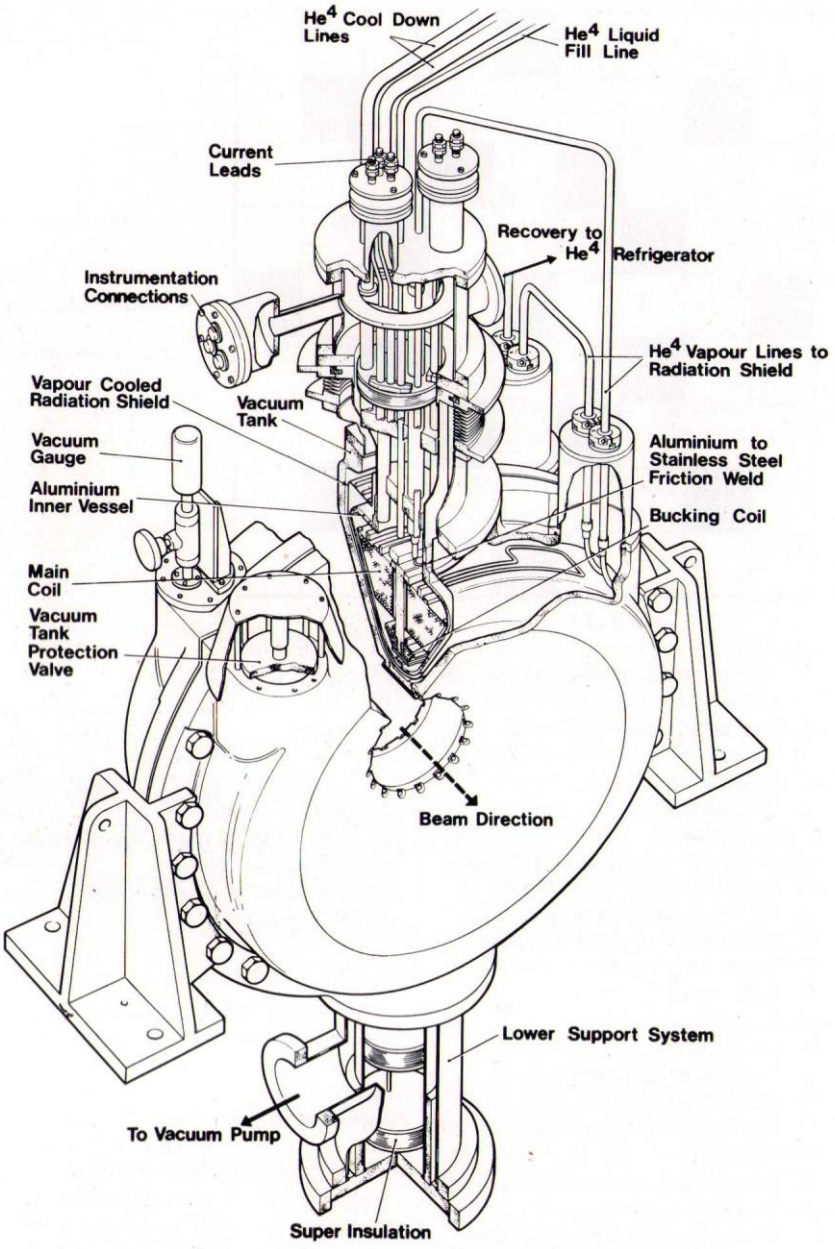
The magnet consists of two pairs of superconducting solenoid coils positioned about a horizontal axis such that there is clear access from the target position over an exit cone of 60° semi-angle to allow secondary particle detection. This special access requirement, much larger than normally used in polarised target experiments, raises difficulties for the magnet designer. To obtain the required field homogeneity it is necessary to employ a pair of main coils with a pair of smaller diameter coils inside them powered to oppose the main field. This in turn means that although the central field produced by the system of coils is only 2·5 T, the peak field seen by the superconductor is 5·6 T.

The interactive graphics computer program GFUN was used to optimise the coil sizes and configuration for acceptable values of field homogeneity, peak field and peak stress.

The coils are constructed from Nb. Ti. superconducting wire of 1 mm diameter comprising 361 twisted filaments of 0·03 mm diameter. Over 13 km are used in the winding which was carried out in the laboratory. The completed coils are individually potted and are easily the largest diameter coils to be handled in the Resin Laboratory to date.

A special power supply was developed by the laboratory to power the assembly and give adjustable current setting for each coil.

For the tests the coil system was mounted in a vertical cryostat. During the test, magnetic field homogeneity measurements were made at 1·5 Tesla and 2·5 Tesla central field and with minor adjustments in the bucking coil currents, the specification of $\pm$ 2 parts in 10^4 over the target volume was easily achieved.



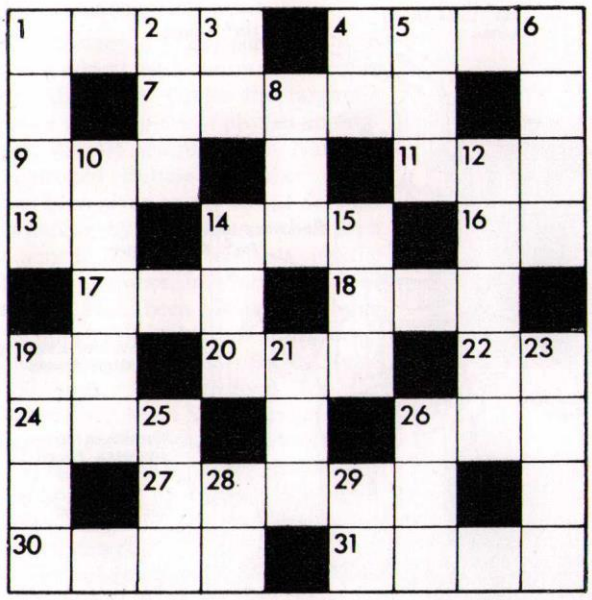
SUPERCONDUCTING MAGNET FOR USE WITH PT55 POLARISED TARGET

During the tests the magnet reached 2·62 Tesla without quenching. This is equivalent to 105% of the operating current (103 amperes).

These tests were carried out at a helium bath temperature of 4·2K. To simulate the actual operating conditions, where a closed circuit refrigeration system will be used, the liquid helium temperature was raised to 4·45K by pressurising the cryostat. The coils were run up again to 2·62 Tesla and held at this field for 30 minutes.

The coils will now be assembled into the specially designed magnet cryostat, coupled to the CTI 1400 refrigerator and given a final test with the target assembly.

Engineering Science and Applied Physics Division carried out the project with support from, in particular, R9 Workshop and the Outside Manufacturing Group.



NUTCRACKER 17

ACROSS

1. Three down multiplied by 16 across.
4. One across minus 9 across.
7. Twenty-nine down multiplied by 6 down.
9. See 4 across.
11. See 2 down.
13. Fourteen down minus 18 across.
14. See 19 down.
16. Six less than 19 across.
17. Thirteen across plus 26 across.
18. Twice 16 across.
19. Four times 29 down.
20. See 12 down.
22. See 30 across.
24. Three times 3 down.
26. See 1 down.
27. Eighteen across multiplied by 20 across.
30. Twenty-two across multiplied by 28 down.
31. Nineteen down plus 17 across.

DOWN

1. Twenty-nine down multiplied by 26 across.
2. Three times 11 across.
3. See 1 across.
4. See 19 down.
5. Same as 11 across.
6. Twenty-nine multiplied by 14 down.
8. Nine across plus 16 across.
10. Eight thousand more than the sum of 27 across and 25 down.
12. Twenty-four across multiplied by 20 across.
14. See 6 down.
15. Seven times 29 down.
19. Four down multiplied by 14 across.
21. Five times 13 across.
23. Eight down plus 17 across.
25. See 10 down.
26. One hundred more than 13 across plus 16 across.
28. One quarter of 20 across.
29. See 19 across.

The prize will be awarded to the first correct entry drawn. Please state whether you would prefer a book or record token. The solution will appear in the next issue.

Inter-Establishment Golf Tourney

The 1975 Inter-Establishment Golf Tourney will be held at Wrexham Golf Club, Wrexham, North Wales on Friday 13 June. The Rutherford Laboratory hopes to enter two teams each of 6 players to compete for the "Brian Flowers Trophy" which last year was stolen from us by Daresbury. The entry fee will be £4 per player. Further details from John Jenkins (R20) Rutherford Lab.

Satellite control

A one day Colloquim entitled "Some Aspects of Satellite Control and Data Processing" was held at the Culham Lecture Theatre on February 25. About one hundred people attended, including representatives from all the SRC Laboratories. The majority of the papers presented were concerned with Ariel–5, but there were also papers about Ariel–4, Copernicus, TD–1, Miranda, and the Ninbus series of satellites.

In his address, Mr Dalziel described the growing complexity of satellite data handling, and the increasing role played by the Appleton Laboratory in this type of work.

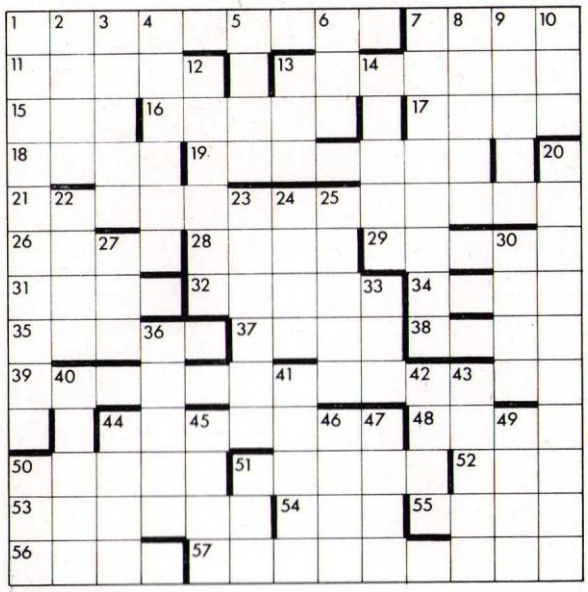
Prof Roderick Redman

As we go to press, we learn regretfully of the death of Prof R O Redman, FRS a former member of the Astronomy, Space and Radio Board. He played a leading role in the Council's work, most recently in the building of the magnificent Anglo Australian Telescope. A fuller appreciation will appear in the next issue.

Solution to Maxim 7

The theme word used was '*Boards*' and the variations were the titles of SRC's four boards. L Martin, Appleton Lab wins a £2 record token.

D	E	L	I	B	E	S	S	P	L	A	S	H
A	L	A	N	O	L	E	I	H	U	M	P	S
L	E	T	D	A	I	N	T	Y	T	E	A	T
E	C	O	U	R	A	G	E	S	I	N	C	E
K	T	M	S	D	N	I	S	I	L	D	E	A
A	R	I	E	S	T	N	U	C	L	E	A	R
S	I	C	X	I	I	E	S	S	E	I	N	N
S	C	I	E	N	C	E	I	P	R	O	D	S
I	C	H	M	T	A	R	N	I	D	N	R	M
S	H	A	P	E	N	I	G	E	R	I	A	A
T	A	S	T	R	O	N	O	M	Y	A	D	D
S	I	T	I	N	D	G	V	A	A	N	I	L
G	R	E	A	S	E	S	A	N	D	B	O	Y



MAXIM 8

MAXIM 8

The unclued answers (marked *), when arranged in suitable order, will be seen to be the first six members of an appropriate group.

Clues

ACROSS

1. *
7. Fuss about after the end of music —the very end! (4)
11. What one's ardour did when one was in matrimonial state? (5)
13. Twitch during seizure in decrepit theatre (4–3)
15. Time to reverse European measure (3)
16. Five, with one soldier, left guard duty (5)
17. Take something from fridge—it needs boiling before eating (4)
18. *
19. *
21. Concerning source of big bang, uncle and mother are almost frenzied (13)
26. Gold in ye olden dayes (4)
28. Star makes come-back at Stratford (4)
29. Rhythms seen in the *Times of Italy* (5)
31. *
32. One leaves the shed, one of 29 (5)
34. The top brass back a parasitic opportunist (4)
35. I'm set, composing what's on the agenda (5)
37. Having lost heart, restrain (4)
38. It's only connected with Dover (4)
39. Domestic appliance creates space daily (6,7)
44. Is an essential product of N.E. shire (7)
48. Most well-built, but lacking, that is St Ives (4)
50. The pivot of faith in Germany (5)
51. Father and friend describe some former states (5)
52. Poem spoilt by female of two species (3)
53. These could be the characters or cast in a play (6)
54. Rock that's large whichever way you approach it (3)
55. Else they might be caught (4)
56. A type of open peasant community unit (4)
57. Swears vulgarly after CID men's talks (9)

DOWN

1. *
2. Worth a risk to unmask the spy (4)
3. Daft in one way (5)
4. Press accelerator before worship (6)
5. Bear turns round—I go to Yugoslavian capital (4)
6. Briefly, I promise to be sick (3)
7. Motor towards London from Swindon, without the sort of driving that's illegal (8)
8. Think of it! To yearn after love! (5)
9. I'd act out authoritative statements (5)
10. Consumed by meat-eaters (3)
12. I'm sad, upset, and left in the same condition (6)
13. If back by ten, make permanent (3)
14. Put up a ruin in Crete (5)
20. Having no-one at the wheel, but in gear, upset liver (10)
22. Noise made by two ducks in dangerous sort of cable? (4)
23. Roughly remove my boss's position in the organisation (4, 2)
24. 1 below n (where n = 1) (4)
25. U.N.I.T. in disarray—what's Lethbridge-Stewart's no 1 up to? (5)
27. Feel regret for the French way (3)
30. There's plenty of this on the carpet (4)
33. *
36. Park in which you'll see animal rise in a tick (5)
40. I accompanied boy to palace and Arab to church (5)
41. We're stony but sharp, we've a lot of the stuff that precedes riches (5)
42. Clever, though we hear he got done in very early on (4)
43. One is out of undies, upset. These are presumably not! (5)
44. Preposition wrongly placed at end of conjunction (4)
45. Experienced aurally is experienced aurally. What a lot of bull! (4)
46. Big project initiates extraordinary procrastination in Council (4)
47. Sort of a sub-continental animal minder (4)
49. A lot of eggs, about a pound, have a part to play (4)
50. Fortune, if read on seaside jetty, is luckier (3)
51. Symbol that is soft is bent (3)

The prize will be awarded to the first correct entry drawn. Please state whether you would prefer a book or record token. The solution will appear in the next issue.