THE NATIONAL INSTITUTE
FOR RESEARCH IN NUCLEAR SCIENCE

THIRD ANNUAL REPORT

1959-1960

RUTHERFORD HIGH ENERGY LABORATORY
HARWELL, DIDCOT, BERKSHIRE

THE NATIONAL INSTITUTE
FOR RESEARCH IN NUCLEAR SCIENCE

Third Annual Report

for the period 1st April, 1959
to 31st March, 1960

Presented to the United Kingdom Atomic Energy Authority
in pursuance of Article 13 of the Institute's Royal Charter

RUTHERFORD HIGH ENERGY LABORATORY
HARWELL, DIDCOT, BERKSHIRE

Sir,

I have the honour to submit in accordance with Article 13 of the Institute's Royal Charter, the Third Annual Report of the National Institute for Research in Nuclear Science. This Report covers the period from 1st April, 1959, to 31st March, 1960.

I have the honour to be, Sir,

Your obedient Servant,

Bridges

Chairman, National Institute for Research in Nuclear Science.

Chairman,
United Kingdom Atomic Energy Authority,
11 Charles II Street,
LONDON, S.W.1.

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THE NATIONAL INSTITUTE FOR RESEARCH IN NUCLEAR SCIENCE

THIRD ANNUAL REPORT

for the year ending 31st March, 1960

INTRODUCTION

1. At the end of the first three years of the Institute's existence, some changes were made in membership. Professor J. Diamond retired and was succeeded as a university member by Sir John Cockcroft. Sir William Penney took Sir John Cockcroft's place as an Atomic Energy Authority Member and Sir Alan Hitchman that of Sir Donald Perrott. Both the University Grants Committee members changed, Sir Keith Murray and Professor F. W. R. Brambell joining in place of Sir George Thomson and Mr. J. C. Gridley. The remaining members have been reappointed. The membership is given in Appendix II.

2. Much of the work of the Institute is carried out through the following committees:—

(a) The General Purposes Committee which has the responsibility of approving and controlling Institute expenditure.
(b) The Physics Committee consisting of specialists advising the Board on matters relating to new physics projects.
(c) The Visiting Committee consisting of representative users of the Rutherford High Energy Laboratory and advising the Director of the Laboratory in matters relating to the Laboratory's administration and programme of scientific research.
(d) The Personnel Committee concerned with matters relating to employment of staff.
(e) The Research Reactor Committee concerned with the provision of research reactor facilities for universities.

The memberships of these committees are given in Appendix III.

One important change made during the year was the considerable enlargement of the Physics Committee so that it now has the same membership as a consultative panel for nuclear research advising not only the Institute but also the Department of Scientific and Industrial Research.

THE RUTHERFORD HIGH ENERGY LABORATORY

3. The site of the Rutherford High Energy Laboratory, which is still the Institute's only laboratory, was transferred to the ownership of the Institute from the United Kingdom Atomic Energy Authority at the beginning of the year. The area of the site is just over 65 acres. Two particle accelerators are under construction at the Laboratory. The first, a 50 MeV proton linear accelerator gave its first beam of protons at full energy in July and by the end of the year was virtually completed and ready for experiments. The second accelerator is the 7,000 MeV proton synchrotron 'Nimrod' and is not due for completion until 1962. Progress on both these accelerators is described in more detail later in this report.

4. Apart from construction of the accelerators themselves, good progress has been made in developing the Laboratory generally and several new buildings and modifications to existing ones have been completed. The most notable is a large three-storey laboratory and office block, having several large, well-equipped physics laboratories on the ground floor and with office accommodation on the floors above, together with a small library and conference room.

5. A start has been made in setting up the nucleus of an administrative organisation for the Laboratory. As an example, financial control of Institute expenditure is now carried out at the Laboratory. Generally, however, the various branches of administration essential to the running of a Laboratory (e.g., personnel, contracts, accounts, general administration, stores, transport, medical, technical services, etc.) were still being carried out by the various Administration sections of the A.E.R.E. as a service to the Institute, although plans for taking over many of these services are being developed.

ASSISTANCE TO UNIVERSITIES

6. In the past the Research Group of the Atomic Energy Authority have provided considerable assistance to universities in the design of their accelerators. It has now been agreed that the Institute should take over this responsibility. The first request for such assistance came towards the end of the year from Oxford University where proposals have been made for building a large 20 MeV electrostatic accelerator. This machine will be in two stages, a horizontal tandem Van de Graff accelerator preceded by a vertical single Van de Graff acting as injector and it is chiefly for the design of the latter that assistance has been requested. The Institute have agreed to this request, subject to the main project being approved. The assistance will be provided by a team of accelerator physicists who have specialised in the design of this type of machine, supported by engineering design staff.

7. It is the policy of the Institute to encourage universities to undertake programmes of research with the object of developing new or improved techniques and equipment which will increase the value of the Rutherford Laboratory accelerators as research tools. Several agreements have been negotiated during the year with various universities under which the Institute bear the costs of approved research projects of this kind. Among the projects being supported is one at Manchester University for the study of factors involved in the production of intense beams of secondary nuclear particles (mesons) required for many experiments. The investigation is also concerned with the types of experiment in high-energy physics for which such particle beams will be suitable. In view of the diversity of the factors involved, the investigation ranges from problems in theoretical high-energy physics to those in accelerator technology.

8. Another programme of research sponsored by the Institute is being carried out at Imperial College, London. This is for the development of a new technique for detecting the tracks of nuclear particles in a device known as a scintillation chamber. A particle in its passage through the special material contained in the chamber produces minute flashes of light or scintillations which if amplified by appropriate optical and photo-electric devices can be revealed as a visible image of the track of the particle.

9. The policy of the Institute with regard to the financing of experiments at the Rutherford Laboratory is, broadly, that the Institute should bear the whole cost with the exception of the salaries of those members of the visiting teams from universities who are graduate research staff. Since in many cases preparatory work, e.g. construction of apparatus, must first be carried out at the home laboratory, the Institute have decided to cover the cost of this by entering into agreements with the universities under which the cost of equipment, services, technicians' wages, travelling expenses, etc. incurred by the university is refunded by the Institute. Several such agreements were negotiated during the year with universities and colleges where teams were currently preparing experiments on the proton linear accelerator. These include Birmingham University, Oxford University and King's College and University College, London.

10. An international conference on high energy physics was held at Kiev, U.S.S.R. in July, 1959. Approximately 20 scientists from the United Kingdom were invited and the cost of their travel and subsistence was shared between the Royal Society and the Institute.

STAFF

11. The first staff to be recruited directly by the Institute have been appointed. They are three nuclear physicists, who have joined the resident nuclear physics team to carry out research on the Institute's accelerators. As it is not the policy of the Institute to employ research scientists on a permanent basis (with very few exceptions), these appointments are for five years only. Two of the men have gone to work on the large accelerators at Berkeley and Brookhaven in the U.S.A. for periods of about a year, in order to acquire experience for use with Nimrod.

12. Certain changes were foreshadowed in the last report concerning the staffing of the Rutherford Laboratory. Briefly, it was suggested that the Laboratory might be run by the Institute's own staff rather than by A.E.A. staff seconded to the Institute for this purpose as was originally envisaged. This change in policy has now been confirmed. Once Nimrod is completed (which is an A.E.A. commitment) the Institute will have the responsibility of providing staff to operate, maintain and develop the Laboratory accelerators, also to design and operate nuclear equipment for use with the accelerators and provide the usual technical and administrative services essential for a laboratory of this kind. It is expected that many of the scientific and engineering staff required for this purpose will be those A.E.A. staff now employed in the design and construction of Nimrod, who will be invited to accept Institute employment. To facilitate such transfers and to avoid separate negotiations on pay scales, etc., it has been decided to adopt the same gradings, pay scales and conditions of service generally as exist in the A.E.A.

13. Until such time as it is found possible to recruit staff directly into the Institute on a permanent basis, an arrangement was agreed with the A.E.R.E. whereby staff required by the Institute would be recruited and employed in the first instance by the A.E.A., but on the understanding that they would eventually be required to transfer to Institute employment. This temporary expedient has been used on several occasions during the year to recruit staff urgently required

by the Institute. In addition, a small number of staff have been seconded to the Institute from the A.E.R.E. on a personal basis. Some of these were required for administrative duties in the secretariat and the remainder are members of the Proton Linear Accelerator Group.

14. One requirement before permanent staff could be employed was to devise an effective superannuation scheme. For the reasons outlined earlier a scheme similar to that of the A.E.A. was considered desirable, and a request was made to the A.E.A. that Institute staff (other than research staff employed for fixed terms who join the F.S.S.U. scheme) should be included in their superannuation scheme. The Authority have agreed to do this at least for the time being, having obtained the necessary statutory power.

15. The first two consultants have been appointed to the Institute. Both are theoretical physicists and senior members of their university departments. They are called on to advise the Director of the Rutherford High Energy Laboratory and his senior staff in matters falling within their respective fields of specialisation.

HOUSING AND HOSTEL

16. Owing to the rural situation of the Rutherford Laboratory and the shortage of houses in the area, the Institute are obliged to provide a considerable number of houses if the necessary staff are to be recruited. As a first step it is proposed to build 48 three-bedroomed houses in Abingdon (seven miles from Harwell). Meanwhile, the Director, A.E.R.E., has kindly agreed to provide on a temporary basis a small allocation of Authority houses for new Institute staff and visitors and some of these were in occupation by the end of the year.

17. Modifications to Coseners House, the Thames-side hostel in Abingdon recently acquired by the Institute, have been completed and at the end of the year the building was almost ready for occupation; it is to be used mainly by university visitors to the Rutherford Laboratory.

RESEARCH REACTORS

18. The Institute have continued to review the requests for the provision of low-power reactors for teaching and research which have been made by certain universities. After discussions with the Treasury and the government departments concerned, it has been agreed that the Institute is to draw up a programme recommending what reactors should be provided for universities and where they should be built. The approval and financing of particular reactors on the programme will not, however, be the concern of the Institute, except in the case of any reactors to be owned and operated by the Institute because they are beyond the scope of the universities concerned.

19. Meanwhile, the Institute is also responsible for supporting and co-ordinating university requests to use the high powered research reactors at the Atomic Energy Research Establishment, Harwell. One such request has so far been received and the Institute have agreed to pay the cost of attaching the man in question (a chemist from Leeds University) to the Chemistry Division, A.E.R.E., to carry out irradiation experiments using the Bepo reactor.

THE PROTON LINEAR ACCELERATOR

20. The year has seen the virtual completion of the 50 MeV proton linear accelerator project at the Rutherford High Energy Laboratory. The accelerator is made up of three sections which accelerate the protons to energies of 10, 30 and 50 MeV respectively and at the beginning of the year only the first section had operated. The second section was completed in May and the final section soon after, and the first 50 MeV beam was produced on 12th July.

21. There followed a period of commissioning with the object of ensuring a reliable beam at high intensity. In the interests of reliability it was decided to use two rather than one triode valve to supply the R.F. power to each of the last two sections. The required modifications to the second section were completed by October, 1959 and the improvement in the performance and reliability of this section has been very gratifying. Similar modifications to the final section of the machine are now in hand and will be complete by the end of 1960. Until such time the machine is being run at 30 MeV. Research is also continuing on the possibility of replacing the triode valves with klystrons.

22. During the year good liaison was maintained with the various university and A.E.A. teams planning to use the accelerator. Their keen interest in participating in the programme of research at the Laboratory has been most encouraging. The Universities concerned are principally Oxford, Birmingham, Glasgow, Manchester, King's College and University College, London.

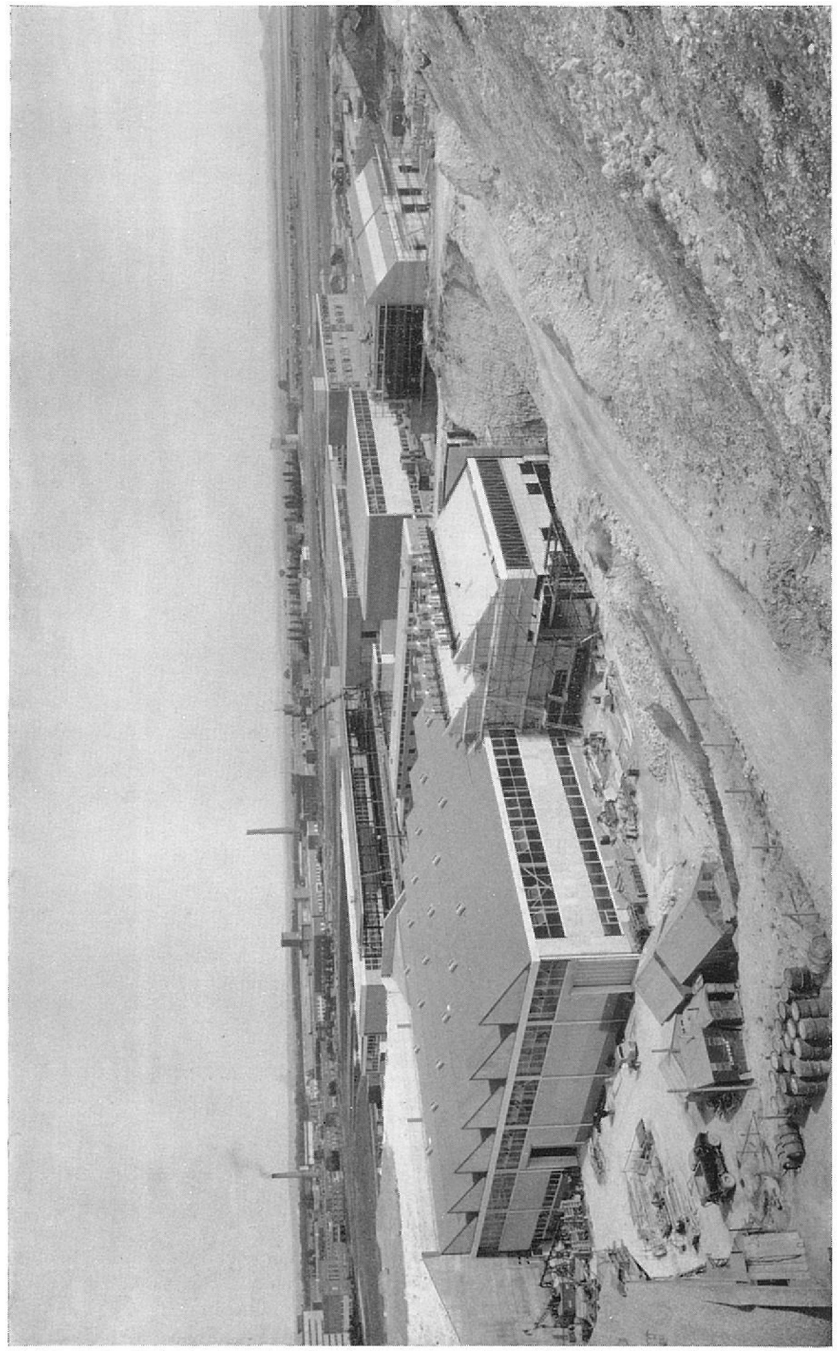
23. For some types of experiment it is desirable to have a beam of protons with their axes of spin substantially aligned in one direction; such beams are said to be polarised. The conventional methods of producing polarised beams at energies greater than 100 MeV are not practical at 50 MeV, and a collaborative programme of research has accordingly been carried out with the Clarendon Laboratory, Oxford, for the development of a polarised ion source. Construction of the apparatus in the laboratory has been completed and preliminary tests carried out satisfactorily. Installation on the accelerator is scheduled for the end of 1960.

24. Detailed plans were made for considerable extensions to the buildings housing the proton linear accelerator and ancillary areas. These would be used mainly for improved laboratory and workshop accommodation and extensions to the experimental area. In addition, it is proposed to build a low-activity radiochemical laboratory for use not only by university workers on the proton linear accelerator (and later possibly Nimrod) but also for university chemists who come to Harwell under the sponsorship of the Institute to carry out irradiation experiments on the A.E.R.E. research reactors.

NIMROD

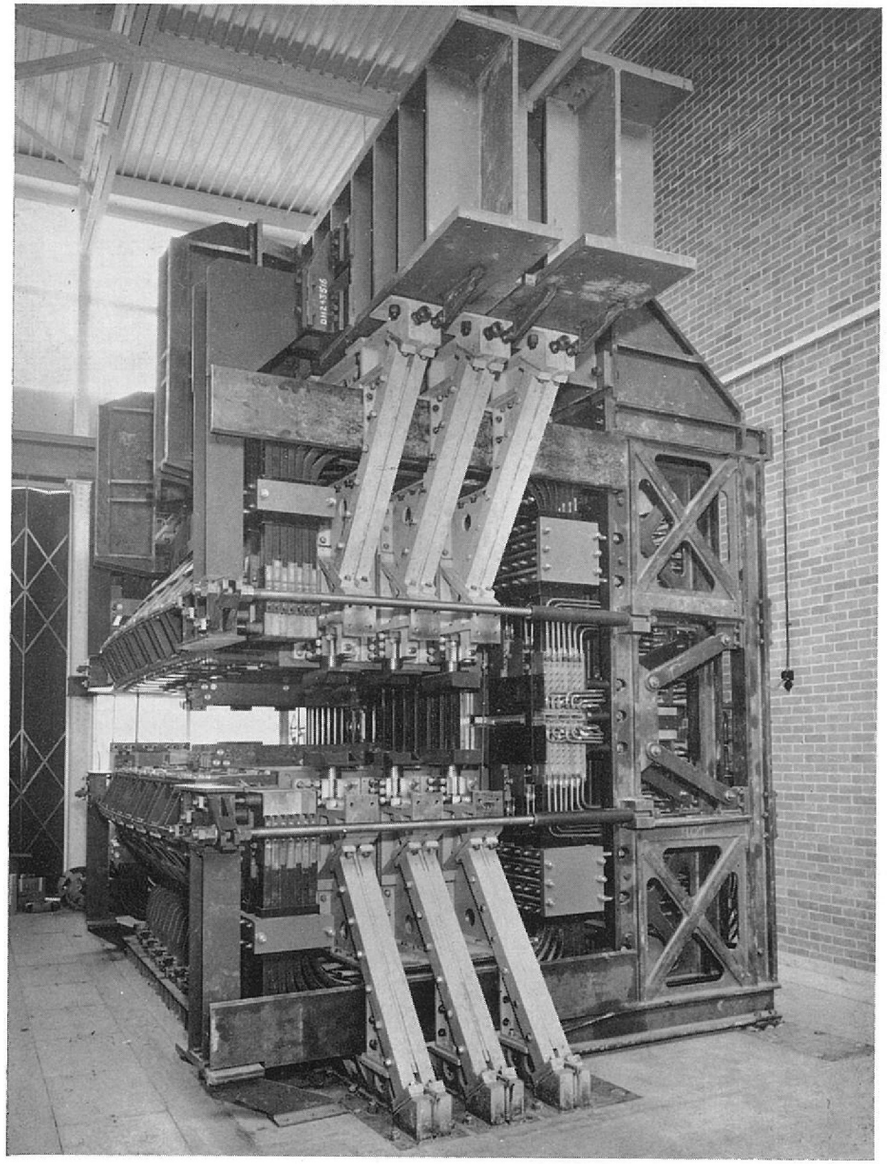
25. Good progress has been maintained with the construction of Nimrod during the year. It will be recalled that Nimrod is a proton synchrotron designed to accelerate protons to energies of 7,000 MeV or 7 GeV. A description of the machine was given in the previous annual report.

26. As the construction of Nimrod has progressed it has been possible to predict more precisely how long it will take to complete. Accordingly it is now estimated that construction (but not commissioning) should be substantially completed by July, 1962. This is six months later than the previous estimate.

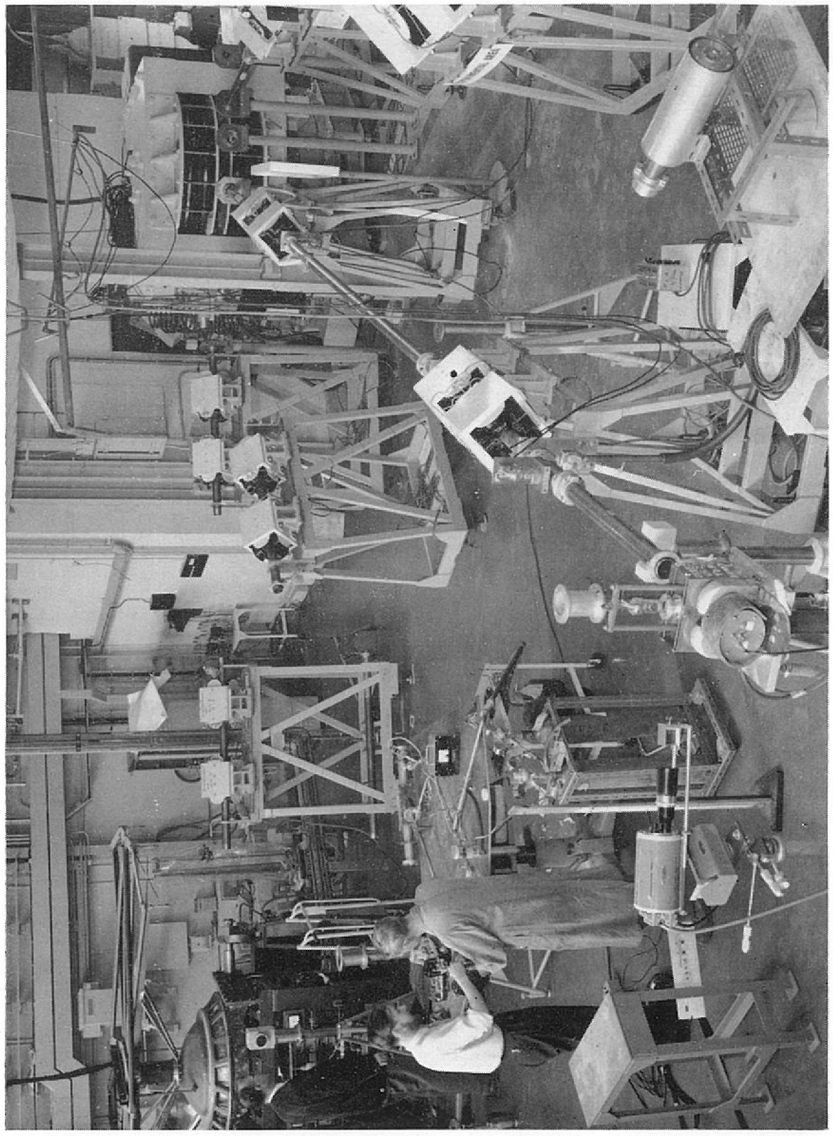


General view of the Rutherford Laboratory from the South West corner. The Nimrod Experimental Area is seen in the foreground.

Interior of Nimrod Magnet Room just before the installation of the first magnet sectors.



Full scale model of a section of the Nimrod magnet built to test various features of the design.



The Proton Linear Accelerator Experimental Area. The bending magnet used to extract the beam in any of several different directions can be seen in the background on the right.

27. As the year progressed and the main buildings housing the accelerator were completed, emphasis was directed more to the problems of manufacture and installation of the various items of plant comprising the machine. This was especially so in the case of the injector. This is the first stage of the machine and consists mainly of a linear accelerator over 40 ft. in length, designed to give the protons an initial acceleration of 15 MeV before they enter the magnet ring. A major component of the linear accelerator is the outer vacuum vessel, 46 ft. long, 8 ft. in diameter and weighing 26 tons. This was delivered and installed in December and towards the end of the year was undergoing a series of rigorous vacuum tests. Good progress has been made with the manufacture of the liner (the copper cylinder in which electrical oscillations are excited for the purpose of accelerating protons down the axis) and delivery was expected by mid-1960. A major contract was also placed for the manufacture of the drift tube assemblies, the series of hollow cylindrical electrodes to be spaced at intervals down the axis of the liner in the gaps between which the acceleration occurs. The drift tubes contain four-pole magnets which prevent the proton beam from diverging from the axis. The ion gun, which delivers a focussed beam of protons to the linear accelerator at an energy of 600 KeV was also delivered and tests successfully carried out. Several other items of electronic equipment connected with the supply of R.F. power to the liner were completed. As the various items have been delivered and installed there has been a progressive build-up of a team who are engaged in commissioning and will eventually operate the equipment. It has also been necessary to draw up a code of safety precautions for the protection of personnel following the installation of the high voltage equipment.

28. The central feature of Nimrod is a 7,000 ton ring-shaped electromagnet, 155 ft. in diameter. The annular gap between the pole faces encompasses the circular orbit in which the protons travel with increasing speed during the period of acceleration (0·75 sec.). The magnet yoke has been manufactured in the form of 336 separate blocks of which over 300 had been delivered to the Rutherford Laboratory by the end of the year and were continuing to arrive at the rate of approximately 6 per week. After initial magnetic measurement, the blocks were installed in the magnet room although not in their final positions. The concrete roof of the magnet room was completed during the year and this has allowed the mounding of the whole building with soil to begin. The purpose of the mounding is to provide extra radiation shielding.

29. Over 250 tons of copper in the form of hollow copper bars are being used to produce the coils which will energise the magnet. Manufacture proceeded during the year and the first coils were delivered to the Laboratory.

30. A major contract has been placed during the year for the manufacture of the pole pieces, which are to be attached to the pole faces of the yoke to give the required 'shape' to the magnetic field. A considerable amount of design work on these pole pieces has been carried out using both laboratory-scale and full scale magnet models.

31. The magnet will be constructed in the form of eight identical 'octants'. The ends of these octants present critical problems of magnetic and mechanical design. A full-scale magnet model was built during the year for experimental design work on the octant ends, and to provide a valuable check on many other features of magnet construction. An extension to the building known as the Preparation Area was built to house the model.

32. The device which accelerates the protons is known as the R.F. accelerator unit, and is basically a resonant cavity continuously tuned by a variable inductance. The cavity which is placed in the path of the circulating protons is excited by radio frequency (R.F.) electrical oscillations at a frequency in phase with the rotation frequency of the protons round the orbit. In this way the protons receive a small increment of energy on each passage through the cavity and are therefore accelerated. Construction and manufacture of most parts of the R.F. system were well under way by the end of the year. All the ferrite blocks (5½ tons) comprising the core of the variable inductance had been delivered and although some difficulty was experienced in joining these blocks satisfactorily, this did not prevent low power tests on the cavity being successfully completed.

33. The vacuum chamber in which the protons travel will be a toroidal-shaped vessel made of glass fibre reinforced epoxy resin located between the pole faces of the magnet. It is of double-walled construction with an outer 'rough' vacuum (·01 mm. mercury) space containing the magnet pole pieces and pole face windings. The pressure in the inner chamber will be 10^{-6} mm. mercury. Considerable effort had been devoted to investigating the best type of epoxy resin to use bearing in mind the need for easy fabrication, good vacuum properties and resistance to irradiation damage. The development of manufacturing processes has continued and the necessarily elaborate tools required for the manufacture of the outer vessel are nearing completion. Manufacture of the forty 24 in. oil diffusion pumps required to pump down the vacuum vessel had begun and the first units had been delivered. Initial difficulties on the proof testing of these pumps had been overcome.

34. The power plant required to supply current to the magnet windings will consist of a motor-alternator set with flywheels for energy storage, converter equipment comprising mercury arc rectifiers and phase shifting transformers. The contracts had previously been placed for the manufacture of the rotating machinery and the power converter equipment. Detailed design of the rotating machinery was virtually complete and manufacture had begun. Final details of the power converter components and circuit arrangements were still being worked out. Considerable progress had been made in the buildings which will house the power plant, although some delay had been caused by the necessity to modify the design of the foundation block on which the motor alternator will rest. This arose from a reappraisal of the effects of the severe pulsating loads which the foundation block would have to withstand. One effect was a tendency to weaken the bond between the concrete of the block and the reinforcing steel. It is believed that the improved design should overcome this difficulty.

BUBBLE CHAMBERS

35. One of the most important developments in high energy physics in the last decade is the invention of the bubble chamber. Briefly, a bubble chamber is an instrument in which individual interactions between nuclear particles may be observed. It operates on the principle that the passage of an electrically charged particle through a superheated liquid leads to a trail of tiny vapour bubbles which persist for a very short time. If photographed at the appropriate instant, a permanent record of the particle's track is obtained. It is planned to install two large bubble chambers at the Rutherford Laboratory for use with Nimrod.

36. The first is a liquid hydrogen bubble chamber. Liquid hydrogen is an ideal target for nuclear collision since it is the simplest form of matter. For this and other reasons a very intensive development programme on hydrogen bubble chambers has been undertaken in many laboratories during the last five years. In 1957 a scheme was first proposed by a group of universities for the construction of a large national chamber for the use by British scientists first on the C.E.R.N. proton synchrotron and eventually on Nimrod. Teams from several universities have co-operated in working on the design and the project received financial support from the Department of Scientific and Industrial Research during the year.

37. Although the hydrogen bubble chamber is not an Institute project it has been agreed that the Rutherford Laboratory should give full support by providing laboratory accommodation to allow the chamber to be assembled on the site, and also to provide all the considerable services which will be needed during operation. These services include such things as power to energise the 300 ton electromagnet surrounding the bubble chamber (the purpose of this is to cause the particle tracks to bend; the momentum of the particles can then be calculated from the degree of curvature), storage tanks for hydrogen and liquid nitrogen, hydrogen compressors and gas purification systems.

38. The chamber will be installed in an annexe to the main experimental hall of Nimrod about 200 ft. from the accelerator. This annexe is specially designed to minimise the dangers of possible hydrogen leaks. Beams of particles from Nimrod will be channelled down a vacuum pipe to the chamber with the help of magnetic lenses. The design of this beam transport system must be such that precisely monoenergetic beams of carefully selected particles—for example pure anti-protons—can be delivered to the bubble chamber in short bursts of duration less than one two-thousandth of a second. The Institute agreed to support a considerable programme of research on 'beam engineering' during the year.

39. A good start was made with the buildings needed to house the bubble chamber and the associated plant. In addition a small team of physicists and engineers was formed at the Laboratory to plan the details of installation and the various services needed, and frequent meetings were held during the year with the main inter-university design team to formulate a detailed construction and installation programme. Accommodation was also provided for a small team from Imperial College, London—one of the participating universities—who came to the Laboratory to carry out tests on the bubble chamber windows (through which photographs of the particle tracks will be taken). Plans for strengthening this team were under way towards the end of the year.

40. One problem connected with bubble chambers is that of examining the products of the chamber, namely the photographs. It is anticipated that at least 500,000 pictures will be obtained from the hydrogen chamber in one year, of which perhaps one third will merit close scrutiny and measurement. (The purpose of the scrutiny is to identify interesting nuclear events and measurement of the lengths and angles of the tracks enables valuable calculations to be made concerning the particular interaction involved.) Under the sponsorship of the universities, a careful study has been made of modern techniques of automation so that the excessive human effort which would otherwise be involved

Representing the Atomic Energy Authority

SIR ALAN HITCHMAN, K.C.B.
SIR WILLIAM PENNEY, K.B.E., F.R.S.
SIR BASIL SCHONLAND, C.B.E., F.R.S.

Representing the Department of Scientific and Industrial Research

PROFESSOR P. M. S. BLACKETT, F.R.S.
SIR HARRY MELVILLE, K.C.B., F.R.S.

Secretary : DR. J. A. V. WILLIS

APPENDIX III

Membership of Committees of the Governing Body of the National Institute for Research in Nuclear Science March 1960

General Purposes Committee

Chairman : *THE RT. HON. LORD BRIDGES, G.C.B., G.C.V.O., F.R.S.	
MR. A. E. DRAKE, O.B.E.	*Atomic Energy Authority*
*SIR JAMES MOUNTFORD	*University of Liverpool*
*PROFESSOR R. E. PEIERLS, C.B.E., F.R.S.	*University of Birmingham*
*PROFESSOR D. H. WILKINSON, F.R.S.	*University of Oxford*
Secretary : DR. J. A. V. WILLIS ..	*Rutherford High Energy Laboratory*

Physics Committee

Chairman : *SIR JOHN COCKCROFT, O.M., K.C.B., C.B.E., F.R.S.	*University of Cambridge*
DR. A. ASHMORE	*Queen Mary College, London*
*PROFESSOR P. M. S. BLACKETT, F.R.S.	*Imperial College of Science and Technology*
DR. E. BRETSCHER	*Atomic Energy Authority*
PROFESSOR W. E. BURCHAM, F.R.S. ..	*University of Birmingham*
PROFESSOR C. C. BUTLER	*Imperial College of Science and Technology*
PROFESSOR J. M. CASSELS, F.R.S. ..	*University of Liverpool*
PROFESSOR P. I. DEE, C.B.E., F.R.S.	*University of Glasgow*
PROFESSOR S. DEVONS, F.R.S. ..	*University of Manchester*
PROFESSOR N. FEATHER, F.R.S. ..	*University of Edinburgh*
PROFESSOR B. H. FLOWERS	*University of Manchester*
PROFESSOR J. C. GUNN	*University of Glasgow*
PROFESSOR J. HAMILTON	*University College, London*
*SIR HARRIE MASSEY, F.R.S.	*University College, London*
MR. L. B. MULLETT	*Rutherford High Energy Laboratory*
PROFESSOR P. B. MOON, F.R.S. ..	*University of Birmingham*

*PROFESSOR N. F. MOTT, F.R.S. ..	*University of Cambridge*
*PROFESSOR R. E. PEIERLS, C.B.E., F.R.S.	*University of Birmingham*
DR. T. G. PICKAVANCE	*Rutherford High Energy Laboratory*
PROFESSOR C. F. POWELL, F.R.S. ..	*University of Bristol*
PROFESSOR G. D. ROCHESTER, F.R.S.	*University of Durham*
DR. G. H. STAFFORD	*Rutherford High Energy Laboratory*
**SIR GEORGE THOMSON, F.R.S. ..	*University of Cambridge*
*PROFESSOR D. H. WILKINSON, F.R.S.	*University of Oxford*
Secretary : DR. J. A. V. WILLIS ..	*Rutherford High Energy Laboratory*

Visiting Committee

Chairman : *SIR HARRIE MASSEY, F.R.S.	*University College, London*
DR. E. BRETSCHER	*Atomic Energy Authority*
PROFESSOR W. E. BURCHAM, F.R.S. ..	*University of Birmingham*
PROFESSOR C. C. BUTLER	*Imperial College of Science and Technology*
PROFESSOR P. I. DEE, C.B.E., F.R.S.	*University of Glasgow*
PROFESSOR S. DEVONS, F.R.S. ..	*University of Manchester*
PROFESSOR B. FLOWERS	*University of Manchester*
PROFESSOR O. R. FRISCH, O.B.E., F.R.S.	*University of Cambridge*
PROFESSOR P. B. MOON, F.R.S. ..	*University of Birmingham*
*PROFESSOR R. E. PEIERLS, C.B.E., F.R.S.	*University of Birmingham*
DR. T. G. PICKAVANCE	*Rutherford High Energy Laboratory*
PROFESSOR C. F. POWELL, F.R.S. ..	*University of Bristol*
*PROFESSOR D. H. WILKINSON, F.R.S.	*University of Oxford*

Joint Secretaries : DR. G. H. STAFFORD
Rutherford High Energy Laboratory
DR. J. A. V. WILLIS
Rutherford High Energy Laboratory

Personnel Committee

Chairman : *THE RT. HON. LORD BRIDGES, G.C.B., G.C.V.O., F.R.S.	
MR. H. G. LINDSELL, C.B.	*Atomic Energy Authority*
*SIR HARRIE MASSEY, F.R.S.	*University College, London*
*PROFESSOR N. F. MOTT, F.R.S. ..	*University of Cambridge*
*SIR JAMES MOUNTFORD	*University of Liverpool*
DR. T. G. PICKAVANCE	*Rutherford High Energy Laboratory*
*SIR BASIL SCHONLAND, C.B.E., F.R.S.	*Atomic Energy Authority*
Secretary : DR. J. A. V. WILLIS ..	*Rutherford High Energy Laboratory*

Research Reactor Committee

Chairman : *Sir John Cockcroft, O.M., K.C.B., C.B.E., F.R.S.	*University of Cambridge*
*Professor P. M. S. Blackett, F.R.S.	*Imperial College of Science and Technology*
**Professor J. Diamond	*University of Manchester*
*Sir Harry Melville, K.C.B., F.R.S.	*Department of Scientific and Industrial Research*
*Professor N. F. Mott, F.R.S. ..	*University of Cambridge*
*Sir Keith Murray	*University Grants Committee*
Dr. T. G. Pickavance	*Rutherford High Energy Laboratory*
Secretary : Dr. J. A. V. Willis ..	*Rutherford High Energy Laboratory*

* A Member of the Governing Body of the Institute.
** A former Member of the Governing Body of the Institute.