National Institute for Research in Nuclear Science

RUTHERFORD HIGH ENERGY LABORATORY

Press Visit 22 April 1964

Address by the Director, Dr. T. G. Pickavance

I am very glad to welcome to the Rutherford Laboratory members of the Press and the B.B.C. This is the first Press Visit to the Rutherford Laboratory, except for one arranged by the D.S.I.R. on 22 February 1963 in connection with the British National Liquid Hydrogen Bubble Chamber. Certainly it is the first occasion for the Press to take a really close look at the work of the Laboratory and to discuss it with us.

You know, I am sure, that we work mainly on research in high energy physics, which can be briefly described as the study of the properties and structure of the elementary particles of which the whole universe is made. The number of these sub-atomic particles talked about by physicists grew in 25 years of work in nuclear and high energy physics from three or four to about thirty. In the last five years, the number has grown from thirty to over a hundred, and physicists have been wondering which if any of them deserve to be called elementary - certainly they cannot all be given this title. That this is one of the most important frontiers of human knowledge is borne out by the fact that it attracts the attention of many of the world's ablest scientists. Our aim at this Laboratory is to work in such a way that the universities can make free use of our facilities for their own research in this field, while remaining full members of their academic communities and, in particular, teaching their students. All our activities are summarized in the booklet which we have issued for this visit, and I shall not repeat much of what you will find there.

Today's visit finds the Laboratory at a most interesting and crucial stage of development. We have crossed the watershed into high energy physics after six years of construction and are beginning to do the work for which we were set up. Since the building phase of high energy laboratories takes such a long time, a few words about our history may not be out of place. The Rutherford Laboratory grew out of the Accelerator Division and a part of the Engineering Division of the A.E.R.E., Harwell, beginning in the middle of 1957, and it was not until January 1961 that almost all of the A.E.R.E. staff working on Rutherford Laboratory projects, then some 300 strong, transferred to N.I.R.N.S. employment. Since then, we have directly recruited all our staff, and the present payroll is 945 and growing slowly. From the beginning the main programme of the Laboratory has been based on two particle accelerators, the 7 GeV proton synchrotron Nimrod and the much smaller 50 MeV proton linear accelerator (P.L.A.). The P.L.A. was transferred to us by the U.K.A.E.A., in a half-built state, and has been extremely valuable to us because it enabled us to make an early start on research in collaboration with universities. We first operated the P.L.A. in 1959, and have been using it for research since the beginning of 1960. Nimrod produced its first high energy particles in August 1963.

These two machines are extremely powerful research instruments. The P.L.A. fills an important gap by operating in a relatively neglected energy range - too high for the electrostatic generators which are much used in nuclear research, but below the energies of the true high energy machines which are used to study the unstable sub-atomic particles. We believe that, with its ancillary facilities, it is at present the most powerful machine in the world in this energy region. We operate it 24 hours a day, to serve an average of 50 nuclear physicists of whom about 40 are visitors from universities and the others are members of the Laboratory staff and the staff of the A.E.R.E. Seven university physics departments are regularly involved, and there is now a steady output of doctorates awarded by universities to their research students for work performed at the P.L.A. A Laboratory staff of 100 operate and maintain the machine, produce the special apparatus needed by the research teams, and develop the machine and its auxiliary equipment to satisfy the increasing sophistication of the research programme.

Nimrod now joins the really big machines capable of supporting "front line" research in high energy physics. There are 12 others now operating in this class, 6 of them in the U.S.A., 3 in the U.S.S.R., and 3 elsewhere in Western Europe. In terms of particle energy, Nimrod is fifth from the top (second in Europe), but in terms of beam intensity it is already among the leaders (3×10^{11} protons per second at 7 GeV). British physicists have for some time shared in the use of one of the two highest energy machines in the world at present (the 28 GeV proton synchrotron at CERN, Geneva) and now in Nimrod have for their own use, closely integrated with the universities, the biggest "national" machine in Western Europe.

But the accelerator itself is only the beginning. Present-day research in this field needs a great deal of sophisticated and massive equipment to separate and transport the beams of particles produced by the accelerator, to detect and record particle collisions and other high energy phenomena (for example by photographing particle tracks in bubble chambers), and to analyse and compute the data collected in the experiments. Nimrod is exceptionally well equipped with such apparatus for the first stages of its research programme - we believe better equipped than any comparable accelerator has been, so soon after its first operation. Developments in the science and technology of this field are very rapid, however, and the effort on research equipment and methods will have to be sustained and extended.

There are three large bubble chambers on the programme, two of which are still being built. The other, the British National Hydrogen Bubble Chamber, is at C.E.R.N. by a long-standing arrangement to put the biggest European bubble chamber at the biggest European accelerator. It will return to the Rutherford Laboratory some time next year, when an even bigger chamber will have been completed at C.E.R.N. Laboratories play international general post with research workers and apparatus; we hope that a group of French physicists will visit us with their hydrogen bubble chamber later this year, for an Anglo-French collaboration at Nimrod. This kind of development, whereby European scientists collaborate in making the most effective use of their joint experience and facilities, is obviously healthy and we should do all we can to encourage it.

We already have 7 sets of equipment for particle beams at Nimrod, either operating or in course of erection, on which experiments can be mounted. 8 groups of physicists, from 9 university physics departments, the Rutherford Laboratory, and the A.E.R.E., have been preparing experiments depending on electronic techniques of particle detection, and 6 of the groups have started their experiments already. In addition, 7 universities have teams working on the analysis of bubble chamber photographs; they work with film from CERN, but they all plan to analyse film from Nimrod also. Altogether, about 150 physicists are already basing some part of their research on Nimrod or are planning to do so soon. Only about 20 of them are on the staff of the Laboratory. We must join in the research ourselves, if we are to be a research laboratory and not a "service station", but it is our policy to give the maximum amount of machine time to universities consistent with operational efficiency and a healthy scientific basis for our own work. The numbers which I have quoted do not necessarily represent the optimum distribution. We shall have to determine this by experience.

Research in nuclear and high energy physics is expensive. The Laboratory budget for 1963/64 is just over £6 million, of which about £1.5 million is for expenditure on the tail end of the major capital construction programme, about

£1.5 million for salaries etc., and about £2 million for materials, equipment, and services directly connected with the research and development work. The remainder is for general services such as electricity, water etc., services provided by the U.K.A.E.A., administrative costs, and certain expenditure not connected with nuclear and high energy research. Of our 945 staff about 100 are physicists with honours degrees and about 80 are fully qualified professional engineers. We have to design our special research equipment, but we have most of it made in industry. Nevertheless, we have well-equipped workshops for very specialised equipment and for small urgently needed items. The A.E.R.E. help us by developing certain special equipment of common interest, notably electronics instruments, and of course we purchase manufacturers' standard instruments and equipment whenever they are suitable for our work.

How can we justify such large expenditure and effort on one field of pure research? Technological fallout has often been quoted (and contested) in defence of vastly more expensive programmes, and the same argument can be applied to high energy physics. But this can never be a justification; it is merely a bonus. The fundamental point is that science is an essential part of our culture, and therefore it is vitally important to develop the most creative branches of science. Few would challenge the statement that the allocation of support for pure research should follow the directions which the leading minds find most challenging, although there are difficulties in putting it into administrative practice. A central and particularly challenging field such as high energy physics should certainly be supported, even though it is expensive and gives no guarantee of direct returns beyond its share of the output, vital for human progress, of trained minds from the educational process which, at its most advanced level, must be coupled with research. The overall problem, obviously, is to decide how much money should be invested in research, and how to distribute it between pure and applied science and between individual fields. It is an extremely difficult problem. Science is a complex structure which could be seriously harmed if, for example, the criterion for getting a grant bigger than some arbitrarily chosen sum were to be a promise of quick economic returns. Pure and applied science feed on each other and prosperity for both is essential to our future progress.

We have a duty in Laboratories like this to be responsible and economical in our demands for and use of public funds, but the normal Government machinery is well adapted to correcting any errors we may make in this connection. It is our special duty to find ways of maximising the usefulness of our expensive facilities and making them available to those best able to exploit them properly. We direct our energies and design our organisation to these ends; they are the purposes of the N.I.R.N.S.