6·45 at Cosener's.

TALK FOR THE MANAGEMENT COURSE AT THE COSENER'S HOUSE ON 27 JANUARY 1972

My talk tonight has nothing to do with the course on which you have all been working so hard. Indeed, its sub-title should be, "And Now For Something Completely Different." I want to talk to you tonight about the organisation of research in a field, namely high energy physics, in which the reasons for doing the research is firmly rooted in the universities and yet the means for doing it are not directly within the universities' own control. As fundamental physics becomes more and more expensive it is a subject which will continue to grow in importance. I believe that the success of the two nuclear physics Laboratories, Rutherford to start with and later Daresbury, in pioneering a new form of organisation is at least as great as the success in prosecuting the physics itself. To substantiate my claim that these Laboratories are indeed different from other Laboratories financed out of public funds, I must first look back a little into history. The way in which fundamental research in physics, particularly nuclear physics, was carried out was irreversibly changed by the events of the second world war. At the end of the war, as senior scientists who had been engaged on major wartime projects (for example, radar, The Manhatten Project and so on) returned to the universities, there was a demand for the re-equipping of physics departments on a scale unprecedented by pre-war standards. A number of universities, for example Birmingham, Glasgow, Liverpool and Manchester, were provided with major new accelerators. The money was provided through DSIR but the work of designing and installing these machines was carried out by the university staff themselves in collaboration with industry. Although the accelerators were all eventually completed and operated it was not a wholly successful operation, due in part at least to the fact that university departments were not staffed or organised in the way required to deal with such large capital installations.

The beginning of international collaboration in Europe came in 1954 with the establishment of CERN and by the late 1950's discussions had started on the next round of equipment for British universities. There were several reasons why the existing university accelerators could not simply be replaced in situ. With a 30 GeV proton synchrotron being constructed in CERN a domestic machine in the range 5 - 10 GeV seemed appropriate. However, the size and cost of such a machine, perhaps £10M, meant that the country was unlikely to be able to afford many. Furthermore, it would not fit easily into a university campus. However, having built such a machine it could support a large number of research physicists, say 100 - 200. Finally, a beast of this size requires a level of support not generally considered compatible with university life as we know it. With the benefit of hindsight a national laboratory seems an obvious solution. There is, however, another side to the argument from the university point of view and perhaps I should try to put that now.

University teaching and research are inextricably bound together and it was not obvious that research in a centre several hours journey from the university could be successfully combined with teaching. Furthermore, the experience of university research workers in government laboratories, including AERE, was not wholly satisfactory. These laboratories had been set up to fulfil various national needs. When the university people were invited in, they were received politely as visitors but they were always far outnumbered by the permanent staff. They thought that they always remained visitors on the fringes with no "rights" and no real means of influencing the way in which the Laboratory operated.

Finally the university nuclear physicists thought that there was a danger that their own departments would be starved of funds to feed the growing monster of a national Laboratory.

To attempt to provide a reasonable compromise between the conflicting requirements, a new organisation was set up. It was called The National Institute for Research in Nuclear Science or NIRNS for short. The first Laboratory of this new organisation was the Rutherford Laboratory. From the beginning the Rutherford Laboratory was conceived as an extension of university laboratories where the university people would participate as a right and not as visitors in the old sense. This concept was enshrined in the Royal Charter of NIRNS under the section labelled "Objects" (paragraph 4c).

> Without prejudice to the generality of the forefoing to provide, equip and operate for common use by universities and by other institutions and persons engaged in research in nuclear and related matters, facilities which by reason of their size or cost or otherwise howsoever are beyond the scope of individual universities, institutions or persons as aforesaid.

The core of my talk tonight is really about the way in which the objects as I have just stated have been realised in practice. It has meant the reconciling of the responsibilities of the Director of a Laboratory, ~~the responsibilities~~ for the spending of public funds and the careers of staff employed in the Laboratory with the need to give the university staff a real say in running the Laboratory, particularly as it affected the research in nuclear physics. Certain policy decisions were made at the outset, other practices have grown up as the Laboratory developed. Here are some of the most important points in our way of life.

1. All the experiments are selected on merit. The Selection Panel has a majority of university members but formally is advisory to the Director.

2. Once an experiment has been selected it is the responsibility of the Director to arrange the Laboratory programme so that there are sufficient funds and other resources to carry out the experiment. All costs of an

experiment, except for the salaries of university staff, are borne by the Laboratory grant. The university research workers can spend money either in their own university departments through a Rutherford Laboratory university agreement or directly using the Laboratory purchasing system. It is an interesting comment on the success of the Laboratory that whereas in the beginning a large fraction of the money spent by the university people was spent through the university agreements, as they gained confidence in the Laboratory system the balance has swung the other way and nearly all the money is spent through the Laboratory.

3. An experiment in high energy physics is not carried out by an individual but by a team. Typically a team consists of a mixture of university research workers from several universities plus one or two from the Laboratory. From the outset it was decided that the proportion of high energy physics research carried out by Rutherford Laboratory staff would not be more than 20%. Furthermore, very few permanent appointments are made in high energy physics. Most of the Rutherford Laboratory staff engaged in this part of the work are Research Associates with 3-year appointments.

4. Reasonably civilised arrangements which are nevertheless within the rules of spending public money are made for the accommodation and travelling of university people. The reason for the existence of The Cosener's House - where we are now - is to provide accommodation for visiting university researchers. It should be borne in mind that Nimrod works on a 24-hours a day schedule which is not compatible with normal hotel hours.

5. University people are brought into the committee structure of the Laboratory wherever possible. In the early days of the Laboratory the Visiting Committee kept an eye on the way in which it was developing. Nowadays the more functional Nimrod Users Advisory Committee concerns itself with all matters, administrative as well as technical, which bear on the experiments.

Both were, or are, predominantly composed of university members.

6. On the other side of the coin we have progressively tried to integrate Laboratory research staff with the university departments. At the moment we have three senior staff members who are visiting professors at various universities. A good few others have joint SRC/university appointments. Still others give regular lecture courses at universities.

The Rutherford Laboratory has been operating in this way for over a decade. The partnership between university staff and SRC staff in the prosecution of experiments on Nimrod, taking as long as 4 years to complete, is now taken for granted. This is as it should be but it is worth reminding ourselves of how big a step it once seemed because we are now starting the second revolution.

I have called it the second revolution, but it is really a natural extension of the first. It is the large scale mounting of experiments on the international complex of accelerators at CERN. Before I deal with this aspect of the Laboratory's work I should make a further small diversion into the nature of high energy physics research.

The extension of the laws of physics to smaller and smaller distances requires higher and higher energies and therefore larger and larger accelerators. About 15 years ago the great Italian/American nuclear physicist Enrico Fermi illustrated this point in a very dramatic way. He showed a graph in which the size of the accelerators was plotted against the year in which they came into operation. A straight line fitted the points fairly well and Fermi made a monstrous extrapolation to the stage where the accelerator would have the radius of the earth. This seemed to be a natural limit. The year turned out to be around ~~x~~ 2010. Of course, Fermi did not intend this extrapolation to be taken very seriously but the extraordinary thing is that if one plots the points for accelerators which have been constructed since then they still fall on the same straight line. Of course, as the size goes up, so the cost goes up and so also does the number

of experimental physicists a single accelerator can support. It is therefore not surprising that the history of nuclear physics has been that of concentration into fewer and fewer centres with larger and larger machines.

What are the implications of using these machines? In monetary terms the most efficient method of doing the research is to create a monastic order of dedicated, full-time professional research workers. It would be efficient but it would also be rather pointless. The relevance of high energy physics research will be lost unless the results of the research are directly coupled to the scholarship and teaching aspects of universities.

What we are trying to do is to use the national Laboratories to help the experimental teams, which are predominately composed of university people, to mount experiments on the CERN machines. This is a large scale undertaking when one considers that for a single experiment on the ISR, equipment worth nearly £0.5M and weighing many tons was constructed in the Rutherford Laboratory, shipped to CERN and assembled there. The data taking and analysis will last for another 2 or 3 years. To take part in these experiments abroad while still retaining reaching responsibilities requires a new way of life for the university physicists. Perhaps they will work 1 year at CERN followed by 2 or 3 in the UK, or a sort of shift system with two terms in the UK followed by two terms at CERN. We do not know quite how it can be done but the organisation problems must be solved if the huge investment in the new CERN facilities is to provide the return we expect. That is our major problem for the next few years.

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