Dr. Hobbs

Speech given by Professor B. H. Flowers at the Rutherford Laboratory on Friday 21st March 1969

I am very glad to be here again. It was something like a year ago since I was last here, and you gave me a very enjoyable time and I am sure you will again.

Since then certain issues affecting the nuclear physics community have clarified, not in the way we would like it, of course; but at any rate our thinking about how nuclear physics is going to go, and indeed how all the science and technology supported by the SRC may go is clarified also. It is a continual process which we shall never know exactly what we are going to do. And I hope we shall not, because that would mean that we were dead. But I thought that you might like to hear from me a little bit about the state of our thinking at the moment, and in particular how it might affect the two Nuclear Physics Laboratories, and of course particularly to-day the Rutherford Laboratory.

Now, all our thinking about nuclear physics, and the major part of our thinking about the whole programme of the SRC, is dominated by the single issue of the 300 GeV project. The Nuclear Physics Board and its various predecessors over the last five, six, seven years have been insisting that a project like this is absolutely essential for the long term future of high energy physics in Europe, and this is a view expressed so forcibly and for such a long time and so consistently that we simply cannot ignore it. And it is for that reason that, in spite of the fact that the Government has said that at the present time we cannot contemplate entering this project, the SRC has said, and will continue to say, that we shall press for a reversal of that decision. Let me just give you, very briefly, a little bit of the recent history of all this.

You will know that the SRC proposals of about two years ago or so, were published in Cmnd. 3503 - the Blue Book as we call it - and that these proposals were based on the ideas that there should be a sort of three-tier structure for the support of Nuclear Physics with a very broad base of the

support in universities; the next up in the pyramid, the National Laboratories, providing facilities for the Universities to use, but also making some use by our own staff in the experimental programme, without which one cannot run these Labs; and then of course at the top the very big international facilities, of which CERN-Meyrin is the present thing, and the 300 GeV has been intended to cap it all. And those proposals, having been whittled down over the years put forward a programme which allowed us to continue in a lively fashion with all components of that programme, including entry into the 300 GeV project, at a price that meant that the total nuclear physics budget would rise (with wiggles of course) with the sort of average growth rate of about 7% per annum. And it was felt that because of the fact that science was expanding generally - there are after all other things than nuclear physics - that would mean that the total growth rate for all of science should be greater than that, and the published proposals, (published) at the insistence of the SRC and of the Council for Scientific Policy, meant that this programme could be contained - the 7% programme - provided that the whole of the science vote would increase at about 9% per annum. And for the high energy physics community- experimental high energy physicists - it was envisaged the existing number of about 350 would grow over ten years or so to something more like 450, a modest but definite growth.

Well as you know, it became clear round about the end of 1967 that the Government were just not going to wear that or anything like it, and for that reason - I won't go into details of why it had to happen at that time - for that reason I put up as a private venture a modified proposal which really had the following motives. Since the Government were clearly not going to wear the published proposal, it seemed to me worthwhile to try to see what would be the absolute minimum programme that would on the one hand preserve the scientific community for which the whole thing was intended, obviously one doesn't kill that and have the facility at once which would be nonsense, and which would allow us to enter the 300 GeV without straining ourselves too much. And there was one further condition that was laid down in trying to work this out, and that was that although we were prepared to face normal wastage - a horrible word that is commonly

used in South America - in our Laboratories, and the corresponding thing in universities and so on, we were not prepared to create redundancy in a deliberate way. Well, if you take those pre-conditions it becomes clear that you get the minimum programme only if the 300 GeV machine is in this country. Now I have explained this very carefully, because it is easy to misunderstand the point that what I wanted to do was to see what the minimum programme would be. If the Government were not prepared to support the minimum, clearly they would not support anything else. So it seemed a good thing to work that out. Now of course, there was never any guarantee that even if the Government said "yes" to that programme that we could have got the machine in this country. As you know the siting of an international laboratory like this is something that has to be argued about and is a very difficult thing, and indeed, if the 300 GeV goes ahead now without us there is still going to be a hell of an argument amongst the participating countries as to where the machine shall be.

Nevertheless, I had hoped that the Government would have said, all right without any commitments on our part, go ahead and study this and see whether you can organise it so that the machine could be in this country. Or if that doesn't come off, see whether there is a programme fairly near to what you are now proposing - without any commitment on their part. And it would have taken us a year or so to have worked out anything definite and I was hopeful that we might do something reasonable. What it amounted to was that (according to very rough figures, we had not gone through the process of normal consultation that we would of course always do if this were a proper proposal; it was a cockshy only) it seemed to us that, with fluctuations again, it would be possible to carry out this minimum programme with a growth rate of something like only $3\frac{1}{2}\%$ per annum. And it would be based essentially on the fact that if the machine were in this country then it would be the British national programme so that one could envisage equal transferring from here and from Daresbury and from the universities or anywhere else to work at this international machine in this country. I would expect that they would do that anyway, but of course, if it were here, it would be a process that would go more naturally and therefore faster and we would not in fact be creating redundancies. Now as you know the answer

was no, we shall not study this programme we will have nothing of it because we cannot face even that sort of expenditure at the present time, and I have to admit that if I were the Chancellor of the Exchequer faced with the situation that he was faced with, and is still faced with, the worst thing that one could do is to accept a very long term heavy commitment for as far into the future as you can see. There were other reasons. A chief one was that they felt that although they understood the nature of my proposals, nevertheless, they thought the chance of getting it agreed to have the machine in this country was so slight and therefore unlikely to get down to something like their minimum programme and of course the dangers of the programme would escalate by a very considerable amount, in any case.

Now, let me just say a few words of what the SRC Council policy is in the light of all this. It supports the Nuclear Physics Board completely in its desire to get this Government decision changed when circumstances are such that one feels justified in pressing the Government to reverse the decision. It is determined to have a meaningful Nuclear Physics Programme, but it wants to have that within a falling proportion of the SRC funds. That is to say that the Council believes very strongly that we have for a variety of reasons, which we all know about and understand I think, put rather too much of our money - but more important than that, our manpower - into nuclear physics of all sorts for a very long time, and other things now must be allowed to go ahead faster. So that although we wish nuclear physics to go ahead in a meaningful way, we want other things in aggregate to go ahead faster than that. Now I do not know how SRC funds are going to grow, I do not know what SRC funds are going to be in six months' time, because over the last few years we have been in a situation where nominally we have been preparing every year the usual rolling five year forecast of what we want to do and justifying it and so on and getting agreements at any rate that the first three years of this shall be something or other. Then of course there has come a fresh economic crisis of some kind, cuts have been imposed, not in any way related to our programming, and so of course I do not in fact know what it is I am talking about in financial terms. All I can tell you is what is the situation at the moment;

how things seem to be going and you should interpret this with caution and not in any sense is it a promise. Our funds seem to be growing at about 6-7% at present time in real terms, something of that order. And so in doing the review of our programme this year, what we have said to our three Boards is the following: that they should prepare programmes that give us flexibility of choice and that for instance the University Science and Technology Board which looks after support of Biology and Chemistry and Mathematics and Engineering and everything else in universities, and also runs the Atlas Laboratory - we told them to prepare a programme within the band of something growing at 9% per annum and something growing at 6% per annum, so we will presumably choose something that wanders around in that band. The Astronomy and Space Radio Board we said should do the same thing but in a slightly lower band - 8% per annum down to 5% per annum - and for Nuclear Physics we said we would like to prepare two programmes each of which rises at about 4% per annum, one of which assumes that we go into the 300 GeV reasonably soon, and the other which assumes that we do not. Now at this week's Council meeting the aims of the Nuclear Physics Board and the aims of nuclear physics as a science were expressed by Denys Wilkinson as Chairman of the Nuclear Physics Board most eloquently and impressively and were very warmly applauded by the Council. I think there is no doubt that the Council was impressed by the very real efforts of the Board to meet this very difficult 4% guide line for its growth. I think they have done their sums as far as I can see, and again there is no promise in this, but as far as I can see, the programme which the Nuclear Physics Board has now reached is something approaching realistic, in financial terms. And, of course, this programme about which I will say a few words is in the spirit of the revised proposals that I put to the Government a year ago. It is not the same in detail of course, because now there is no question of thinking the 300 GeV as being in this country. The details are entirely different but the spirit of the thing is about the same.

Let me just say a few words then about the essential elements of the whole thing. The first thing I must stress is manpower because in the situation in which we are - I will say something about this in a moment - manpower is very much more important than money. What we are going to do is to reduce the size of the high energy and nuclear structure community which is supported by us by about 10% over the next five to seven years. We have already decided to limit the number of research students who may enter the subject - this begins this year. We intend over these years to cut by about 50% the number of academic research assistants, the people we support by grants, people who give assistance qualified (in various ways) to work as assistants in university groups, we shall cut that by about 50% and we shall make a small reduction in the number of research associates working at Laboratories. Now this for some of you may seem very hard. It is hard, and if I were back running a Nuclear Physics Group in a University I would probably be seething, nevertheless it has to be seen in a certain context, and let me tell you what the context is. It is a context whereby the balance of our qualified scientists and engineers appears to be not just slightly wrong, but wildly wrong. There are produced in the universities and, therefore, available in the country about twice as many scientists, in a broad sense, as engineers also in a broad sense. If you look at other countries which are heavily industrial and, therefore, somewhat comparable to ours, you will find that the ratio is roughly speaking the other way round. It is a factor of four wrong. Now you can argue just about what you mean by engineer and whether a British engineer is precisely equivalent to a German engineer and so on and so forth until the cows come home. You may be able to change this factor of 4 down to 3 but it is still a factor which I think I can describe as a gross factor. And so when I thought about reducing the size of the high energy physics community by about 10% over about five, six, seven years you will see that that is a very gentle touch on the brakes compared with what is really necessary if we have to put this balance of manpower right. I am not going to say much now unless you ask me to and I shall be very ready to answer any questions about it what programme we tried to do on the positive side to deal with this manpower problem. We are planning to do a lot, of course.

Another major element in the whole thing of course is that the large fraction of the budget going into Nuclear Physics goes to CERN. CERN is an international organisation and it is, therefore, not within our sole control. Therefore there is a danger that if the CERN expenditure goes up and up and up we can't do anything about it, and then within a total the funds available to us increase less rapidly. However, expenditure at CERN is not entirely beyond our control and the various people who attend the Council of CERN and Finance Committee and so on have been very active indeed over the last twelve months or so in urging CERN to face up to the realities of the situation, and to realise that in all countries we are getting to recognise that Nuclear Physics expenditure has been something which has been extremely difficult to cope with. We have managed to persuade CERN, to some extent at any rate, to give a bit of a lead in recognising this rather than increasing the problem by galloping away as if the difficulties with the member states did not matter. Particularly aided by the Germans we have persuaded CERN that it must envisage lower growth rates in the future than it has been accustomed to in the past. And it is now envisaged that CERN-Meyrin will rise in expenditure at something like 5% per annum within the next few years. Correspondingly we are making them realise that they must match their manpower requirements to the circumstances because in the end, of course, if they have more manpower they themselves generate a rise in the financial situation. So in this way, hard as it is to have to hit CERN which is a magnificent institution, it must be done if we are to have a healthy nuclear physics community as a whole in Europe. And we are succeeding.

The third thing is that we are quite clear that in a situation where it is necessary to make cuts on the work of the two Nuclear Physics Laboratories the University Groups, whether they work with the National Laboratories or not, cannot get away scot free. And, therefore, we are imposing cuts on University Grants and we are being extremely restrictive in the provision of research assistants to work in University Groups so that they shall in any circumstances build up in total as they build up at one expense or another. That is, in total the University Groups are going to be held back strongly as well as what we are going to do in Laboratories.

Well now, if we assume first of all that we enter the 300 GeV machine (and I have said before I can see no sensible long term programme unless we go into that or something similar, so let us assume that we shall indeed enter the 300 GeV project in around two years' time) then it will be necessary to find, if not all the money that that will require, at any rate a major part of it - if we are to keep within the 4% growth rate in total - by phasing out Nimrod or NINA as fast as possible. I stress again that no redundancy has been contemplated, I said this to the Staff Side of the Whitley Council, I said it to the Select Committee on Science and Technology and I am saying it again to-day - we have not contemplated creating redundancy. Nevertheless, it is only by phasing out one or other of these two accelerators as fast as possible that we can find the wherewithal to enter the 300 GeV. And moreoever, insofar as it was a serious doubt in the minds of the Government whether we could do this or not, it is a very important argument in persuading them to let us join in the 300 GeV that we show that we can do what we said we could do a year ago.

Now let me just say a few words about what would happen if we did not enter the 300 GeV and in that case things would be temporarily much easier. It would not be necessary to phase out Nimrod or NINA, it would be possible within the 4% growth rate to consider improvements to both machines, reasonably substantial improvements. We could, I think it is quite fair to say, have a fluorishing nuclear physics programme for something approaching ten years. Beyond that, however, and this is the very carefully considered view of the Nuclear Physics Board, and I completely agree with it, beyond that there would be no future for high energy physics in this country and we would have to do one of two things - one would be to enter the 300 GeV at that very late stage and that would mean paying all the back payments for eight or something years, which would be a very large sum of money, and I am quite sure that we could not expect any Government to find it unless it was a bit bonkers and one just doesn't go about things in that way. The only other alternative would be a planned withdrawal from high energy physics altogether in this country, and I believe, speaking entirely for myself, that it would be an extremely dangerous thing in any area of science to say that this country intends to play no part whatever, and that I think is what it would

mean. Still, of course, for the next eight to ten years we should be happy, we should be running our programme as it is now, there would be no uncertainty and all that. But the gamble you see is enormous. I am afraid this is a case where the short term interests and they must be the interests of many of you here, and we are acutely conscious of this, are in direct conflict with the long term aims and needs. Now as it happens, either programme - one which assumes that we join the 300 GeV soon and one which assumes that we do not, or at any rate for a very long time - either programme is identical in financial terms and details for a further year or so, I mean this is just the way things fall out, and I am sure Dr. Pickavance will be prepared to give you details of this, if you want it, but there is no possibility really of changing anything over this twelve months or so, and this is very fortunate because, of course, it gives us more time to consider what we are going to do, it means that we don't have to actually take any decisions for a year, although we have to try to learn to face up to them. It gives us time to see how the economy is going, time to see whether the mood of the Government is changing a bit and, of course, most important, time to consult everybody concerned. I think I should now say a few words, particularly since I am being tape recorded for the benefit of Daresbury, about the Nuclear Physics Board's views about how the two Laboratories would be treated, that is to say, whether Nimrod or NINA should be the machine selected to be phased out. I think I can summarise the arguments like this - Denys Wilkinson can add to it if he likes - and I will give the points in any old order. Nimrod, of course, is the older machine which has already achieved a lot, NINA has only just started. Protons are available at CERN. The Rutherford Laboratory is about twice as expensive as Daresbury and, therefore, there are greater possibilities of savings. Most important, Rutherford Laboratory has by far the wider base, expertise and everything else, so there are greater opportunities in the case of the Rutherford Laboratory for work on things here other things than Nimrod itself, and then finally, although one can contemplate improvements to Nimrod that would be substantial and useful, we don't envisage that it would be possible substantially to develop the machine to something that is quite different from what it is now. That is not so with NINA. As you know

there is the possibility of adding to it the Booster which would place it in the world class of machines - an absolute world beater for many purposes - and we don't know now whether we can afford it or not - it looks indeed as if we can't, but certainly if we enter the 300 GeV we can't on my present prognostications of how finances are likely to come to us, but at the present time it would be foolish to throw away that possibility. So these factors, put much too simply, have led the Board regretfully to choose Nimrod to be the one to be closed down. The close down will start, if it starts at all, in a year or so, and it will take 5 or 6 years to bring off. It will not be switched off finally according to present plans - which are still tentative - until something like the end of 1975. I should emphasise and I am sure Denys will want to emphasise that this was an extremely hard conclusion to have to reach, but the Board is quite clear about it and the Council accepts it, although it is recognised that in fact no decision yet needs to be taken and need not for about another year. During that year I would expect further clarification of the plans, a great deal of consultation. And just a word about Daresbury. It is not yet up to full strength, it was hoping for a strength very much higher than it has now, there is no possibility in the foreseeable future for it to obtain anything like that strength. The intention is that it should rise in staff numbers to a complement slightly above what it is now, and then would be held level for a good many years.

Now I have deliberately dealt with the negative aspect of all this first, I wanted to get it over, but now I would like to say a few things about the positive aspect because we are all extremely conscious of the problems of morale in an establishment that is going to have to face running down in activities, running down in staff and so on. Now it is a simple fact that it is impossible to make use of a great international facility like the 300 GeV or even a very considerable facility like CERN-Meyrin, particularly when it has got the ISR project going, without having a very substantial home base. In the end it is, of course, mainly university groups that make use of these machines. There are some university groups who think that they would be very happy to have some money from us to help them work directly with CERN or in future directly with the 300 GeV. It just is not on. They couldn't do it. They would not be viable enough, and to make them viable

enough would cost much more than to have the properly constituted home base through which they can approach these international facilities. In any case, for reasons which will be obvious to you from what I have said already, that solution will not be tolerated. The national, the home base, must be the Rutherford Laboratory, and to a lesser extent it could of course be at Daresbury; I would not want to rule that out. So the Rutherford Laboratory has got to be the staging-post of a very sophisticated kind. It has got to be a development Laboratory for large equipment, you know quite well the high field bubble chamber that is under consideration at the present time, this is the sort of thing I mean, and this particular thing will not be coming up to decision again by chance in about a year's time because your considerations of it are not yet complete. But this is the kind of thing I am talking about - large development projects.

Thirdly, the Rutherford Laboratory, because of its wide base of expertise and equipment and all that, is a possible site for further large projects outside the high energy physics area. The present possibilities which most of you will know about as existing are, of course, the nuclear structure facility which has been talked about and the high flux beams reactor. Neither of these have yet been approved, both are under active consideration, the Rutherford Laboratory must be considered as a possible site for things like that, and there will be others in the future. And then finally this is really a Laboratory full of advanced technology of all sorts, in fact, it is 90% technology and only 10% physics if you like. These facilities simply must be attacked by university engineering groups. You have here just the sort of thing that engineers in training ought to know about and ought to make use of. I am determined to do everything I can to involve university engineering groups in the technical expertise of the Rutherford Laboratory. The only example I can give at the moment is gradually one is beginning to see the idea of superconductive magnets being used much more widely than just in high energy physics. I hope that industrial use of magnets like this will be coming in before very long. I am sure the magnets will look very different from the ones you are building, but you have the expertise to do it, and I would like to see some university groups involved in designing magnets of that sort, and they could do it here.

Well now, according to these present plans which I stress are tentative and can be fixed up over the year in consultation with everybody concerned, that over the next eight or ten years, something like that, the plan envisages the staff required at the Rutherford Laboratory for high energy physics purposes to be something around 800, instead of the 1,260 or so that it is now. So for the high energy physics programme, this is a reduction from 1,260 down to something like 800 over eight or ten years. It is not in fact a very rapid growth rate, it is not something which cannot be met through normal wastage, that is people going to jobs that they prefer to go to in the circumstances, and I would hope that the 300 GeV is one.

Now I want to stress very strongly that these 800 or so people are wanted for something very definite, and something very important, without them we shall not be able to do high energy physics, whatever the international facilities provided are, so they are absolutely vital. Moreover, of course, any further projects that we can bring to the Rutherford Laboratory apart from high energy projects, I mentioned one or two, any such projects will have to have staff of their own and to that extent for things other than high energy the total numbers of the Rutherford Laboratory could be higher than 800.

So there is possibly a possibility of diversification. I want to stress right away that the problem of the rundown of Nimrod and the staffing consequences of that rundown must be seen, and I am insisting that they must be seen by all concerned as a problem in total for the SRC and not just a problem for the Rutherford Laboratory, not just a problem for the Nuclear Physics Board, but a total problem of the SRC. We have other projects, not high energy projects, for which the staff here would be ideal. We, I am sure, are going to have projects of a smaller kind going to universities or being done on university campuses for which your expertise will be ideal. We must bear in mind the total SRC programme and all the opportunities it will offer in considering how in detail we run down Nimrod, and the staff who service it. I have talked already for much too long; I just want to end up by saying, by doing just a little bit of crystal ball gazing into the longer term future, and this is extremely tentative, vague, and all that. I want to

say just a few words about 1975 and beyond, in general. We are at the moment of course going through an extremely difficult time, but it is a fact, and I think most people both here and abroad are now beginning to realise this, that our economy has taken an up-turn. It is the sort of turn however, that one describes in terms of productivity improvements. You have to bear in mind that we are a debtor nation to an extraordinary extent at the present time, that has to be made up for, and improvements in the present state of affairs will have to go on for quite some time before the screws can be taken off. And until we have paid our debts and become independent again. I am not giving a Party Political Broadcast, but these are just hard facts about our present situation.

Well just let us suppose then that this process goes on whether under this Government or the next one, and that we achieve something like a growth rate in real terms of a gross national product, that is how we measure our total wealth, of something like 4% per annum. That is a sort of reasonable figure for a healthy industrial nation. Now there is another factor as well, it is that due to the way that the birth rate went 15, 16, 17 years ago, you know the university population has reached an enormous plateau and has now levelled off. So the expansion of the universities over the next few years will be really rather small, something like 1% per annum or so, a bit more than that, but that is all. But by the time that we reach 1973 or thereabouts, people became healthier 18 years before and the birth rate turned up and people reaching universities will go up in numbers too. So the university expansion round about this time I am talking about will be on again in a very substantial way. And, of course, science budgets are to some extent insofar as we are tied to support of the university system, tied to the size of the university population. And in these circumstances we may hope that in some way the growth of money available to science will be correlated with an expanding university population and with the growth of science-based industry. Now if the total GNP is going up something like 4% the growth of the more science-based part, and I think you know what I mean, I don't have to explain it, will have to be higher than that, let us say 6 or 7%. Now that as it happens, 6 or 7% I am hoping that the growth rate of science-based industry may be something like that, that happens to be the growth rate of the SRC

at this moment, we are not doing badly on that comparison. Well allowing, as I said before, for university expansions, I would even hope that the growth rate of science as a whole might go up again as far as 8 or 9% . By then the proportion of SRC funds, providing we don't get clobbered too hard in the meantime, will in fact have gone down a bit. I think in any case if the economy is better attitudes will be different, so I think that by that time there is a real hope, and you will understand how very tentative and crystal ballish I am being, that there is a real hope that by then the nuclear physics growth rate need not be much below the average. I am only trying to suggest that it may be that by 1975 or so, we shall not be talking about 4% growth rate of nuclear physics any more, but shall be talking about "an extremely restrictive growth rate of around 7%" which is how we used to talk. I want to be quite clear about one thing, I don't believe we shall ever again return to the growth rate figures of 10, 15% per annum ever, which is what we have been experiencing for the last few years, for quite a long time and of course the Americans have too. I don't think we shall ever return to that. But I do think that there is a reasonable hope that by 1975 with not too many crises we may find that we can get something like 7% in nuclear physics, and within that sort of growth rate some of our considerations that I put before you now could be different. It would, of course, be true that by that time Nimrod, would be pretty well beat out any way, not so much in itself, but in comparison with other things available and, of course, it would still be by then, even with 7%, extremely difficult to pay all back payments on entry into the 300 GeV. Nevertheless, I think that by that time there is real hope one could envisage a nuclear physics programme with a new vigour within a scientific situation that would also contain a new vigour. Now I don't think that look into the future would justify the gamble of saying, all right let us not say that we intend to go into the 300 GeV as soon as possible, let us hope that things will come out better later on, and give it up for now. I think that gamble would be too great and therefore what I believe is that the Nuclear Physics Board is right to insist that we join the 300 GeV as soon as we can. That we make whatever plans we have to to enable us to join, however black it may be, but to keep the whole situation under continuous review so that we know we can take advantage of any movement in our circumstances that may come along at any time.