

SUBMISSION TO MINISTERS

By Sir John Cockcroft

This paper sets out proposals for the organisation of a National Institute for Nuclear Research, including its terms of reference and possible constitution. The paper is for consideration by the Authority and discussion with the University Grants Committee and subsequent submission to the Atomic Energy Office and Treasury Ministers.

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1. Various problems have arisen in the financing of nuclear physics research in the Universities during recent years, resulting in the main from the need for large accelerators, exceeding one or two MeV. These problems arise from two causes; firstly, the great costliness of the machines and their maintenance which is disproportionate to other university expenditure on Physics and expenditure in other departments of the Universities; secondly, some of the expenditure - and very large sums are involved in this - is difficult to predict and therefore this work does not fit into the normal quinquennial university budgeting.
 2. Preliminary estimates show that the cost of the next generation of big machines is likely to be considerable, and it will probably be necessary during the next 7 - 10 years to build two large machines of different types together costing of the order of £8 million. Other equipment needed might well bring the total capital cost to £10 million, and it is thought that running expenses might rise to a peak of about £400,000 a year. Given the cost of complexity of the necessary machines and the limited resources available, the needs of the Universities for the larger machines can hardly be met in the future on the basis of separate provision for each University or even each major University. The setting up of a new research institute for the use of the Universities and other Organisations working in the field would appear to be the best alternative solution. The Institute might in the course of time have more than one laboratory.

3. In the United States similar difficulties have arisen and a new Institution has been set up at Brookhaven owned by the Atomic Energy Commission and operated by a Committee representative of a number of the Universities concerned, where work by these Universities involving the use of such large machines can be concentrated.

Discussions have been taking place between the Atomic Energy Authority, the Department of Scientific and Industrial Research, officers of the University Grants Committee, and the Treasury on the possibility of such a development, and proposals were submitted in preliminary form to the Lord President and Treasury Ministers in February 1956. Treasury Ministers approved the submission in principle subject to timing and examination of the financial arrangements. The Lord President agreed to the examination of this possibility.

4. Such a National Institute for Nuclear Science should have the following general terms of reference:

1. To operate, and when necessary provide, facilities which are beyond the scope of individual institutions such as large accelerators, nuclear reactors and special laboratories in the nuclear sciences and related fields for the use of University and other research workers.
2. To encourage appropriate use of its facilities by scientists of colleges, universities, the Atomic Energy Authority and industrial laboratories.
3. To co-operate with the Atomic Energy Authority in the solution of specific problems which utilise the Institute's unique facilities or the special talents of its staff.
4. To make use of the Institute as an important auxiliary in the training of scientists and engineers and otherwise to assist in the dissemination of scientific and technical knowledge.
5. It is proposed that the management of the National Institute should be vested in a Governing Board appointed by the Lord President in consultation with the Chancellor of the Exchequer. The Governing Board would be responsible for the policy of the Institute. It would have a Chairman nominated by the Lord President and the Chancellor of the Exchequer and would include seven representatives of the Universities, one of the Royal Society, three of the Atomic Energy Authority, two of the Department of Scientific and Industrial Research and two of the University Grants Committee, a total of a Chairman and 15 members.

members should be academic persons. It is proposed that the names of the several University representatives would be submitted to the Lord President by the Chancellor of the Exchequer who would be advised by the Chairman of the University Grants Committee after consultation with the Chairman of the Committee of Vice-Chancellors and Principals. It would be desirable that the University members of the Board should include one or two representatives who would be able to look after the Universities' general interests in addition to those who would contribute their expert knowledge.

6. To assist the Board it is proposed that there should be Visiting Committees, to be appointed by the Board as required, for the various fields of study which would be involved in the use of the facilities of the Institute, such as Physics, Chemistry, Medicine, Engineering and Biology.

7. The Institute would have a full-time Director appointed by the Authority on the recommendation of the Board. He would be assisted by full-time administrative staff. He would also be assisted by scheduling committees, made up of the senior members of the Universities using the Institute, in planning the use of the experimental time of the machines.

8. The Institute would be financed under a separate Sub-Head of the Authority's vote which would provide for both capital and running costs. The Universities' expenditure would be limited to the payment of salaries and incidental expenses of their own academic staff who were attached to the Institute for research. The Member for Research of the Authority would be executively responsible for dealing with the Administrative functions of the Institute in relation to the Authority.

9. The responsibility for the design and construction of the large facilities to be provided for the Institute such as the large accelerators or a high flux reactor would be with the Atomic Energy Authority. On completion such facilities would be handed over to the control of the Institute for its use.

10. The staff of the Institute would consist of the following categories:-

(a) Operating and maintenance staff for the accelerators. (Permanent Atomic Energy Authority staff).

(b) Administrative and Industrial staff (Permanent Atomic Energy Authority staff).

(c) Atomic Energy Authority staff of experimental physicists (about 20 per machine, or secondment). *This staff would be changed from time*

(d) Visiting and attached University staff (about 30 to 40 per machine).

(e) Research staff of the Atomic Energy Authority and Industrial organisations doing long range fundamental work on attachment.

11. Members of the Universities working at the Institute might be of two categories, visiting or attached. Attached staff would include senior members of University departments working for periods of one or two years on leave of absence from the Universities, and graduate students working for higher degrees under the supervision of a University member. Visiting staff would be members of the Universities and graduate students carrying out short-term experiments with apparatus made partly in the Universities. Payment of the stipends of these two categories of workers would be made either by the Universities or by the Department of Scientific and Industrial Research or by other grant-awarding bodies.

12. Further developments in advanced nuclear physics, such as the provision of reactors for co-operative research, might also subsequently be placed under the general supervision of the Board of the Institute though they would probably be on a separate site

13. The provision of such facilities in the Institute would be supplementary to the existing facilities, now established in the Universities. The maintenance and operation of these existing machines will be met by the Universities and the Department of Scientific and Industrial Research under the new scheme for the division of this responsibility between the University Grants Committee, and the Department of Scientific and Industrial Research.

14. If these proposals are brought into operation the Atomic Energy Authority would agree not to conduct any secret work in the Institute. If future circumstances appear to make it necessary to consider the imposition of security restrictions, and the Atomic Energy Authority do not at present foresee any need for this, such action would only be taken after approval by the Lord President and the Chancellor of the Exchequer acting on the advice of the Governing Board.

15. Design studies have been proceeding for a year on the first large accelerator to be built. There is now general agreement amongst Authority and senior University physicists that this should be a proton-synchrotron designed to produce protons of 6.5 billion volts energy with an intensity about 100 times higher than that now available from the Berkeley 6 billion volt proton acceleration. This

Energy and intensity would enable effective work to be carried out on the production and properties of all the "strange particles" so far discovered - including heavy mesons, hyperons and anti-protons. The high intensity would make possible work on those particles which could not be carried out with any other machine. Detailed cost estimates of the machine should be ready by the end of 1956 and if the necessary financial and siting approval can be obtained, work on building foundations could start by early 1957.

16. If high energy physics in Britain is not to fall even further behind that in America and Russia, it is extremely urgent to start the construction of the next machine as soon as possible. Buildings could be started at a developed site such as Harwell by April 1957, providing the location is decided upon by September 1956 and financial approval is obtained for the project by January 1957. This timetable should make it possible for the machine to be completed towards the end of 1960. It would be desirable for the site to be discussed and approved by the Governing Board. If this cannot be set up within the next three months an ad hoc conference of representatives from the bodies constituting the Governing Board should be convened to decide on the site.

A site adjacent to A.E.R.E. at Harwell could be made available and offers many advantages as the location for the first machine. Moreover, changes in the security arrangements at Harwell will soon make it possible to give freer access for University workers to some of its own facilities such as the proton linear accelerator, the 110 inch cyclotron and the high flux reactor Dido.

17. The estimated build-up of staff to design, build, operate and use one machine on the Harwell Site is shown in the table:-

	<u>1956</u>	<u>1957</u>	<u>1958</u>	<u>1959</u>	<u>1960</u>	<u>1961</u>
A.E.A. Design, manufacture and commissioning	67	90	110	90	60	10
A.E.A. Operation & Maintenance	-	-	-	10	30	40
A.E.A. Research	-	-	-	10	20	20
Universities	9	10	12	40	50	50
	<hr/> 76	<hr/> 100	<hr/> 122	<hr/> 150	<hr/> 160	<hr/> 120

The A.E.A. and University staff shown in 1956 are those now engaged on the design study of the machine.

On the assumption that the machine and buildings will cost between four and five million pounds to build on the Harwell site, the estimated rate of expenditure is shown below:-

Financial Year	1957/8	1958/9	1959/60	Subsequent Years
Buildings	200,000	900,000	150,000	
Plant	200,000	900,000	1,500,000	1,000,000
	400,000	1,800,000	1,650,000	1,000,000

The machine now proposed for the National Institute is intended to replace the 600 MeV proton linear accelerator which the Atomic Energy Authority had already received approval in principle to build at an approximate cost of £2 million. The first stages of the proton linear accelerator going up to an energy of 50 MeV are now in an advanced stage of manufacture and will, when completed, provide an extremely valuable tool for nuclear research in the lower energy region. However, due to important technical advances in the field of accelerator design, it is considered that the country's interests will best be served by the construction of this 6.5 BeV proton synchrotron for the National Institute rather than the continuation of the Authority's proton linear accelerator project to an energy as high as 600 MeV.

19. Some provision for housing and hostel accommodation will be required for University and A.E.A. attached staff by 1958. About 20 houses and 20 hostel places would be required. They should be made available at approximately the following rates:-

Year	<u>1957/8</u>	<u>1958/9</u>
Houses	5	15
Hostel Places	15	10

20. We recommend:

1. That Ministers should now approve the proposal in principle and that the Chairman of the Governing Board and the Governing Board should now be appointed.
2. That detailed proposals with estimates of expenditure for the construction of the first accelerator and the auxiliary facilities of the Institute be worked out for submission to Treasury by the end of 1956.
3. That the Governing Board be invited to settle the site of the first accelerator as soon as possible.