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Funding of Physics in Britain

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Although the nations of Europe are so close culturally, they have evolved different patterns of operations which show up most markedly in government where they are least overlain by the powerful impression of market forces. Science funding is no exception to this rule, and the British system is still evolving from the attempts of government to introduce something of market forces into decision making. A series of decisions taken in 1972, following a study by Lord Rothschild, has created a basic pattern which is likely to continue until the next administrative upheaval. These upheavals are like earthquakes — one does not know when they will happen but governments erupt on average about every ten years.

Present Pattern

Research in the UK runs at about 2 % of the GDP. It is conducted in industrial, government, academic and Research Council laboratories. Rothschild argued that research could be divided into *basic* and *applied*. Basic research is carried out for the good of the whole of the community (possibly the whole world) but is long-term and does not have a clearly defined product as its objective. Such research is properly the duty of universities, polytechnics, and Research Councils. Government laboratories, on the other hand, exist to carry out applied research, i. e. research where some clearly defined pay-off can be expected on a reasonably clear time scale. Industry pays for its own research, so can presumably do what it likes, although it will mostly do applied research. Rothschild argued that applied research must be done for a *customer,* and, in the government departments concerned with the physical sciences, committees of industrialists and academics have been set up to form 'Requirements Boards'. These Boards are the customers who commission the research in government laboratories.

Most members of EPS, however, will be doing research which Rothschild would classify as basic, and here he accepted that the major decisions should be taken largely by researchers themselves, though they should also have an input from industry and the community in general. Such research in the UK is funded through the Department of Education and Science. The funds are administered through what is known as the 'dual support system'. One part of this system, the University Grants Committee, makes block grants to universities, which pay for their infrastructure, their staff, all their teaching activities, and in principle at least, for a basic level of research activity. The UGC is, in principle, independent of government, and in allocating its resources to universities prefers to give as little direction as possible about how these resources should be used. British universities thus have great freedom to make decisions about the core of their budgets.

The second part of the dual support system comprises the five Research Councils — Medicine, Agriculture, Social Science, Natural Environment, and Science. Of these it is the Science Research Council which has responsibility for funding the vast majority of physics. It supports research in universities by research grants, by awards of studentships and fellowships, by providing central facilities in its own laboratories, and by participation in international organizations.

The Research Councils all report to an Advisory Board for Research Councils (ABRC) whose most important function is to advise the Secretary of State for Education and Science on how the Science Vote should be divided up. The Research Councils have a much more selective and much more interventionist function than the UGC, and are also much more closely linked to central government. In principle they can be directed by Ministers, but in practice there is little formal intervention, because a working relationship exists and Mini-

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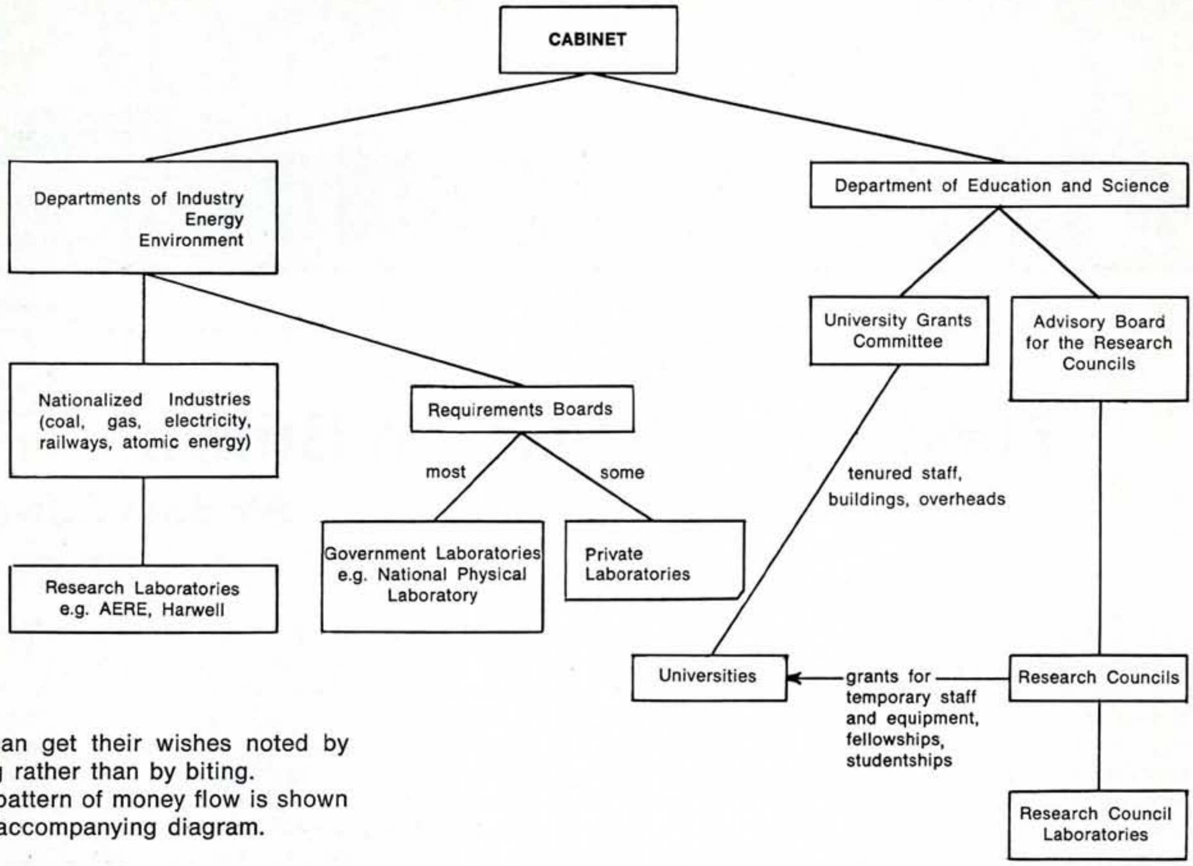
sters can get their wishes noted by barking rather than by biting.

The pattern of money flow is shown in the accompanying diagram.



SRC's Support for Physics Research

In the field of physics, SRC supports some 1150 postgraduate students, the vast majority studying for PhD's, and some 50 postdoctoral fellows. Many more postdoctorals, however, (some 600) are supported indirectly by SRC, through research grants to universities. These grants, which also provide other staff, equipment, consumables, etc., run at about £8M per year. A much larger sum, over £35M, goes to provide central facilities for the UK as a whole, the majority of them in the SRC's own laboratories. This sum includes, for example, the running of the proton synchrotron Nimrod and the Isaac Newton Telescope, computing facilities, satellite work, the construction of the Nuclear Structure Facility at Daresbury, and the support of UK experiments at CERN. Another large sum, over £30M, goes to provide UK physicists with access to international facilities such as the Anglo-Australian Telescope, CERN, and the high-flux reactor at Grenoble.

Physics Policy in the UK

From many points of view, British physics is in good shape. There is a large and active community which includes a number of outstanding individuals and groups. A large amount of money is being spent on the subject, and British scientists have access to a number of first-class facilities. Further major facilities are under construction (the Nuclear Structure Facility, a 3.8m infra-red telescope, a dedicated Synchrotron Radiation Source, the high-power laser laboratory, a major interferometer for Jodrell Bank, the satellite UK 6) or planned (the Northern Hemisphere Observatory, a neutron spallation source, a millimetre wave telescope, and various international space projects).

But the true picture is not as rosy as this may suggest. The number of studentships has had to be cut. The level of research grants to universities is planned to reduce slightly over the next few years. Major projects have had to be abandoned (the electron-positron colliding beams accelerator EPIC, the Mark V radio telescope, satellite projects), and some of those now planned may never come to fruition.

The problems facing physics are largely financial, and stem ultimately from Britain's poor economic performance. The growth rate of the Science Vote has been progressively reduced to zero, and in addition it has been subject to sudden Government cuts. The unpredictability of these cuts has added to their severity ; one may be forced to cancel an important capital project simply because it is the only way of saving money quickly.

Moreover, the ABRC has been reducing SRC's share of the Science Vote quite substantially, because it believes that medicine, agriculture, etc. should grow relative to the expensive sciences like high energy physics and space science. Although the ABRC's advice is not binding on SRC, one ignores it at one's peril. Coupled with the fall in the value of sterling, which has given us great difficulties in paying the CERN and ESA subscriptions, this policy has led to particularly hard times for physics.

The financial situation has also thrown into much sharper relief a number of other problems which would have affected us to some extent even in happier times. One of these is the interdependence of national and international planning. This can be seen most clearly in high energy physics. Already we are planning to give up both our national accelerators, Nimrod and NINA, in favour of CERN. But we are now running a serious risk of imbalance between our CERN contribution and the resources needed nationally to exploit that contribution to the full by mounting experiments and developing apparatus for use at CERN. Since the total sum for high energy physics is essentially fixed, the obvious solution is to reduce our commitment to CERN, and the CERN Council has acknowledged this problem in agreeing to reduce CERN budgets by 3% a year over the next few years. But the wider problem is that CERN budgets are determined internationally and on timescales which do not always mesh well with any individual nation's own planning. Thus any nation attempting to balance national and international programmes must face the fact that the latter are only partially within its control.

Another difficulty stems fundamentally from the changing nature of science, but has been exacerbated by the financial problems of the universities, and in particular the virtual extinction of the UGC equipment grant. These financial problems have been particularly severe for physics departments, where declining student numbers have led universities to switch resources to more popular areas. As a result, departments are seeking SRC support for things which once would have been funded by their universities, and in particular for the replacement of equipment bought in the boom time of the mid 'sixties and now becoming obsolete.

This has sharpened for us the problem of sophistication, whereby scientific equipment becomes bigger and more complex, until it can no longer be provided for every university, but must be provided regionally, nationally, or internationally. It was in areas of physics (such as astronomy, high energy physics, and space science) that this trend first became apparent, but it is now spreading to the traditionally "small" sciences. It could well be, for example, that by the 'eighties research lasers will have to be provided centrally, and much crystallography will be done on central synchrotron radiation sources. With such a change must go major changes in organization and in scientists' methods of working.

I should not like to end this article on too gloomy a note. Physics in Britain is still alive and relatively healthy. But its continued good health depends very much on our having sufficient stability to plan a forward-looking scientific programme.

Research with CERN 400 GeV Accelerator

Research with Europe's new 400 GeV proton synchrotron, the CERN SPS, has now begun, comfortably within the programme schedule which all but the most sanguine of the high energy physicists had at one time thought unrealistically optimistic. When the '300 GeV Programme', to give it its official title, was given its first airing in the report of the newly formed European Committee for Future Accelerators published in 1963, the target date for completion was 1976, but as the years passed and the fortunes of the project fluctuated back and forth, punctuated by the decision of the CERN Council in 1965 to give priority to the building of the ISR, the withdrawal of the UK from the project in 1968, the break-down of negotiations in 1969 over the choice of site for the reduced project .... the completion date seemed to recede ever faster into the distance. However, the proposal of J.B. Adams (then Director-General designate of the project and now joint Director-General with L. Van Hove of a re-integrated CERN) to build a 2.2 km diameter synchrotron alongside the existing CERN laboratories, using the existing 25 GeV PS as injector, led to a re-unification of the CERN Member States and all the "wasted" years to be recouped.

The project to which the CERN Council gave its assent in February 1971 was for an 8-years programme of construction, which included under the 1150 M Sw.Fr. ceiling (1971 prices), about 750 M Sw.Fr. for the accelerator, about 130 M Sw.Fr. for operation during the programme leaving the rest for experimental facilities and contingencies. Final costs may well be lower than the estimates.

First priority was given to the construction of the synchrotron up to its full design potential of 400 GeV and the transformation of an existing experimental zone (the west area) to accommodate neutrino beams of full energy and hadron beams up to an energy of 200 GeV. Attention has now moved to the equipping of a second experimental zone (the north area) where construction work is already well advanced. In the north area the accent will be on muon physics using a high flux muon beam and on hadron physics at the highest energies.

First beam tests on the SPS were scheduled to begin in April. The month before, following the annual shutdown of the PS when the final components of the ejection system had been installed in the PS ring, the continuous transfer system had been tested and shown to deliver a 10 GeV/c beam over 10 turns of good uniformity and with high efficiency. Beam guidance and focusing through the 1330 m of tunnel which links the PS to the SPS presented no problems and for

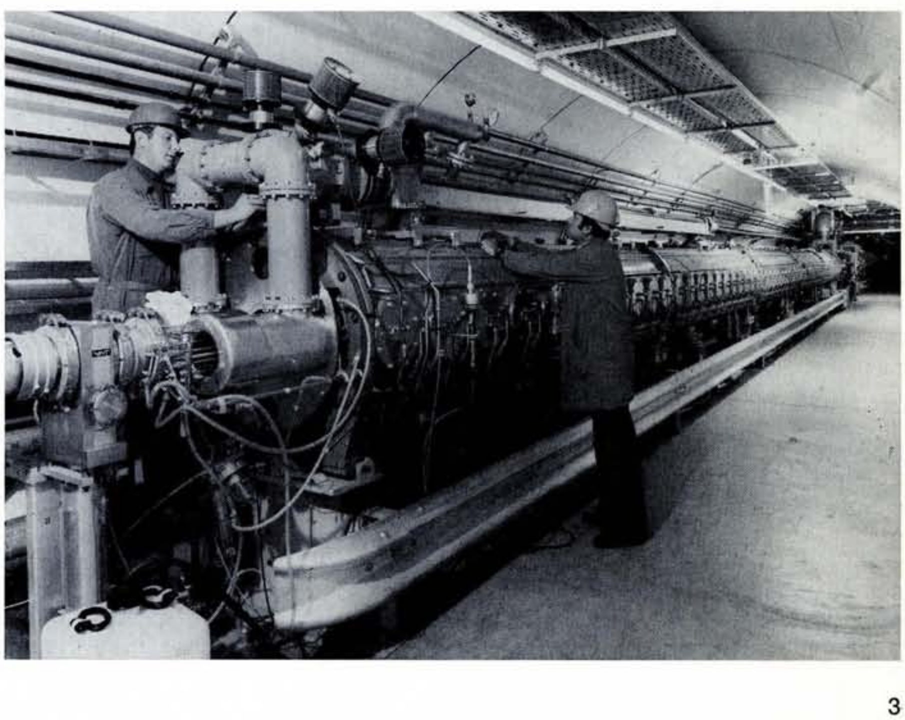


Fig. 1 One of the two accelerating cavities of the CERN SPS.