laboratory facilities for molecular biology on a European scale. Sir Harrie is also the chairman of a group studying the criteria on which a system of support for scientific research in universities should be based. The council is particularly interested in the problems of making quantitative estimates of the benefits of scientific research. A working group under Professor H. Johnson of the London School of Economics is tackling this problem and a preliminary report will be published next week.

AVIATION

Can the TSR2 Recur?

BETWEEN 1951 and 1967 the cost to the British taxpayer of cancelling defence projects involving military aircraft and missiles amounted to £430 million, of which £125 million was lost on a single project, the TSR2. A case study of the TSR2 compiled by the Royal United Service Institution affords a melancholy history of the management of the project and warns that major changes in the system of government decision making remain to be made if the shortcomings of the project are not to be repeated with its current successor, the MRCA 75 (*Crisis in Procurement: A Case Study of the TSR2* by Geoffrey Williams, Frank Gregory and John Simpson, RUSI, London, 1969).

According to the study the faults of the project were partly that the specification of the aircraft was too ambitious but chiefly that the business management methods of the government were hopelessly antique. The TSR2 first flew in September 1964, four and a half years after the first contract had been awarded, whereas the F111, the American competitor, left the ground in December 1964, only 21 months after contract. The comparison is not quite fair, because research into basic components such as the F111 swing wing had been under way in the United States for several years before contract, while most of the TSR2 systems had to be developed from scratch. Nonetheless, the rate of spending on the TSR2 programme was probably too slow by half, amounting only to £125 million at the time of cancellation. The report says there was no really strong controlling authority and that the powers of the main contractor, the British Aircraft Corporation, were too circumscribed to control the 1,800 factories to which it had sub-contracted work and were in any case continually eroded by the supervisory activity of the Ministry of Aviation (now absorbed in the Ministry of Technology). The report complains about the system of cost-plus contracts, never an incentive for economics of time or of money, but also draws attention to the decision not to hand build prototypes but to construct a development batch. This would have given a shorter time to first flight if all went well, but little opportunity for design changes. In the event the Air Ministry demanded constant changes in specification up to a late stage.

This deficiency of management extended to the government accounting procedures. The study argues that although the decision to cancel was substantially correct, the basis for comparison with the F111 was false, largely because the major portion of the estimated £250 million spent on research and development was assigned to the TSR2 by fairly arbitrary conventions. The bulk of this expenditure was essential to the

development of any advanced military aircraft and should have been debited to general "policy" development rather than the TSR2 specifically. (Research on the TSR2 project has in fact proved useful for the Harrier, the British built parts of the Phantom order and other projects.) At the time of cancellation the unit cost of 50 TSR2s was said to be £9.5 million compared with £2.5 million for an F111. But the real unit cost for a 50 aircraft programme may have been more like £1.5 million. With different accounting systems, the RUSI report concludes, "it would have been valid to argue that the TSR2 ought not to have been cancelled for the F111".

Are the mistakes of the TSR2 project likely to be repeated? The study takes heart in the fact that all major aeronautical research is now combined under the Ministry of Technology and that management of subsequent projects such as Nimrod and Harrier has been placed unequivocally in the hands of the aircraft industry or of joint international companies. The horse-trading between service chiefs and politicians out of which the TSR2 was born has now given way to decisions based on cost effectiveness. Unfortunately, international projects, such as the Multi-Role Combat Aircraft (MRCA75), the successor to the TSR2, seem to have escaped this net. If this is the case, the MRCA75 "may yet turn out to be another over-complex and costly weapons system, without this time any opportunity for a British government to cancel it if costs appear to be escalating out of all proportion to the related benefits. . . . Indeed, major changes in the British system of governmental decision making, planning and control, and attitude to international projects, may be necessary before there can be any certainty that the shortcomings of the TSR2 project will not be repeated".

SPACE PROBES

Missing the Viking Bus

from our Astronomy Correspondent

THERE seems to be a serious danger that British participation in the round of lunar and martian missions now being planned in the United States will be less than it might be. What seems to have happened is that the British summer holidays have played havoc with preparations. The flights immediately concerned are the Viking plan to soft-land instruments on Mars in 1973 and flights to the Moon in the years 1971-75. Earlier this summer, NASA offered British scientists the opportunity to participate in the Viking missions and in Apollos 16 to 20, and the deadlines for applications are now near. Proposals for investigations to be carried on the Viking missions have to be received at NASA by 5 pm EDT on October 20 and for the Apollo missions by October 21. Before then, however, British proposals must be endorsed by the Science Research Council, which will submit a complete British application to NASA. The deadlines originally set by the SRC are long past—September 26 for the Viking missions, for example. And it is laid down that proposals must be submitted through an official agency, so that there is no point in applying direct. Perhaps the best hope now is that other applicants have been similarly affected.

Not only did details of the American offer come in

the holiday season, but their arrival also coincided with a sensible streamlining of the working groups of the SRC's Space Policy and Grants Committee. Instead of seven working groups, including one on the Moon, planets and interstellar matter, there are now three which can be roughly classified as geophysical, astronomical and one concerned with technical facilities. This has meant that there are for the time being no well trodden paths for cooperation in the planetary sciences.

The objective of the Viking missions is "to obtain scientific data which will significantly increase our knowledge of Mars, with particular emphasis on providing information relevant to life on the planets"—a statement which has a hollow ring after Mariners 6 and 7. Several of the experiments are concerned with what must now be a hopeless search for signs of life, and the planners ought to be asking themselves whether physical experiments might be more useful. The two Vikings which are to be launched by Titan Centaur rockets in 1973 into Mars orbit, where each will detach a package of instruments for a soft-landing, will nevertheless be among the most significant spacecraft of the decade.

POPULATION

Ford saves British Demography

THE 2 per cent annual growth of world population and the problems of urban living might seem to make demography a relevant, not to say urgent, subject of study, but British universities boast only a single department of demography between them, at the London School of Economics. And even that is nominally part of a sociology department and largely supported by the Ford Foundation.

Last week, the foundation gave a second five year grant, this time of \$230,000, to support the post-graduate teaching programme in demography. The programme, which is jointly organized by the LSE and the Population Investigation Committee, a research institution chaired by Professor D. V. Glass, is designed to meet the needs of students working in developing countries. Fifty-six students have been trained since the start of the programme and it is hoped that at least ninety students will be accepted in the next five years. The government committee looking into the population carrying capacity of the British Isles could do worse than to consider whether the present support for demography in British universities is appropriate to the need. Even the official projections of the British population compiled by the Registrar-General have recently shifted from 75 million in the year 2000 to 66 million, a discrepancy which must have given forward planners some doubts about the reliability of their basic data. The Ford Foundation seems to be supporting more than its fair share of research.

SCIENCE POLICY

Policy Evolution

DEVELOPING a policy for science and technology is a difficult business. This was one (perhaps the only) conclusion to be drawn from a seminar on science policy held last week by the Science of Science Foundation. The seminar, the first of a series of eight, was opened by Dr Douglas Hill, director of Shirley Develop-

ment Ltd (previously the Shirley Institute). His main objective, he said, was to pose some important questions, not necessarily to answer them.

The title of the series of seminars is "Evolving a New Policy for Technology", which suggests that there is already a policy to replace. Dr Hill was not convinced of this. Past government policy for science, he said, has consisted mainly of transferring responsibility from one department to another, often without much effect. But one cannot blame the government for neglecting issues about which public opinion is itself apathetic. For Dr Hill, the solution must lie in education. This viewpoint was widely shared by participants in the seminar, and endorsed by a speaker from IBM who bemoaned the neglect of interdisciplinary studies. Dr A. Mackay of Birkbeck College argued that it is for technical people to explain technology to lay people, especially when arguing for more research money, and the present education system does not provide them with this ability.

There was general agreement with Dr Hill's remark that the rapid growth of science and technology makes control at once more difficult and more necessary, the general feeling being that a good science policy "picks the right man and lets him get on with his research". Formulating such a policy involves several difficult questions. Should science and technology have the first call on resources? Should a national policy for science and technology also include a consideration of the social consequences of science? Who is to devise and implement such a policy? It was generally agreed that the resources allocated to science and technology should be substantially increased, although Dr D. Smith of the Natural Environment Research Council argued that plant and manpower could be utilized much more efficiently. Dr P. T. Houldsworth of the Welding Research Institute also maintained that there is a greater shortage of people "willing to have a go" than there is of risk capital, although British industry leaves no margin for failure: "If you want to get an idea adopted in British industry," he said, "it has to work first time and work damn well", otherwise any capital needed to improve on an idea will not be forthcoming.

Dr Hill suggested that only the government is capable of carrying out a policy for science and technology, but he argued that policy should be formulated by scientists and opened up to public debate. This requires an increase in public awareness of science policy issues. The Council for Scientific Policy, which was intended to be a decisive influence in the formulation of science policy, was strongly criticized by Dr M. Goldsmith in his summing up for failing to fulfil these intentions.

LABOUR PARTY

From Brighton to Europe

TECHNOLOGY seems to be a dirty word in Brighton. Even the Common Market debate at the Labour Party Conference last week produced only one mention of technological cooperation. Mr Stanley Henig, MP for Lancaster, said in a speech welcoming "the determination of the Labour Government to negotiate Britain's entry into the Common Market", that "the advantages in technological cooperation are enormous if we are not to become engulfed by the United States".