Whether this will be sufficient to answer the critics remains uncertain. While scientists were voicing their fears about academic freedom, several investment houses were saying in public last week that they thought it was a bad thing for a university to get involved in commercial operations. Dr Bok's announcement about whether the university intends to go ahead with plans to set up the new company is therefore awaited with great interest.

David Dickson

European science

Foundation stones

Strasbourg

The European Science Foundation ended its annual general assembly here last week (13 November) in a vaguely hesitant frame of mind. Unlike previous assemblies, this was less a general amplification of the enthusiasm for international collaboration of member organizations (now 47 research councils and learned academies from 18 countries) than a reluctant recognition that the next six years may be more difficult than the past — and first — six.

Part of the hesitancy stems from changes of personnel. Lord Flowers, rector of Imperial College, London, and president of the foundation for the past six years, handed over at this year's assembly to Professor H. Curien, director of the CNRS (Centre National d'Etudes Spatiales) in Paris, while Dr. John Goormaghtigh succeeded Dr Friedrich Schneider as secretary-general only a year ago. But the member organizations seem also to be preoccupied with domestic funding problems and thus less able to think expansively than in recent years.

Several of the foundation's recent initiatives appear also to be at critical, even anxious, stages. Thus the development of a plan for what is called the European Synchrotron Radiation Facility, on which a foundation study group has been working for the past three years, is in the air. At the general assembly in 1979, the retiring secretary-general, Dr Schneider, was asked to spend a year sounding out European governments on their willingness to contribute towards the cost of the machine, estimated at something of the order of $100 million.

Dr Schneider appears to have found this a disappointing year. Potential contributors to the cost of the machine have taken the view that haste might jeopardize eventual construction. Some governments also appear to be suspicious that the foundation is usurping their role of making treaties among themselves for multinational projects. The study group (under Professor Y. Farge of Orsay) will, nevertheless, remain in being during 1981, concentrating on the further refinement of its proposals.

The foundation is also despondent about the prospects for space research in Europe. A year ago, one of the foundation's published reports took the European Space Agency to task for the degree to which its then programme was biased to the development of the Ariane launching system, to the detriment of plans for launching scientific satellites. At this assembly, delegates were told that there has been no substantial improvement. Plans for launching European scientific satellites are so sparse that scientists who are members of space research groups in Europe may have to wait about five to seven years between successive experiments. Professor Curien told the assembly that this might be inevitable in studies of "the reproduction of the elephant, or of silviculture", but that it was an entirely artificial circumstance in space research.

The foundation is not, however, entirely frustrated. Its programme on polymer structure is going well (see box), while the assembly agreed to launch a number of new projects in the social sciences while continuing most of its past successes, the programme of training in "brain and behavioural research", for example.

On more general questions, the foundation has decided to keep in being the Liaison Committee on Recombinant DNA Research even though, according to a statement from the committee, the need for attempts to coordinate containment guidelines has melted away. The focus of anxiety has moved to what are called "second generation" issues, including the pace and the manner in which recombinant DNA techniques are being commercialized with the possible consequential risks to academic research. Dr Philip Handler, president of the US National Academy of Sciences, said in his invited address to the assembly that academics forming commercial links with DNA companies were "creating a great deal of difficulty for the others working in this field".

The foundation has also issued a statement asking that national governments planning new legislation on the confidentiality of computerized data banks should also bear in mind the value of such data, suitably shorn of identification, for the research community.

The assembly approved the foundation's budget for 1981, which exceeds FF5 million for the first time, and which does not include the cost of the special research projects (called "additional activities") to which member organizations contribute on a voluntary basis.

Lord Flowers estimated, in his final address to the assembly, that the total expenditure on the foundation's activities amounted to less than 0.1 per cent of the budgets of member organizations, and hoped that the next six years would see a tenfold increase in this proportion in the next six years, as well as a further extension of the foundation's sphere of interest. The academy of Finland was admitted as a full member of the foundation with effect from 1981.

Something ventured, something done

Both the new research projects approved by the 1980 assembly are in the social sciences. One, under the rubric of "comparative law", and to which ten countries have agreed to contribute, includes an attempt to define and compare the medical responsibility within Europe. The study will include the responsibilities of physicians and drug firms towards patients and the influence of medical insurance on the behaviour of physicians. There is also to be a European study of procedures for summary jurisdiction in civil and other courts.

The social scientists are preoccupied with migration and language, and have won approval for two other research projects — the problems of language acquisition by adult migrants within Europe (of whom there are estimated to be 11 million) and a series of research workshops on the human and cultural aspects of migration within Europe.

There is also to be a one-year study of problems of technical innovation and social change, chiefly so as to identify fields in which coordination by the foundation might be beneficial.

Continuing projects that appear to be flourishing, or nearing fruition, include:

- *Chinese studies.* A handbook of Chinese literature in the period 1900-49 is nearing completion, while a descriptive catalogue of the body of fifteenth century Chinese literature known as the *Tao-Tsang* is well under way.
- *Brain and behaviour research.* The foundation plans to spend in 1981 a total of FF1.3 million on this programme of training awards and travel grants.
- *Taxonomy.* The *ad hoc* group on European taxonomy is to be disbanded, and its final report published in March next year. The draft report claims to have made substantial progress towards understanding the difficulties of coordinating European taxonomic nomenclature.

Fusion research

Livermore looks up

Washington

After a period of considerable uncertainty, scientists in the two main fusion energy programmes at the US Department of Energy's Lawrence Livermore Laboratory in California are confident that recent technical advances are given a significant boost to the chances of being able to exploit nuclear fusion as a commercial source of power.

In the magnetic confinement programme, successful tests with so-called tandem mirrors, which could be used to

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"plug" the ends of a solenoid containing plasma, have led to the decision to include the mirror devices in the Mirror Fusion Test Facility (MFTF) at present under construction. Work is already under way on plans for a new, larger machine, tentatively referred to as the Tandem Mirror Next Step (TMNS), which could become a serious rival to the tokamak design.

The programme based on inertial confinement techniques is also looking well. Recent experimental data indicate that solid state lasers made from vanadium-doped magnesium fluoride crystals have characteristics, high energy efficiency chief among them, which may overcome the difficulties experienced with the use of more conventional solid state lasers to ignite a deuterium–tritium pellet.

The tandem mirror is a device first proposed in 1976, when experimenters were experiencing considerable difficulty in preventing plasma from escaping its containing magnets along field lines which are open rather than closed (as they are in a tokamak). Its ancient ancestor is the machine called DCX, developed at the Oak Ridge National Laboratory in the 1950s.

Proposed simultaneously by Ken Fowler and Grant Morgan at the Livermore Laboratory, and Soviet scientists at Novosibirsk, the mirror acts by using two magnets to contain a plasma in an electrostatic potential well, the plasma being positively charged because electrons are able to escape faster than protons.

Small-scale experiments were carried out by research workers at the University of Tsukuba in Japan last year, demonstrating that, in principle, a tandem mirror designed to contain a plasma in this way does create the predicted potential well.

Subsequently, Livermore scientists have concluded a series of experiments on the tandem magnet experiment (TMX) in which they have been able to demonstrate that a solenoid with such plugs at each end can contain a heated plasma at a mean energy of 0.2 keV per atom, as compared with 13 keV within the end mirrors.

The attraction of a commercial fusion reactor based on this design would not only be the easier design tasks presented by a straight solenoid rather than a toroidal tokamak, but also that, once the end plugs have been produced to the tandem mirror design, the length of the solenoid between them can be adjusted at will to provide the power characteristics required.

The US Congress has already been sufficiently impressed to approve substantially increased funding for the MFTF now being built.

Its success or otherwise will determine whether the department should proceed to the next logical step, the TMNS, Livermore scientists feel that magnetic mirror designs could catch up with tokamak technology, the most likely design for a Fusion Energy Device (FED), and which the department hopes to build over five to ten years.

Meanwhile, those working on the inertial confinement techniques are hoping that the promise of vanadium-doped magnesium fluoride lasers may overcome doubts about the ultimate potential of solid state lasers as fusion drivers.

Most of the research so far has been done on glass lasers, initially with red light and more recently, following the development of techniques for doubling the wavelength, with green and blue light which has a greater ability to focus energy on a small deuterium–tritium pellet.

Preliminary evidence suggests that, in contrast with the conventional krypton fluoride laser, which only has an efficiency of between 5 and 7 per cent, a $V:MgF_2$ solid state laser would have an efficiency of between 5 and 10 per cent. With other advantages, this would help to reduce the cost of electricity from an estimated $300 million to $100 million per megajoule.

Livermore scientists are now carrying out further experiments to determine whether crystals with such characteristics can in fact be grown for use in lasers. If so, solid state lasers will remain a serious contender in the fusion stakes.

David Dickson

Radioactive waste

Brussels helps

The parallel research programmes of the European Economic Community (EEC) and Canada on the storage of radioactive waste are to be linked. A five-year agreement was signed in Brussels on 3 November between the European Atomic Energy Community (Euratom) and Atomic Energy of Canada Ltd. It follows on from the original Euratom/Canada agreement of 1959.

The new agreement relates particularly to the evaluation of the environmental impact of the storage of wastes in hard rocks, and to collecting data on the development of safe waste storage systems. There has already been considerable cooperation between scientists in these fields, so the agreement puts this on a more formal basis and opens the way for even closer cooperation.

Initially the agreement will lead to exchanges of technical information, organization of joint scientific meetings, and exchange visits of scientists between Canadian and European laboratories.

The agreement is the first in this field between the community and an outside country. It is likely to be a pointer to a trend towards more international cooperation, and the United States is already showing interest in closer cooperation with the EEC.

The community's own research programme was unveiled with a great fanfare in Luxembourg in May this year. The community's contribution, US$130 million, is planned to extend over four years. Of the total, $100 million will be contributed on a fifty-fifty basis to national research programmes, while $30 million will be spent at the joint research centre at Ispra.

Research on the disposal of high-level wastes is well advanced in France, West Germany and the United Kingdom. In each case, the objective is to embody high-level radioactive wastes in some solid form — France and the United Kingdom are chiefly interested in vitreous solids, while West German studies have also taken account of bitumen-like materials.

In several member states, investigations are also under way to identify disposal sites for solidified radioactive waste. France and the United Kingdom are exploring granite formations, West Germany salt formations while Belgium and Italy are concentrating on silaceous (clay) formations.

Jasper Becker

Waste disposal

UK goes French

British Nuclear Fuels Ltd (BNFL) whispered last week its intention to use the French AVM process for vitrifying highly active nuclear waste emerging from the Windscale reprocessing plant, thus bypassing the British "Harvest" vitrification research programme which has been under way at Harwell. There was no official announcement by BNFL: rather, the news emerged during a routine meeting of the Windscale local liaison committee, a group convened to keep the local community aware of developments at the plant. The leak was intentional, and confirmed rumours that BNFL had chosen AVM some time before.

A full commercial agreement between BNFL and Cogema, the French company which developed AVM, has not yet been reached, and if Cogema's price is too high the deal may still fall through. As presently envisaged, it would entail constructing an AVM (*atelier de vitrification a Marcoule*) plant at Windscale in the late 1980s, under licence from Cogema.

BNFL will not say at this stage why it has chosen AVM, though the reasons are not far to seek. Both the French and the British began work on vitrification in the late 1950s but work halted in Britain in 1966 when the principle had been demonstrated. (It was felt at the time that it would be possible to store liquid high active waste indefinitely in tanks.) Political pressure led to the setting up of the Harvest programme (Harwell vitrification engineering study) in 1973, but by then Cogema had established a seven-year technological lead.

While the Harvest team at Harwell is even now using only simulated nuclear waste, a plant called PIVER was built at Marcoule eleven years ago to handle the real stuff in commercial quantities. PIVER ran from 1969 to 1973, and produced 12 tonnes of vitrified waste containing 5 million curies of activity — roughly speaking the arisings of a 1 GW nuclear power plant working over the same period.

PIVER was a batch process, like

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