on energy, research, and technology, says his committee has been "pushing ahead a Commission which has not been very dynamic."

On the other side of the argument have been the research (and finance) ministers of the three largest EEC nations, France, West Germany, and the United Kingdom. Each, while committed to the creation of what Commission president Jacques Delors describes as a "European Technological Community," argues that this is not necessarily achieved merely by pouring money into joint research projects. German finance minister Gerhard Stoltenberg, for example, described the Commission's first proposals as a "pre-planned financial crisis."

Their reservations have been based partly on ideological opposition to increased public support in areas of technology that should in principle, they claim, be left to the private sector. EEC officials such as Fasella respond by arguing that, in practice, the private sector does not have a good record of support for long-term research, that the relatively small size of even Europe's largest companies places them in a weak position compared to many of their U.S. competitors, and that even the U.S. government subsidizes technological development through military contracts.

A second complaint is over the alleged inefficiency of EEC research. This was highlighted last year in a report on the four laboratories making up the Commission's Joint Research Center (JRC) by the research director of Shell, Harry Becker, claiming that the labs were badly managed and not responding to the needs of industry.

EEC officials acknowledge that there is a problem with the JRC, and say they are determined to improve the situation. Major cuts, however, which some of the larger countries would like to see, are strongly opposed by the host countries involved.

Britain, the last of the three major critics to accept a compromise research budget, has been particularly fierce in demanding much stricter selectivity and evaluation of research programs. Prime Minister Margaret Thatcher has argued that the same stringent economies should be applied to European projects as she has already imposed on her domestic research community.

But even British officials acknowledge that the stakes are higher than questions of cost-effectiveness. The Single European Act talks explicitly about the need to preserve "the technological and industrial conditions for European security." This means that, provided politically acceptable forms of collaboration can be found, the "Europeanization" of research through the EEC is likely to remain an important goal. ■

DAVID DICKSON

CERN: Adapting to Middle Age

Europe's premier particle physics laboratory, now 35 years old, is facing funding constraints, uncertainty

Geneva

FEW European research efforts have achieved either the scientific status or the public recognition of CERN, the giant particle accelerator near Geneva that has put Europe at the forefront of high energy physics for the past few years. The facility, which since 1954 has been formally known as the European Laboratory for Particle Physics, is arguably Europe's most successful venture in scientific cooperation.

Yet, for all its achievements, CERN is facing an uncertain future as some member countries—most prominently Britain—are questioning whether it is as cost-effective as it could be. In addition, European physicists are intently watching the debate in the United States over the Superconducting Super Collider (SSC). Whatever decision is made on the SSC will profoundly affect CERN's long-term plans.

Herwig Schopper. *"The boundary conditions have changed, CERN needs to adapt."*

"CERN is now 35 years old," says Herwig Schopper, the laboratory's director general. "The boundary conditions have changed, and CERN needs to adapt."

In the early 1950s, when the laboratory was set up at the joint prompting of U.S. and European physicists, CERN's justification was relatively straightforward. As a recently published book on its history demonstrates, three appealing arguments—in addition to the scientific case—helped convince governments to provide support: that CERN would guarantee Europe's involvement in the "nuclear" research considered essential in the postwar world; that its restriction to fundamental science would avoid the complications of cooperating on applied research; and that an international laboratory would be a major step toward the political integration of Western Europe.

Today, none of these justifications is particularly powerful. High energy physics is no longer considered by European countries (except perhaps Italy) to automatically deserve special treatment, either nationally or internationally, compared with other areas of basic science. And the questions being raised by member governments have more to do with cost-effectiveness and management efficiency than with claims that CERN should be preserved as a necessary symbol of either European unity or its scientific talent.

Such were the main arguments behind the conclusions of a government-requested report produced 2 years ago by a British committee headed by molecular biologist Sir John Kendrew. The report lavished praise on CERN's scientific achievements. But it went on to argue that significant economies could be achieved in the operation of the laboratory that would allow Britain to reduce its subscription by 25% by 1991. Indeed, the committee said that Britain should remain a member after that date "only if this can be achieved at a significantly lower cost."

Kendrew's conclusions drew much angry comment. The European Committee for Future Accelerators described the suggestion of a 25% cut in CERN's budget as "totally unrealistic," while the London *Times* thundered that withdrawal would mean "the effective end of Britain's long and leading contribution to the scientific study of the nature of matter."

But because the basic concerns that led the British government to commission the Kendrew report are privately shared by

many of its other European member states, the report has proved a powerful catalyst for joint consideration of future changes in the way that CERN is run.

Even before Britain raised the stakes, CERN was facing mounting financial pressure internally. This stemmed largely from the promise made by the laboratory in the early 1980s that the new 27-kilometer-circumference Large Electron-Positron Collider (LEP), currently under construction and due for completion in 1989, would be built with no increase in CERN's operating budget of $490 million a year.

The financial pressures are leading to a gradual evolution in the way that CERN's activities are funded, and hence the way decisions are made. Originally, CERN's 14 member states paid dues to cover the costs of all the experimental facilities on the basis of their gross national products. Recently, however, there has been a shift toward "*á la carte*" funding, under which member countries can decide whether or not to contribute to a specific project. This principle has already been applied, for example, to the financing of the four detectors for LEP.

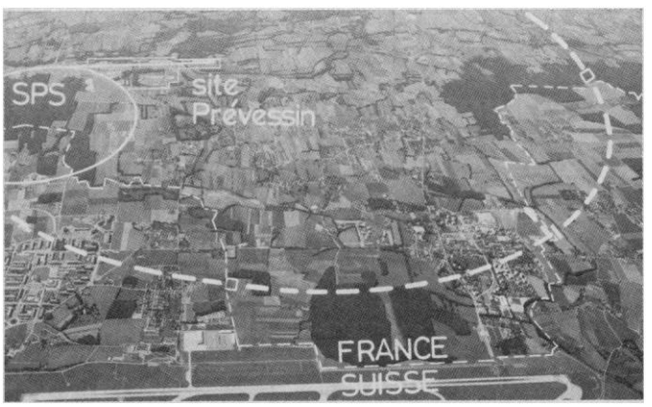
Another shift is that, whereas in the past a policy of *juste retour*, under which member countries receive construction and supply contracts in proportion to their membership subscriptions, has been deliberately eschewed, some countries are being allowed to make their contributions to the LEP detectors "in kind." This avoids selecting equipment solely on the basis of price and performance.

Such changes have not been wholeheartedly welcomed by CERN's physicists. "There is a danger that the increased involvement of external institutions could lead to uneven treatment, for example, between physicists in a big laboratory in a member state which is able to build some large equipment, and those in a university which does not have anything comparable to offer," says Maurice Jacob of CERN's theory division.

There is also some concern over the implications of preliminary recommendations made recently by a committee set up by CERN at Britain's suggestion under the chairmanship of French physicist Anatole Abragam. The committee suggested that more use be made of professional managers and outside contractors to carry out work currently performed by in-house teams, and that between 350 and 500 positions—up to 15% of CERN's work force—be eliminated over the next 2 years. Some fear that although such proposals may produce a leaner, fitter organization, there could be a price in terms of tighter control by member governments that would jeopardize some of the scientific freedom the laboratory has enjoyed up to now.

The LEP ring

CERN's next big project. It should be completed over the next few years; what will follow it is uncertain.



Schopper, however, says that in principle the thrust of the Abragam committee's proposals are "very reasonable." CERN officials hope that they could, if implemented, go a long way toward meeting the conditions suggested by the Kendrew committee—and subsequently endorsed by the United Kingdom's Science and Engineering Research Council (SERC)—for Britain's continued membership.

Bill Mitchell, SERC's chairman, says he calculates that the Abragam committee's recommendations could lead to a 15% reduction in Britain's subscription over a period of 4 years, and considerably more after that date. Such reductions, he says, could make "attainable" the reductions being sought by both the SERC and to the British government, although others point out that a recent drop in the value of the pound has already made Britain's CERN contribution significantly more expensive than it was when the Kendrew report was delivered.

One suggestion in the report that is already being implemented—and could have important implications of its own—is that CERN should look beyond its own member governments for funds. Thus, two-thirds of the costs of the four LEP detectors are being paid for by outside scientific institutions, and half these funds are coming from non-CERN members, such as the United States.

In addition, full collaboration is being sought from non-European countries in future projects, and proposals are even being discussed about how these countries might be made eligible for an intermediate form of membership. This, of course, would mean the end of the idea that CERN is a purely European laboratory. (Foreign research workers have always been welcome, but core finance has come from European members.)

"The original objective of promoting international collaboration has not changed, but it has been modified," says Schopper. "Originally the main aim was to get European collaboration; this is still pre-eminent, but now our goal is to get collaboration on a worldwide basis."

Fortunately, no major decision about the future needs to be made until 1989, the year in which LEP will be completed. By then, work will have started on the upgrading of LEP, and, just as importantly, definite decisions are likely to have been made in the United States over whether or not to proceed with the SSC.

If the SSC plans are delayed, then CERN is likely to push for the construction of the Large Hadron Collider (LHC), which would involve placing a second set of superconducting magnets in the LEP tunnel, as an "intermediate step." The LHC would be able to perform some of the same physics as the SSC but at a much lower cost.

If by that time agreement has been reached on the immediate construction of the SSC, then CERN's focus may shift toward a very different machine, a 2 × 1 trillion electron volt electron-positron linear collider currently known as CLIC (for CERN Linear Collider). This has already been described as "exceedingly attractive" in a report presented in June to the CERN council by an internal committee on long-range planning headed by Carlo Rubbia. U.S. physicists have implicitly pledged their support for a large linear collider to be built in Europe—provided the Europeans support the construction of the SSC.

Whether the LHC or CLIC is chosen as the next project, raising the money will not be easy and may require even further dilution of the idea of CERN as a purely European laboratory. But few doubt that the laboratory will continue to thrive. "The survival of CERN will be determined by the survival of this kind of physics," says Jacob. "If the physics continues to be exciting, then CERN will survive." ■ **DAVID DICKSON**