European Unity, Inch by Centimeter

Even as Europe's business community tears down national barriers, "small" science remains largely a collection of national programs. At long last, however, a variety of collaborations are sprouting

BRUSSELS AND STRASBOURG—For 800 years, scientists moved relatively freely around Europe while commerce faced formidable barriers. But now, says Michael Posner, who runs the European Science Foundation (ESF), an association of 56 research councils and academies from 20 European countries, "we're behind soap salesmen in the ease with which we can operate globally."

Viewed from ESF's Strasbourg headquarters, this makes for an ironic situation: Europe's business community will this year complete the job of creating a "Single European Market," allowing goods and services to flow freely throughout the 12 nations of the European Community (EC), while European science remains a crazy quilt of diverse national programs. "It's as if Rhode Island, Delaware, and every other state insisted on running their own completely separate scientific system," says John Tooze, who heads the 17-nation European Molecular Biology Organization based in Heidelberg.

Some examples: A doctorate takes 3 years in Britain and 5 in Germany; no two nations have similar scientific career structures (France is giving out lifetime tenure, Britain is abolishing it); every nation has its own set of research councils, review boards, and referees; and most nations recruit their scientific workforces from within their own territory—regardless of whether there are better people just across a nearby border.

Unity at last? As long as their research needs were met by individual governments, European scientists were not bothered by this fragmentation. But in recent years, a combination of idealism, the example set by businessmen, EC funding regulations (which insist on cross-border collaborations), and the simple fear of being overwhelmed by better organized scientific enterprises in the United States and Japan is finally nudging scientists toward closer European unity. Evidence for this can be seen in new links being forged between the national research councils, in a collection of international projects involving existing laboratories scattered across the continent, and in efforts by the leaders of some scientific societies to recruit members from Europe as a whole. "Ten years downstream," predicts Mike Springford, a professor of physics at Bristol University who chairs the physics committee at Britain's Science and Engineering Research Council (SERC), "we shall be seeing far more of what we think of as small science—now almost exclusively national—being supported by European programs."

Posner sees change too: "Our member organizations have until quite recently been entirely locked into their national frameworks, but they're learning—not particularly fast—that science can be done transnationally. Little bits of the organization learn. Slowly it begins to spread. Then lots of people start to say the same thing. Suddenly, one day, in a blinding flash, everyone will realize it is true" that science doesn't have to be constrained by national borders.

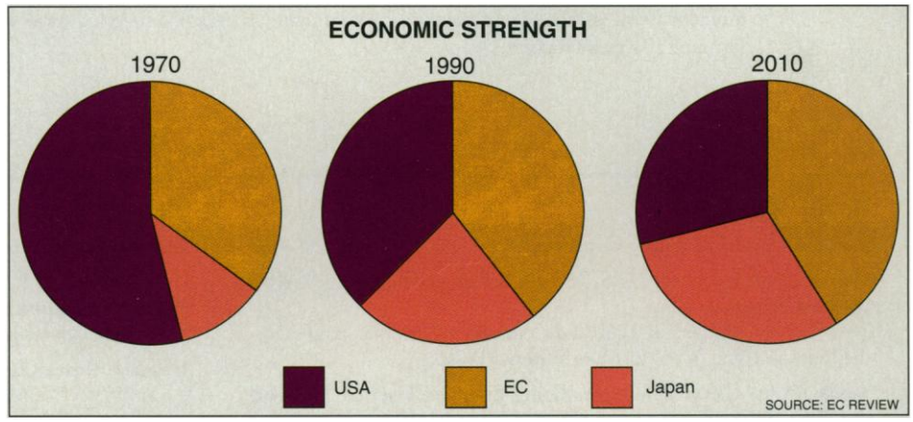
That realization came a long time ago to researchers in big science. They already have flourishing European centers at Switzerland's CERN (high-energy physics), the UK's JET (fusion research), and Germany's Garching (astronomy). It's the researchers and government officials responsible for the thousands upon thousands of smaller science projects who are only now beginning to be won over to the joys of international collaborations.

At the moment, however, there is still "a high ratio of talk to action," as Sir Martin Rees, professor of astronomy at Cambridge, sums it up. And there is no clear answer to the key question of whether any one organization will step forward and seize the initiative, speeding the Europeanization of science.

The most obvious place to look for leadership is Brussels, where the European Commission has the only sizable pot of money for pan-European science and its administrators can command the ears of the EC's science ministers. But ask anyone at the Commission's Directorate General for Science, Research, and Development ("DG XII") in Brussels if the EC expects a dominant role for itself in the future and the answer is: "That's not our mandate."

Brussels connects. So they say, anyway. But Brussels has already played a key role in stimulating Europe's basic researchers to look beyond their own borders. "We provide something that no other structure can provide, the catalytic effect of transnationality," says Dreux de Nettancourt, chief of the Biotechnology Division. The EC's $2-billion-a-year research program is applications-oriented but contains basic research components in almost every field of science, from genome analysis (projects on yeast, *Arabidopsis*, and the pig in the BRIDGE biotechnology program that de Nettancourt runs) through computational neuroscience (in the ESPRIT information technology program) to plasma physics (at JET in the FUSION program).

One program, appropriately called SCIENCE, has been particularly popular with basic researchers—it is the only program aimed specifically at them. Praise is easy to find: "The SCIENCE grant enabled

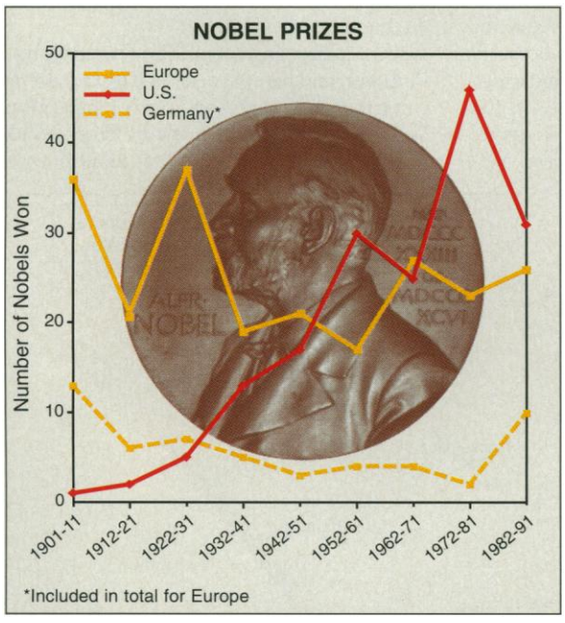


Changing balances. The European Community is now the world's largest economic group. By 2010, its combined gross national product will be 1.45 times that of the United States and 1.4 times that of Japan, according to EC projections. The increase will be due in part to the expected addition of Austria, Sweden, Finland, Norway, and Switzerland to the 12 current members (Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, and the United Kingdom). European dominance of the Nobel Prizes ended in the 1940s (right), but in the 1980s, the U.S. share declined while that of Europe increased, thanks largely to several awards to German researchers.

us to link with some of the best geneticists in Britain and the Netherlands," says geneticist Jean-Louis Guenet at the Pasteur Institute in Paris. Guenet is part of a 19-laboratory network that is mapping the mouse genome. And at Britain's Daresbury synchrotron facility, a $2.7 million SCIENCE grant made it possible to provide space for researchers from all over Europe. "It's been very successful," says Alan Ledbetter, who runs the laboratory. "We've brought in very high quality scientists and projects from 50 laboratories, as far apart as Spain, Italy, Germany, France, and Greece."

Large numbers of basic biomedical researchers have been involved in a program called BIOMED-1, which takes networks to an extreme through what project officials call "concerted actions," each of which involves exchange of information among scores of laboratories across Europe. "In the last program, we had 5000 teams in 140 concerted actions," says Tony Dickens, who runs the program.

But while no one questions that Brussels is doing good business as Europe's biggest international marriage bureau for researchers, as a leader of European science, the city has its drawbacks—and these include ones that are not likely to disappear this century. Two basic principles agreed on by EC members set limits for Brussels. One says that the EC can do only what national governments cannot do on their own, which means support for multinational projects only; and the other stresses European industrial competitiveness as the main goal, which means little money can be spent on fundamental research.



Brussels is also handicapped by severe political problems. Most EC research projects are collected into a series of big, 4-year "Framework Programs," which are meant to roll smoothly through the legislative process as one budget package. Unfortunately, the latest package has come apart. The $800 million Third Framework program should be running from 1990 to 1994 but some parts of it (including the successor to the SCIENCE program) still haven't won approval. The problems look as though they will go on almost to the end of the century. The next Framework Program should run from 1994 to 1998, but it hasn't entered the legislative process yet—which means there is no hope of it winning approval before 1996, and a 2-year funding gap is opening up in EC's research plans. As a potential 21st-century center for European science, funding the best wherever it may be found in Europe as a whole, Brussels is not the place to look.

Selling hot ideas. The ESF in Strasbourg is the other obvious place to seek leadership for European science. It may not have much money of its own (appropriately, it is located in a medieval nunnery), but its staff wins lots of admiration from scientists for coming up with clever ideas. ESF staff have to put together proposals for pan-European research programs that are so good that the foundation's members—the 56 national research councils and academies—will agree to pay for them out of national budgets. "It's like being a used car salesman," says Jan-Hendrik Koch, a Finn who runs ESF's biomedical programs.

But Koch is being hard on himself: The ideas that ESF sells are not used models. Some are large scale: Take the European Geotraverse, completed in 1990, in which a multinational team constructed a several-hundred kilometer deep picture of Earth's crust and mantle in a slice of Europe running 4000 km. from northern Norway to southern Tunisia. A massive synchrotron radiation facility for Europe began as a hot idea from ESF—and now the $465 million 12-nation facility is almost complete at Grenoble.

With its own modest funds, ESF puts together research networks (currently 21, lasting 3 years each) that link teams from 10 or so laboratories across Europe. "The philosophy is to invest in areas with growth potential," says Koch. Then, sounding more like a Wall Street stock analyst than a car salesman, he adds: "When the curve turns and the field begins to plateau, ESF should already have pulled out." A current hot topic: the dynamics of complex systems in biosciences. A network brings together people across Europe studying nonlinear dynamics in fields as apparently separate as epidemiology and pattern recognition.

ESF successes have convinced some of its staff that the foundation has the potential to grow into a full-scale research council for Europe. The problem with Brussels, explains Manfred Mahnig, ESF scientific secretary for physical sciences, is that it is working with "a very restricted remit which defines only a handful of political objectives, such as industrial competitiveness and regional development." So why not pass 5%-10% of the research money directly spent by Brussels over to ESF? That, he believes, could create "the research council which Europe needs."

But Posner demurs, arguing that ESF does not have the political support to make a grab for power. "We have no ambitions to take over," he says. "Some people talk about a European research council—us being the executive arm of Brussels, but it's not likely."

Instead, Posner sees a much more ad hoc and complex future for European science. "Different organizations are likely to get together like mad, separately from Brussels, on a European scale," he says. "That could result in a collection of separate bodies and it could be done quite differently for different types of science."

If Posner is right, then don't expect any big new power centers for European science; instead, look for collaboration here, there, and everywhere in a new and multiple pattern of interactions between the research councils and academic groups that have so far focused on their own national interest.

In fact, this pattern is already starting to emerge. Changing consciousness in the research councils is evident in their new willingness to talk over small science projects. Springford from Britain's SERC physics committee last year began annual meetings with his European counterparts to look at whether national research councils "might come together to support projects in the half to 1 million ECU-class [$600,000-$1.2m]—projects which are very difficult for us to fund within one research council."

Diplomatic science. Research councils' "ambassadors" are also going overseas to talk to other countries' scientists and scientist-bureaucrats. The biggest concentration of foreign representatives is in Brussels. "Ninety percent of the European pure science agencies are represented in Brussels.... Brussels is the focus for European collaboration and discussion," says Alf Game, who represents all the British research councils there. Close by are the offices of CLORA, representing 10 of France's state research organizations and, just arrived last November, a representative of the German research councils. With so many representatives in one place, some spontaneous "summits" have already taken place in local bars, says Anne Mandenoff, president of CLORA.

The French Centre National de la Recherche Scientifique (CNRS) has led the way in establishing links with foreign researchers with representatives in the United

Kingdom, Germany, Japan, Brussels, and the United States. Jacques Bordé is CNRS's representative in London. He gave up a research career in quantum mechanics to move to Britain 6 years ago. "The number of cooperations was ridiculously low. I saw there was really something to be done," he says. Bordé says he has personally been in touch with 400-500 labs since he came to Britain and has a database listing more than 1000 collaborations. And although he modestly refuses to accept much of the credit, joint publications by Anglo-French teams increased by 50% in the 4 years after he arrived. It's not all plain sailing, however: Bordé wrote recently in the CNRS journal that "British researchers are exceptional partners but difficult to work with."

A particularly sweet success came last December with the establishment of the first "Associated European Laboratory (LEA)," a laboratory without walls that fuses research projects from the Institute of Astronomy in Cambridge, the Astrophysical Institute in Paris, and the Leiden University Observatory in Holland. "The initiative came from François Kourilsky, the director-general of CNRS," says Simon White, the LEA director. "His idea was that there was need for a collaborative structure somewhere in between a small collaborative research project and the very large-scale projects like CERN." Four more such laboratories are now being created in materials science, plant molecular biology, magnetism, and viruses and cancer.

One key element is missing from this picture of the emerging Europeanization of science, however: an active lobby from the scientists themselves for international collaboration. Alas, when it comes to fighting for the greater European good, scientists have shown themselves to be just as bad as their political masters with their squabbles over small concessions to other countries.

Although many scientists join European organizations out of a sense of duty, every effort to set up true pan-European academic societies—ones that could lobby for science throughout Europe—has so far disappointed. Just like national governments, national academic societies have never proved willing to back pan-European societies wholeheartedly. The result is that the pan-Europeans are left with an endless struggle for funds: After 24 years of difficulties, the European Physical Society is now trying to reconstitute itself; the 13-year-old European Neuroscience Association is even considering that it might have to shut down (see p. 468); and the European Cell Biology Society and Developmental Biology Society are pale shadows of their U.S. relatives. If scientists lag behind soap salesmen, they have partly themselves to blame.

–Alun Anderson

With reporting by Peter Coles

MOLECULAR BIOLOGY

U.S. Juggernaut Overwhelms Divided European Elite

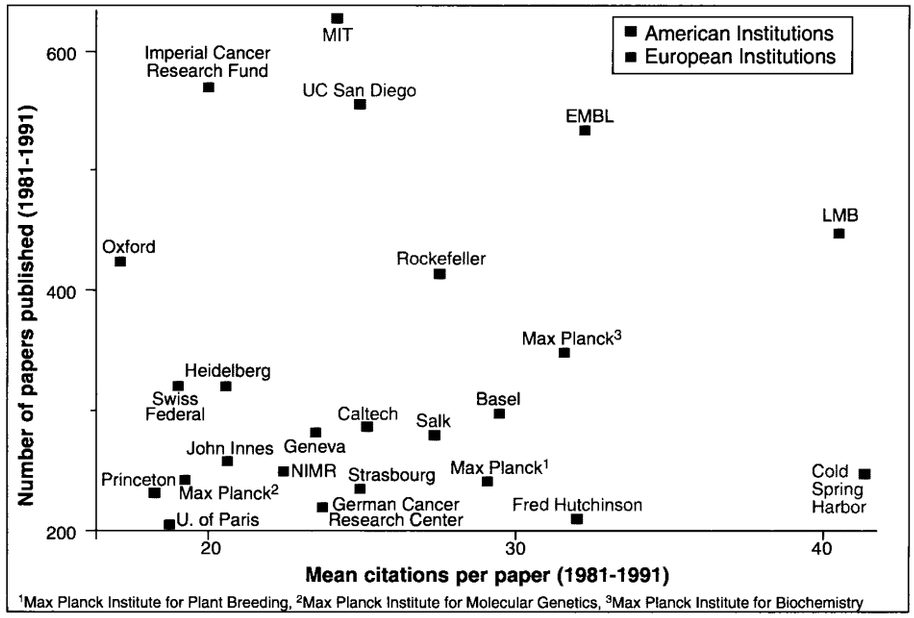
"Molecular biology worldwide is 80% American, more or less," says Pierre Chambon, director of the Laboratory of Molecular Genetics of Eukaryotes in Strasbourg. "We are lagging behind the United States," says John Tooze, executive secretary of the European Molecular Biology Organization (EMBO) in Heidelberg. "It's not a total disaster—there are many areas where Europe does excellent work—but we're behind."

Data on citations and manuscript output confirm the opinions of Chambon and Tooze (see chart): After a European lead, when people like Max Delbrück, John Kendrew, Francis Crick, Fred Sanger, Jacques Monod, and François Jacob virtually created molecular biology, most of the action is in America.

What would it take to raise European molecular biology to the U.S. level? More money is the obvious answer, given that the difference between the two continents is quantity not quality. The best research teams and institutes in Europe are as good as any in the United States—some are even better. In the frequency with which its papers are cited, the Laboratory for Molecular Biology (LMB) in Cambridge beats every other molecular institute in the world, except for the much smaller Cold Spring Harbor Laboratory. And the European Molecular Biology Laboratory (EMBL) in Heidelberg is not far behind, ranking third among the world's elite institutes. The problem for Europe is that there aren't enough labs like LMB and EMBL—and it's wishful thinking to suppose that Europe's national funding agencies are about to increase research support dramatically. "The funding will not be better," says Chambon, who points out that over the past 10 years, the budget of the U.S. National Institutes of Health (NIH) has increased in constant dollars by more than 50% while France's support hasn't changed. Instead, several of mainland Europe's senior molecular biologists suggest that strength lies in unity: There should be more central funding and peer review of Europe's highly fragmented molecular biology and greater mobility of young scientists, they argue.

"We are not well equipped to become competitive unless we join together," says Lennart Philipson, head of the EMBL. "If we took advantage of everything in Europe we could do much better."

Like European economists of a decade ago, Philipson and his colleagues are essentially arguing for a free market and open competition. Why not make grant reviewing Europe-wide so that money goes to the best in all Europe,



World ratings. At the very top, America and Europe come out even. List institutes (excluding small ones) by the frequency by which their papers are cited and Europe takes half the top 10 places (2. LMB, 3. EMBL, 5. Max Planck Institute for Biochemistry, 6. University of Basel, 7. Max Planck Institute for Plant Breeding). But a little further down the list, the United States weighs in with scores of high-quality laboratories. Source: ISI Science Indicators Data Base. To obtain more detailed listings, see p. 488.