well, Butler says. "I have yet to see the kind of acrimony that is just endemic to bureaucracy, although there are tense moments." He adds: "There is a sense that there is enough work for everybody."

A more guarded appraisal is offered by Francis Bretherton, director of the Space Sciences and Engineering Center at the University of Wisconsin at Madison, and one of NASA's chief academic advisers. He points out that NOAA has already declined to join NASA on the first EOS platform scheduled for launch in 1996 because it is concerned about potential delays. NOAA is an operational agency providing regular services to a broad clientele. It takes the position that it cannot risk any gaps in coverage, the kind that it sees in NASA's recent record. NOAA may decide in 1997 to jump aboard a later platform, after the system has proved itself. Meanwhile, the two agencies are designing their instruments and orbit profiles for full compatibility.

At the top level, Bretherton says, everyone agrees that NOAA is on board the program spiritually if not physically. At the working level, however, one encounters the view that "NOAA has dropped out, so forget 'em." The discrepancy may simply be a problem of poor communication, but Bretherton says it is "very, very important" that it be resolved quickly. Failure to reach agreement would endanger not just the quality of the data bank but the monitoring program itself. It would be fatal for NASA and NOAA to seek duplicate instruments to collect similar atmospheric data. "We could end up with a situation in which neither approach is viable on its own, and yet we've got two separate approaches," Bretherton says. "I'm not sounding any major alarms yet," but he is worried.

NASA officials believe these rumblings are normal for a program in the early stages of formation. They are certain that NOAA's special concerns can be accommodated. And they say they have begun to work on the problems of scientific direction raised by Hansen and others. They insist that existing global research projects will not be asked to make sacrifices, but that, on the contrary, they will benefit because of the increased attention given to the Earth Observing System.

The test of these commitments and of the government's good faith may come soon. If the existing earth observing projects—such as Landsat and the ocean and weather monitors run by NOAA—are not given better support in the next budget than they have received in the past two administrations, promises of future growth in space-based environmental research will be hard to credit. ■ ELIOT MARSHALL

German Biotech Firms Flee Regulatory Climate

A law that puts roadblocks in the way of new facilities is causing many firms to locate production plants overseas; the government has responded with a less onerous proposal

Ludwigshafen, West Germany

ALFRED VELLUCCI would probably appreciate the irony. A decade after the feisty mayor of Cambridge, Massachusetts, fought bitterly—and unsuccessfully—for the right to impose local controls on recombinant DNA research, the West German chemical company BASF has announced plans to open a new biotechnology laboratory in Boston, on Cambridge's very doorstep. The reason: BASF sees the Boston area as a safe haven from the public opposition the project may face back home.

"We were faced with the decision of whether to invest in Germany, in order to make biotechnology grow here, or to go to the U.S.," says the company's director of biotechnology research, Rolf-Dieter Acker. "We decided to do both; to develop some biotechnology facilities here, but also to build up a research group in the U.S., just to be on the safe side."

BASF's decision to set up shop in Boston, where a group of 60 scientists will eventually work in a brand new research institute on the development of anticancer drugs, follows a similar decision by the Bayer company. Bayer recently announced plans to open a facility for the production of recombinant Factor VIII in Berkeley, California, rather than closer to its home base of Leverkusen, outside Cologne.

These two moves have dramatically brought home to West German politicians the extent to which the country's large chemical companies are finding genetic engineering to be a "no go" area at home. Faced with public concerns about both the safety and ethical aspects of genetic engineering, the nation's biotechnology industry has been contending with growing regulatory problems for several years, which is why even some politicians are joining German scientists in warning that something must be done quickly, since many of the best and brightest young molecular biologists are already fleeing the motherland for the United States.

What drives the corporate leaders to distraction is an amendment that was added last September to existing environmental legislation. It requires that proposals for all new production facilities using genetically engineered organisms—whether they are inherently pathogenic or not—be put to public debate. That may not seem too onerous, but the problem is that there are few administrative guidelines on how the law should be put into practice, and this has resulted in a kind of regulatory limbo. No new production facilities have been approved in the 8 months since the amendment was passed. A related and, to the companies, no less disturbing aspect of the legislation is its implicit threat to commercial secrets that they claim are embedded in the requirement for full public disclosure.

One consequence of all this is that many companies have put on ice any development plans that include the use of recombinant DNA techniques. Another is that they have virtually stopped recruiting molecular biology graduates until the situation is clarified. "Students finishing their Ph.D.'s in molecular biology now tend to look to American or Swiss companies [for jobs]. They are voting with their feet," says Hermann Bujard, director of the University of Heidelberg Center for Molecular Biology.

"Some people feel that they cannot always trust the scientist."

—Ernst-Günter Afting

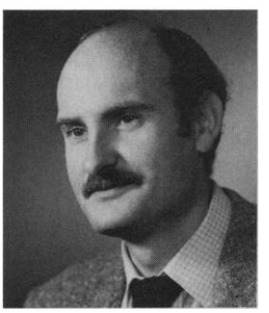
And few U.S. biotechnology companies are willing to risk joint ventures (as they have done elsewhere in Europe) in a country where full public discussion of their proposed activities is required. Last year, for example, when Genentech set up a Research Institute of Molecular Pathology with the German company Boehringer Ingelheim, the U.S. firm insisted that the new institute be located outside Germany, and a site was found near Vienna. Indeed, "no U.S. company has invested over the past year in anything related to genetic engineering in Germany," says Acker.

In an attempt to meet some of industry's concerns, the government of Chancellor Helmut Kohl—who himself represents BASF's home town of Ludwigshafen in the federal Parliament in Bonn—has just produced draft proposals for an umbrella law covering all aspects of genetic engineering.

The proposed law would, for example, give the Federal Ministry of Health authority to license new facilities (except those using only nonpathogenic organisms, which would continue to be licensed at a local level), based on advice from the Central Commission for Biological Safety. All organisms would be classified according to their degree of potential hazard and only those production facilities involving highly pathogenic organisms would need to be publicly debated.

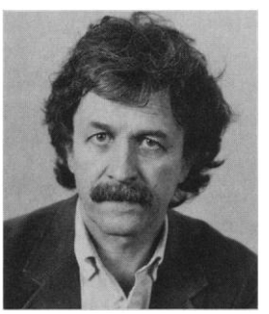
The proposals have met with cautious support from industry, but they face some potentially tough opposition. Many individual states, for example, are expected to resist any reduction in their local licensing powers, and environmentalists are likely to criticize the proposed reduction in public involvement in licensing decisions. "The proposed law seems to be aimed at protecting genetic technology from the public, and not the other way round," says Bärbel Rust, a parliamentary representative of the Greens Party.

Bärbel Rust: *Greens Party member criticizes proposed new law.*



BASF

Rolf-Dieter Acker: *"We are running out of time."*



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Hermann Bujard: *Young Ph.D.'s "are voting with their feet."*

The battle lines, in fact, are already being drawn. Industrialists are arguing that, without workable regulations, German chemical companies could find themselves cut out of any domestic production using genetic engineering techniques. In such circumstances, "any chemical company will have to decide in which country it is going to do its work," says Acker. Rust warns, in contrast, that any reduction in public involvement and discussion "could lead to more confrontation and to a situation in which no dialogue is possible."

The chasm of distrust between scientists and their critics will be particularly difficult to overcome because the conditions that have created it did not arise overnight. The debate over biotechnology has been influenced by a growing public dismay over Chernobyl, the Bhopal accident, and last year's major chemical spill in the Rhine. This has led to public cynicism regarding official statements about the safety of such technologies. "Some people feel that they cannot always trust the scientist," says Ernst-Günter Afting, head of pharmaceutical research for Hoechst in Frankfurt, which is still trying to get permission to operate a plant for producing human insulin that it started developing in the early 1980s.

Not all German scientists feel the public is entirely to blame. Says Afting: "We have been living in an ivory tower and have missed the opportunity to tell people what is really going on in science." Other scientists argue that political and scientific leaders should be doing more to promote a positive image of genetic engineering. Says Bujard: "In Bonn, no one now talks of genetic engineering in a positive way, and we do not have a National Academy of Sciences in Germany that might provide a public defense."

It is no surprise that the supporters of the amendment approved last September argue that members of the public need to be more deeply involved in decisions about new technologies. "If a new laboratory or factory is going to be built, then it must be possible for people to raise questions about safety and other issues, and the people who want to build these factories must be prepared to answer these questions in public debate," says Rust.

Industry representatives say they do not challenge the principle of public accountability, but "the whole situation places German companies at a clear competitive disadvantage compared to other nations," says Norbert Rau, a marine biologist turned biotechnology consultant. "If this is not changed, we might see a situation emerging in which both German and foreign companies go 'shopping' for research results in Germany, but these are turned into products outside Germany, which are then brought back to the country for sale."

Acker at BASF says that, because few genetic engineering products have yet reached the production stage, the full impact of the current law is yet to be felt. But, he says, "we are running out of time." Says Afting at Hoechst: "At the moment, we are reluctant to invest more in genetic technology, at least on the production side, here in Germany." Referring to the difficulties with the insulin plant, he adds: "We must know that if we build a plant, it can be completed and put into use within a specific period of time; at present, we have a legal situation which causes major delays, because of the requirement for a public hearing before permission to build and operate a production plant is granted."

Is there no way out for Germany? Despite the ferocity of the rhetoric, compromise may still be possible. Wolfgang Catenhusen, the chairman of a parliamentary commission of inquiry that first suggested an omnibus genetic engineering law 2 years ago and a member of the opposition Social Democratic Party, says that he does not have any "fundamental opposition" to the draft law being proposed by the government. However, he says that he would like to see retained "perhaps for 2 or 3 years" those parts of the current legislation that allow public participation in the licensing procedures for all genetic engineering facilities.

As for the Greens, Rust says that their previous hard-line opposition to all forms of genetic engineering has recently been softening. Officially, the party is still demanding that a moratorium be placed on all industrial uses of genetic engineering until more is known about the potential risks. But, says Rust, "personally I would not be against certain applications, for example research for a vaccine against AIDS or into the treatment of cancer."

The parliamentary debate on the government's proposals, due to take place this fall, is widely expected in Bonn to be both long and heated. But what if, in the end, there is no compromise? What will German companies do? Says Afting of Hoechst: "We are a German company, and, for the time being, we will stay in Germany. But we have to think of the future. Here in Europe we rely on the export of knowledge, since we currently have dying technologies; we have to add new industries in the long run. . . . We should not have tougher guidelines than other countries. After all, neither science nor production should stop at national borders."

■ DAVID DICKSON