53. Lung disease patients with negative DTHR-T had: caseating granuloma (1), silicosis (3), tuberculosis with pleural effusion (1), intravascular angiogenic tumor (1), chronic bronchiectasis (5), chronic organizing interstitial pneumonitis (4), recurrent cyst (1), coccidioidomycosis (1), sarcoidosis (2), chronic obstructive pulmonary disease (8), chronic asthma emphysema, and pneumonitis (5), pneumonia (3).
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National R & D Policy: An Industrial Perspective

Roland W. Schmitt

Industrial policy has become one of the hot issues on our national agenda, with various advocates telling us how to beat the Japanese and solve the problems of unemployment, inflation, and industrial stagnation. The 1984 presidential candidates are picking up these ideas and testing them.

Industrial policy has many components—fiscal, monetary, and regulatory, for example. It touches on many areas, from international trade to retraining the work force. I can bring my expertise to only one corner of this many-sided subject: research and development policy. To me, industrial policy means what the government must do to shape our national industrial posture, and a clear understanding of what government should not do.

There has been no lack of proposals. Bills put before Congress in recent years have called for such changes as the establishment of a National Technology Foundation, or a Cabinet-level Department of Trade and Industry; the selection of a National Commission on Technological Innovation and Industrial Modernization to tell us "what the economic, educational, and industrial priorities of the United States ought to be"; a Presidential Program for the Advancement of Science and Technology; and a Commission on High Technology and Employment Potential. Another proposal would establish a government program to conduct research and development on improved manufacturing techniques; others would exempt joint research and development efforts from the antitrust laws.

All these proposals to aid U.S. R & D show a healthy and encouraging concern about the state of American industrial technology, but they may at the same time distract politicians and policy-makers from the most important need and the most important step that government can take to strengthen U.S. innovation. That task is to ensure and strengthen the health of our university system—in both the performance of basic research and the training of research manpower. The distraction is especially great if Washington pays too much attention to the growing number of calls for the government to take over the job of selecting and supporting R & D programs aimed at commercial results.

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The Federal Role

In the commercial R & D area there are some things that government must and can do, and other things it cannot and should not do. Government has a crucial role to play in creating favorable conditions for commercial innovation, but not in actually producing those innovations. There are several reasons for this.

First, successful innovation requires a close and intimate coupling between the developers of a technology and the businesses that will bring products based on that technology to market and are themselves in touch with that market. This is essential in a diversified company, and even more essential in a complex and diversified economy. The R & D people must comprehend the strategies of the business as well as know what the market constraints are and what the competition is up to. The business people, in turn, must understand the capabilities and limitations of the technology. They must possess the technical strength to complete the development and believe strongly enough in the technology's potential to make the big investment needed to bring it to market.

first commercial successes, criticism of its deal with the MRC shifted from the political to the industrial community. Both large and small companies complained at being locked out of access to MRC's research. "The academic excellence in places like the MRC should be treated as a national resource and the government should be providing even-handed access to it," says Chris Keightley, managing director of one of the newest and most active small biotechnology companies on the British scene, IO (Bio) Ltd. in Cambridge.

The main product of Keightley's company, set up in 1981 by Acorn Computers and recently recipient of a $1.2-million investment from Rothschild's BIL, is a technique for improving the sensitivity of enzyme-based diagnostic tests. It is based on the research of a scientist whose work was not supported by the MRC, Colin Self of Cambridge University's biochemistry department.

Given the growing pressure to encourage similar initiatives, the MRC has recently renegotiated its licensing arrangements with Celltech. The company will retain first option to developments in fields in which it has already started to develop products. In other fields, however, it will now have to become a competitive bidder, for the MRC is setting up an industrial liaison office to distribute licenses more widely among companies interested in turning its research into commercial products.

The new arrangements have met with general approval in both the industrial and academic worlds. Sydney Brenner, director of the MRC's laboratory in Cambridge, says that at the beginning "there is no doubt that in terms of goodwill, the MRC connection was a major asset to Celltech."

Since then, however, the laboratory has been receiving an increasing number of direct approaches from industry. "In the past, we have had to tell them to go away, since the first options on research in the defined fields had to be offered to Celltech. Now we no longer have to do so."

Brenner and other British scientists point out that there are several differences between the United Kingdom and the United States in the factors affecting the growth of links between the academic biomedical research community and the private sector.

One is a greater reluctance on the part of British academics to get involved in the process of transferring research results from the laboratory, a tradition which is admittedly changing as cuts in government support for the universities as well as general, increase the pressure for university scientists—and universities in general—to look elsewhere for financial support.

A second factor until now has been the tax structure, which has made it more difficult to offer stock options to employees in small companies with initially low turnovers (or profits). The budget proposed in mid-March brings British policy in this area more in line with that in the United States, however.

On the other side of the coin has been a greater willingness to combine public

Pressure for Patent Reform

Cambridge, England. British scientists contend that differences in patent laws between Europe and the United States give U.S. companies a potential advantage in the commercialization of biotechnology. Under European patent laws, a scientific discovery cannot be patented once it has been published in the open literature or even referred to in public debate. In contrast, up to 1 year is allowed after publication for a patent application to be filed in the United States.

"I believe that the greatest inhibitory influence on a closer working relationship between academic and industrial scientists, and the greatest management problem for people like me, comes from this business of prior disclosure," says Sydney Brenner, director of the U.K. Medical Research Council's Laboratory of Molecular Biology in Cambridge, England.

There has long been an awareness of this discrepancy, particularly among patent officers on both sides of the Atlantic, but until now no serious pressure for change. Large corporations, in particular, often welcome being able to scan the scientific literature for new (and unpatented) ideas while employing patent attorneys to keep a close watch on the proposed publications of their own scientists. They tend to argue that they find little wrong with the current system. Robin Nicholson, chief scientific adviser to the British Cabinet, claims that "no one brought the issue to our attention" when his office was preparing a recently published set of recommendations for changes in the British patent law, and expresses some doubt over whether change is really necessary.

Among smaller companies, however, the situation is seen differently. "In this field, the 1-year grace period after publication gives the Americans a considerable competitive advantage" says Gerard Fairtlough, chief executive of Celltech. "I feel that Europe should have the same system."

Although admitting that biotechnology patents can frequently be successfully challenged by sufficiently motivated competitors, such companies also argue that patent rights are seen as crucial assets by potential investors.

Brenner also argues that it would ease the management problem in basic research laboratories such as his—as well as taking some of the pressure off individual scientists—by removing the immediate conflict between the professional demands for fast publication and the commercial demands of patent application. "Patents could be the currency of the interaction between research scientists and industry" says Brenner. "At the moment they are just a burden."

Change will not come easily. Friedrich-Karl Beier, director of the Max-Planck-Institute for Foreign and International Patent Law in Munich, and long a campaigner in favor of a 6-month grace period in Europe to bring it more in line with the United States, points out that this would now require an internationally agreed change in the European Patent Convention. "To do this, it will mean finding sufficient support within the whole European community," says Beier. However, he has already convinced the International Association for the Protection of Intellectual Property to endorse the idea, and suggests that there may be a general move in this direction "within the next 2 or 3 years."

Some British government officials point out that a grace period would help avoid situations—such as that which occurred with monoclonal antibodies in the mid-1970's—where the commercial potential of a discovery is only realized after it has been published, and when it can no longer, under the present system, be patented in the United Kingdom.—**D.D.**

perspective, the Department of Energy's program expense for just one unproved, highly speculative energy technique, magnetically contained fusion, was $295 million in 1982 alone. We face the same problem in several other crucial areas of university research. This is particularly true of engineering research—fundamental research in such areas as software engineering, automation, machining systems, materials engineering, and computer-aided engineering techniques.

The crucial distinction again is between support of the underlying research (the job that the government should be doing) and support of efforts aimed directly at generating products (the job the government should stay away from). Some of the bills before Congress do not clearly make this distinction. Consider, for example, the calls for government support of R & D in manufacturing technology. If a program for conducting the underlying research at universities is to be established, I will support it wholeheartedly. But when programs to produce more efficient manufacturing technologies are proposed, I worry that someone has ignored the difference between broadly relevant research and the job of selecting specific technology targets for new products and processes. And when anyone proposes conducting research utilization activities to encourage widespread adoption of these technologies, then I have serious reservations.

In the technology of controls, for example, fundamental theoretical advances are needed to catch up with the speed and power of microelectronics. Such work should be strongly supported at universities. But the job of putting research to work in, say, robots or machine tool controls for commercial markets should be addressed by private companies.

Some may be concerned that with so much emphasis on support of academic research in fast-moving areas, such as microelectronics and computer science, the needs of core industries, such as automobiles and steel, will be neglected. That is not so. The increases in efficiency needed by these industries will be provided much more by some of these fast-moving areas than by advances in the core technologies. These industries, too, are dependent on strong university research in the fast-moving areas. Moreover, these industries suffer from a lack of investment in already available technology. Giving them new technology without the corresponding investment to use that technology is hardly likely to improve their plight.

Immigration Policy

Another policy issue that strikes at the heart of our universities, yet is rarely discussed in the context of R & D policy, is immigration policy. In 1982 as many foreign students received engineering Ph.D.'s in our universities as did American students. Some regard these foreign students as a problem, and there even have been proposals to reduce their numbers. But the real problem is that not enough Americans are entering doctoral programs. The solution is to encourage more of our students, through adequately supported graduate fellowships, to go on to graduate studies. What is clearly not a solution is to force foreign students to leave. They are an important resource for our country. They account for a disproportionately large portion of our skilled manpower in the fast-moving areas of science and technology. They are not taking jobs away from Americans. They are filling a void and advancing U.S. science and technology. Historically the United States has benefited immeasurably from opening our doors to immigrant scientists and engineers. I need only mention such greats as Steinmetz, Alexanderson, and Giaever at General Electric; Tesla, Zworykin, and Ipatieff at other companies; and Fermi, Debye, Mark, and many others at American universities. Yet current laws create obstacles for foreign scientists who seek employment here. If we are truly concerned about enhancing U.S. industry's capability to do R & D, we should ease the regulatory barriers to hiring foreign-born students, especially those trained in this country. Proposed amendments to the Simpson-Mazzoli immigration bill now before Congress would do exactly that. Unfortunately, for reasons that have nothing at all to do with science and technology, that bill is now stalled in the House. The critical role that foreign scientists play in the United States must be addressed directly, rather than as an afterthought to a bill intended to deal with the problem of illegal, and largely unskilled, aliens.

Technology Leaks

A related national issue also directly affects the health of our universities: the problem of leakage of technology to the Soviet Union. In an attempt to stop that leakage, the Department of Defense and the Department of Commerce proposed regulations that would prevent foreign nationals from taking part in advanced microelectronics research in universities and industry. This is intended as just a first step. In the long run, the two departments are proposing to impose the same restrictions on virtually all fast-moving areas of advanced technology considered to be militarily critical.

There is no question that we must do a better job of preventing the Soviets from acquiring our technology, but such regulations are overkill. The Defense and Commerce Departments propose to change the export control regulations in ways that would seriously disrupt the nature of scientific discourse in U.S. universities and industrial R & D laboratories. No doubt some technology does leak to the Soviets in the course of our open scientific discourse. But by the Administration's own account, this is a very small part of the problem. It is counterproductive to impose such major restrictions on U.S. science and technology for such a small part of the problem. Again, foreign scientists play a critical role in most of our important areas of science and technology. Deny them access to these areas of research and we will do far more to damage our technological capabilities than any of the proposals being made in the name of industrial policy will do to help.

Conclusion

National R & D policy today poses both risks and opportunities. The excitement and attention that proposals for industrial R & D policy have generated threaten to distract us from the federal government's most important tasks. We need to go back to the basics. We need to remind ourselves of what it is that the government can and cannot do, and what it is that industry can and cannot do.

In summary, I want to suggest four specific guidelines for federal R & D policy: (i) concentrate direct support on academically based research, not on government-targeted industrial R & D; (ii) concentrate on sunrise science and technology, not on sunrise industries and products; (iii) concentrate on strengthening the climate for privately based innovation, not on government-selected innovation; (iv) concentrate on development for the government's own needs, not on development for market needs. I believe that these simple guidelines—many of which we have followed with success in the past, some of which we have violated with pain—will go a long way toward greatly strengthening and rejuvenating the dynamic innovative powers of our American system of research and development.

Boom Time for British Biotechnology?

Venture capital is now flowing into small companies and the government is encouraging the commercialization of university research it funds

London. After a relatively slow start in the late 1970's, Britian's biotechnology industry is beginning to pick up speed. Government officials, academics and industrialists all claim that a recent report from the U.S. Office of Technology Assessment (OTA) was excessively pessimistic in its claim that Britain lacks the "dynamism" to produce serious competitors to American companies. They also contest the OTA's conclusion that Britain ranks second behind West Germany among European nations.

"I think that conclusion is completely wrong, particularly if you take the combination of the science and its applications into account" says Gerard Fairtlough, chief executive of Britain's principal biotechnology company, Celltech, which is currently riding a crest of investor enthusiasm.

British industry has benefited from various forms of direct government support for biotechnology. Many smaller companies, for example, have made good use of consultancy grants and other special funds offered as part of a $24-million biotechnology package launched by the Department of Trade and Industry in November 1982. Other industrial initiatives in fields such as fermentation technology have been successfully catalyzed by the Biotechnology Directorate of the Science and Engineering Research Council (SERC).

According to Robin Nicholson, chief scientific adviser in Prime Minister Margaret Thatcher's Cabinet Office, broader political changes must also share the credit. "The policy of the government since 1979 has been to free restrictions and to remove barriers to enterprise," says Nicholson. "The relatively healthy state of biotechnology in the U.K. seems partly to reflect the success of those policies."

He picks out, for example, efforts to encourage Britain's venture capital market—now considered the second largest in the world after the United States—through developments such as the Business Expansion Scheme, which allows individuals to write off against tax an investment of up to $60,000 in a small company, provided the money is left in for up to 5 years.

"The Business Expansion Scheme was the first real fiscal change in small company funding for 50 years" says Peter A. Laing of Biotechnology Investments Limited (BIL), a venture capital fund set up by merchant bank N. M. Rothschild in 1981 and chaired by a previous top government science adviser, Lord Rothschild. BIL is said to be the largest biotechnology-oriented venture capital fund in the world. Partly due to this recent flow of venture capital, Britain now has more small biotechnology companies than any of its European competitors.

The government's willingness to let the commercial and industrial communities act as the senior partner in its efforts to boost biotechnology research and development has played a large part in both the establishment and subsequent operation of Celltech. The company was set up in 1980 primarily at the initiative of the National Enterprise Board, a government body recently amalgamated into the British Technology Group. Although initially providing 44 percent of Celltech's start-up capital, with the four remaining stakes of 14 percent each divided between a group of financial and industrial institutions, the government always intended to hand over its share to private enterprise. It moved in this direction last year when Rothschilds' venture capital company—previously criticized for not investing its funds in any British biotechnology company—bought out a proportion of the government's stock and gained with it a seat on the board of the company.

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Celltech chief says OTA misjudged Britain.

Like similar companies in the United States, Celltech has actively sought collaboration with larger companies with broader industrial interests or special marketing skills. A joint venture was launched last year with Britain's largest pharmacy chain, Boots, for example, to develop the application of monoclonal antibodies to new diagnostic products. And a technology licensing agreement has been signed with the Japanese company Sankyo to develop tissue plasminogen activator and calcitonin.

Fairtlough says that Celltech, with a current research staff of about 120 scientists and technicians, does not at present share the ambitions of companies such as Genentech to grow into a major corporation. However, with a number of clearly defined product lines, each in a potentially large market, "We could be talking about a turnover of hundreds of millions of dollars in a few years."

Celltech is already earning profits from a reagent for the purification of interferon and has recently created a Culture Products Division which, based on techniques developed with direct government funding, already claims to be the world leader in the in vitro bulk production of monoclonal antibodies.

One reason for Celltech's early success is a unique—and in some quarters highly controversial—agreement with Britain's Medical Research Council (MRC), under which the company was initially given first option on the rights to all results produced in the fields of genetic engineering and monoclonal antibodies in the council's laboratories. These include the prestigious Laboratory of Molecular Biology in Cambridge.

This arrangement was approved by the Conservative government over the opposition of officials in the Treasury, who felt it wrong that one company should be granted exclusive access to what was considered public property. One factor in the decision, it is widely rumored, was the failure in the late 1970's to take out a patent on the technique for producing monoclonal antibodies, which was first developed in the MRC's Cambridge laboratory. Giving Celltech exclusive rights to MRC's work might avoid such lapses in the future.

When Celltech started to register its

Summary. An analysis of how the government can and cannot use research and development policy to improve the nation's industrial posture suggests four guidelines for federal R & D policy: (i) concentrate direct support on academically based research, not on government-targeted industrial R & D; (ii) concentrate on sunrise science and technology, not on sunrise industries and products; (iii) concentrate on strengthening the climate for privately based innovation, not on government-selected innovation; (iv) concentrate on development for the government's own needs, not on development for market needs.

Second, innovation works best if this close coupling is in place during the entire innovation process. It should exist when the R & D project is identified and should continue through planning and development. It must survive the inevitable adjustments during development, caused by shifting market constraints and technical surprises. It must withstand the decision points—when to go ahead or when to quit.

Finally, in a free-enterprise system, governments not only do not create the markets for products but are notoriously slow in reacting to shifts in the marketplace. They lack the crucial entrepreneurial spirit to perceive or acknowledge opportunities early in their development.

During the years of heavy government involvement in energy R & D, we used to hear over and over again the expressions "technology transfer," and "commercialization." Those terms embodied the notion that once a technology was developed by a government contractor or a national laboratory, the technology could then somehow be transferred to the marketplace and commercialized.

That did not happen for a simple reason. Technology transfer is not a separate process occurring downstream from R & D. The user and the performer of targeted R & D need to have established a close relation before there is anything to transfer.

In energy R & D, there were some who fell into the trap of thinking that if they got a concept defined, the technology to work, and someone to produce a favorable economic analysis, then commercialization would follow. They forgot to find out whether the customers would buy the product. The result was a misdirection of effort and money into technologies that never had a chance of commercial success.

Even in agriculture, where the United States has a great history of innovation, underlying research on corn genetics was performed at university research stations and largely supported by government. But private seed companies converted that research into hybrid corn products.

A close relation between the user and the performer of R & D cannot, in general, form when government selects commercial R & D targets. Instead, the government ends up being a third party—one that knows a great deal less about the technology than the developer and a great deal less about the market than the user.

As an example, there are proposals that the government fund R & D in manufacturing technology, in such application areas as programmable automation, robotics, advanced sensors, and computer-aided design and manufacturing. Part of this funding is to support R & D work to be done by industry.

These are key technologies for the future but, because they are so important, a large and growing number of companies are already addressing them. General Electric is investing millions of dollars in each of them. And, in each one, we are faced with a large number of tough competitors—foreign firms and U.S. firms, established firms and new ventures, joint ventures and industry-university cooperative programs. In just one corner of computer-aided design, for example, the field of solid modeling, we are competing against at least a dozen capable firms—established giants, smaller rivals, and newer ventures.

It is simply not plausible for an administrator in Washington—even with the help of a blue-ribbon advisory panel—to pick the winning solid-modeling product better than the dozen firms slugging it out in the marketplace. And even if government could pick the winner, that is only the first step. The suppliers of the funds, the performers of the R & D, and the businessmen who deal with the customers have to tie themselves together in a long-term relation. A government funding agency cannot create that kind of relationship.

There is, however, one important exception. It occurs when the government is the customer for innovation—as in defense R & D. Government should concentrate its development efforts on these needs of its own. If history is any guide, it will thereby also generate products and technology that can be tapped for commercial uses.

The government has clear needs in the area of supercomputers for weapons research, cryptanalysis, weather forecasting, economic modeling, the design of improved airfoils and projectiles, and many other uses. By meeting its needs in supercomputers, the government will also be sponsoring the development of a product that has many valuable civilian uses, such as improved oil exploration, better understanding of crack formation and propagation in alloys, new techniques in computer-aided engineering, and the design of new materials based on theoretical principles. The supercomputer is a prime example of a technology in which the government should take the lead.

In very large scale integrated circuits (VLSI) the government will also be a major customer and thus has a major role in sponsoring development work. One emerging opportunity is in the area of inference chips—VLSI implementations of intelligent electronic systems that work in real time, based on custom chips rather than computers. These inference chips could be used in military systems, for example, to help the pilot of an F-18 with an engine hit by shrapnel make the best use of the 3.6 seconds he has in which to decide whether he can limp home or should bail out.

Inference chips will also have great value in many commercial uses, such as in creating three-dimensional computer-aided design images in real time and in helping smart robots plan their paths. Again, by meeting its own development needs, the government may advance technology that can be used in commercial innovations. When the government is not the customer, government selection of developments is unlikely to promote such innovation and economic growth.

Competition from Japan

At this point, I would expect some people to be thinking about the Japanese. Did their government bureaucracy not pick the commercial technical winners and put money behind them? No, it did not. At the heart of that question is a misunderstanding about the Japanese government's Ministry of International Trade and Industry (MITI). The popular picture depicts MITI as selecting target industries, picking out the technological developments they need, establishing a consortium of Japanese firms, and supporting the commercial R & D needed

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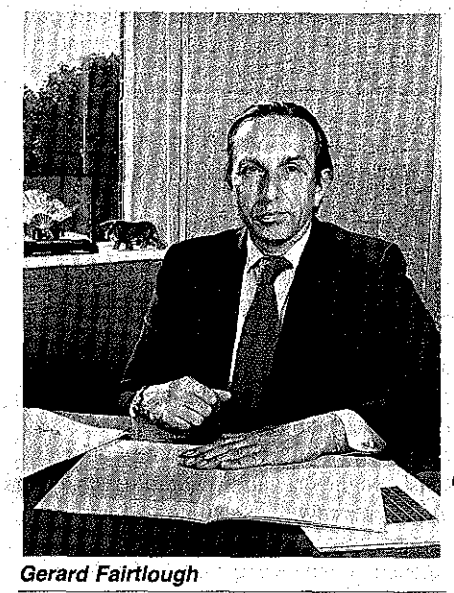

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first commercial successes, criticism of its deal with the MRC shifted from the political to the industrial community. Both large and small companies complained at being locked out of access to MRC's research. "The academic excellence in places like the MRC should be treated as a national resource and the government should be providing even-handed access to it," says Chris Keightley, managing director of one of the newest and most active small biotechnology companies on the British scene, IO (Bio) Ltd. in Cambridge.

The main product of Keightley's company, set up in 1981 by Acorn Computers and recently recipient of a $1.2-million investment from Rothschild's BIL, is a technique for improving the sensitivity of enzyme-based diagnostic tests. It is based on the research of a scientist whose work was not supported by the MRC, Colin Self of Cambridge University's biochemistry department.

Given the growing pressure to encourage similar initiatives, the MRC has recently renegotiated its licensing arrangements with Celltech. The company will retain first option to developments in fields in which it has already started to develop products. In other fields, however, it will now have to become a competitive bidder, for the MRC is setting up an industrial liaison office to distribute licenses more widely among companies interested in turning its research into commercial products.

The new arrangements have met with general approval in both the industrial and academic worlds. Sydney Brenner, director of the MRC's laboratory in Cambridge, says that at the beginning "there is no doubt that in terms of goodwill, the MRC connection was a major asset to Celltech."

Since then, however, the laboratory has been receiving an increasing number of direct approaches from industry. "In the past, we have had to tell them to go away, since the first options on research in the defined fields had to be offered to Celltech. Now we no longer have to do so."

Brenner and other British scientists point out that there are several differences between the United Kingdom and the United States in the factors affecting the growth of links between the academic biomedical research community and the private sector.

One is a greater reluctance on the part of British academics to get involved in the process of transferring research results from the laboratory, a tradition which is admittedly changing as cuts in government support for the universities as well as general, increase the pressure for university scientists—and universities in general—to look elsewhere for financial support.

A second factor until now has been the tax structure, which has made it more difficult to offer stock options to employees in small companies with initially low turnovers (or profits). The budget proposed in mid-March brings British policy in this area more in line with that in the United States, however.

On the other side of the coin has been a greater willingness to combine public

Pressure for Patent Reform

Cambridge, England. British scientists contend that differences in patent laws between Europe and the United States give U.S. companies a potential advantage in the commercialization of biotechnology. Under European patent laws, a scientific discovery cannot be patented once it has been published in the open literature or even referred to in public debate. In contrast, up to 1 year is allowed after publication for a patent application to be filed in the United States.

"I believe that the greatest inhibitory influence on a closer working relationship between academic and industrial scientists, and the greatest management problem for people like me, comes from this business of prior disclosure," says Sydney Brenner, director of the U.K. Medical Research Council's Laboratory of Molecular Biology in Cambridge, England.

There has long been an awareness of this discrepancy, particularly among patent officers on both sides of the Atlantic, but until now no serious pressure for change. Large corporations, in particular, often welcome being able to scan the scientific literature for new (and unpatented) ideas while employing patent attorneys to keep a close watch on the proposed publications of their own scientists. They tend to argue that they find little wrong with the current system. Robin Nicholson, chief scientific adviser to the British Cabinet, claims that "no one brought the issue to our attention" when his office was preparing a recently published set of recommendations for changes in the British patent law, and expresses some doubt over whether change is really necessary.

Among smaller companies, however, the situation is seen differently. "In this field, the 1-year grace period after publication gives the Americans a considerable competitive advantage" says Gerard Fairtlough, chief executive of Celltech. "I feel that Europe should have the same system."

Although admitting that biotechnology patents can frequently be successfully challenged by sufficiently motivated competitors, such companies also argue that patent rights are seen as crucial assets by potential investors.

Brenner also argues that it would ease the management problem in basic research laboratories such as his—as well as taking some of the pressure off individual scientists—by removing the immediate conflict between the professional demands for fast publication and the commercial demands of patent application. "Patents could be the currency of the interaction between research scientists and industry" says Brenner. "At the moment they are just a burden."

Change will not come easily. Friedrich-Karl Beier, director of the Max-Planck-Institute for Foreign and International Patent Law in Munich, and long a campaigner in favor of a 6-month grace period in Europe to bring it more in line with the United States, points out that this would now require an internationally agreed change in the European Patent Convention. "To do this, it will mean finding sufficient support within the whole European community," says Beier. However, he has already convinced the International Association for the Protection of Intellectual Property to endorse the idea, and suggests that there may be a general move in this direction "within the next 2 or 3 years."

Some British government officials point out that a grace period would help avoid situations—such as that which occurred with monoclonal antibodies in the mid-1970's—where the commercial potential of a discovery is only realized after it has been published, and when it can no longer, under the present system, be patented in the United Kingdom.—**D.D.**

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