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# CONGRESSIONAL ACTION ON TAX INCENTIVES FOR R&D

Innovation, according to Edward Dennison of the Brookings Institution in Washington, DC, was responsible for 64 percent of the gains in the United States labor market productivity between 1929 and 1982. Further, because research intensive companies have established themselves as the most promising segment of our economy, our hopes for reducing the national deficit, now over $140 billion, rest heavily on them. Thus the research and development tax incentive issue is provoking intense interest in the business office, the ivory tower and among policy planners.

This interest was reflected in the political arena on April 3 when the Senate Finance Committee's Subcommittee on Taxation and Debt Management held its hearings on R&D tax provisions. The large hearing room contained no empty seats as a diversity of participants testified before the subcommittee including university professors and administrators, executives from the industry, and members of the Council on Research and Technology (CORETECH).

CORETECH is of particular interest because of its unique representation of both the academic and industrial sectors of the R&D community. Its constituency includes corporations such as Control Data Corporation, IBM, Hewlett-Packard, and Procter and Gamble; and universities such as Caltech, MIT, Cornell, Dartmouth, Harvard, Princeton, and Purdue. (For more information, see **RDM Digest**, March 1987.)

The primary topics under debate were the possible removal of research and development disincentives such as Treasury regulation section 1.861-8, and the two credits available to corporations for applied as well as basic research and development.

## 1.861-regulations

Under 1.861-8 regulations United States corporations with foreign operations must allocate a percentage of their research and development expenses as if they were incurred abroad. The net effect of Section 861 is to deny companies full tax benefits for a portion of their domestic R&D expenses. Since most of these companies operate in foreign countries almost exclusively through foreign subsidiaries with the U.S. parent performing R&D in the United States, many foreign governments do not permit these allocated funds to be deducted from foreign taxes as a part of research and development expenses. Thus companies subject to section 1.861-8 regulations obtain no tax benefit from R&D expenditure anywhere in the world.

Tax technicians, however, believe that Section 1.861-8 is appropriate because the new products and processes resulting from such R&D activities are utilized not only in the United States, but abroad as well. Theoretically, the adverse effects of the regulations are balanced by excess foreign tax credits.

Issued in 1977, the regulations have been under a series of temporary moratoriums since 1981. They are due to become effective August 1, 1987. The uncertainty surrounding the 861 issue has frustrated long-range R&D planners, but recently two bills that would permanently and completely repeal section 861 as it applies to company research and development expenditures were sponsored in the House and Senate. Through the work of the Senate Subcommittee on Taxation and Debt Management, a tentative compromise has been hammered out between Congressional R&D proponents, the Treasury department, and

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industry, allowing 67% of U.S. incurred R& D expenses to be allocated to U.S. income.

Dean Morton, executive vice-president and chief operating officer of Hewlett-Packard, addressed the Subcommittee about the regulations. He expressed the concern of many people that the net effect of the regulations is to encourage **multi-nationals** to establish their R&D facilities in countries where tax benefits will be more available, Mr. Morton said. "One key point to understand in this regard is that manufacturing activity seems to follow R&D . . .it is typically easier to manufacture at the same facility or nearby, than to transfer manufacturing responsibility for the product to another country. This is why it is critical for the U.S. tax laws to provide incentives and not to provide disincentives to conducting R&D in the United States. Much more than the R&D activity is at stake." In concluding, Mr. Morton endorsed the compromise proposal reached by the Congressional sponsors of the 100 percent moratorium legislation, saying, "When enacted on a permanent basis, it will provide needed stability to U.S. R&D tax policy."

## R&D AND BASIC RESEARCH TAX CREDITS

In addition to the debate on the Treasury regulation, the R&D Tax Credit and the Basic Research Credit were discussed. The R&D Tax Credit, first adopted in 1981 as part of the Economic Recovery Tax Act, provided a 25% credit for any increase in company R&D spending above the company's average R&D spending for the prior three-year period. The original credit expired on December 31, 1985 but was extended as a 20% credit until December 31, 1988 as part of the Tax Reform Act of 1986. Congress also adopted a new tax credit for company support of basic research under the 1986 Tax Reform Act. The new Basic Research Credit can be claimed at a fixed rate of 20% of total contract research payments over a company's average spending for basic research during the fixed period of 1981-1983. Under the new regulations,contract payments and grants to universities and other non-profit organizations for basic research qualify for the new credit. It is to be in effect for a period of two years from January 1, 1987 to December 31, 1988.

## CORETECH'S ENDORSEMENT

Industrialist Dr. Joseph A.Saloom, Chairman of CORETECH, stressed the need not only to remove R&D disincentives (the 861 regulation), but also to ensure that the most effective incentives are in effect. Speaking for CORETECH, he said, "The Research and Development Tax Credit and the new Basic Research Tax Credit form and core of our nation's effort to stimulate private support of research. Both of these tax credits work to correct the underinvestment that would occur if the market were left to its own devices." Saloom also urged that Congress make the credits permanent although he said he realized there were economic reasons behind the initial temporary status of the credits.

## UNIVERSITIES AND THE BASIC RESEARCH CREDIT

Dr. Hans Mark, Chancellor of the University of Texas System, addressed the flat credit granted by the Basic Research Tax Credit to companies sponsoring basic research at universities and nonprofit research institutions beyond a threshold amount. "The new tax credit will encourage our industries to work more closely with universities in all the important areas of research. . .(it) provides an incentive for corporations to spend a portion of their research budget on expanding the basic knowledge on which they ultimately depend for the creation of a new product," he stated.

## THE R&D CREDIT AND EMERGING COMPANIES

Mr. Ron Pherigo, President of Applied Computing Technology, a start-up computer engineering firm, discussed drawbacks of the credit provisions for new companies. As the law is presently written, a companies research and development expenses are not eligible for the R&D credit until its products are being sold. "Just as the company starts to take-off with an innovative product the tax law puts on the brakes," Pherigo told the Subcommittee. Hundreds of firms disappear every year due to acquisitions, mergers, failures and bankruptcies. Pherigo stated that "often the

acquisition takes place because the original owner of the business has no other alternative: he's out of capital; he's shipping product, but the after-tax earnings will be insufficient to fund the new R&D necessary to keep the product's technology progressing at the same pace as the rest of the industry. That's the point where the company can best use the lift of a tax credit of offset taxes on new income earned as product is being shipped and sold. That's what the credit ought to do, but it doesn't.

PROSPECTS

Whether any new legislation will be enacted by Congress this year remains to be seen, but CORETECH is very hopeful, especially about the 67% compromise on Treasury regulation 1.861-8. Stephanie Becker, CORETECH spokesperson, said that the widespread feeling is that the compromise is a fair one and CORETECH is "pretty optimistic" that a resolution will be reached before the 861 regulation is due to take effect in August. Of the R&D tax credits, Becker said the hearings on April 3 were "more of a beginning than a debate.... They are an opportunity to examine the credit and to look at suggestions to make it more effective,, particularly in the context of competitiveness." Scot Williams, press secretary to Subcommittee Chairman, for Senator Max Baucus, reports the one sticking point of the credits is that they cost money, and the financing to make them permanent has not yet been nailed down. He said if for this reason the bills die they will probably be reintroduced next year because competitiveness is of great importance in today's market.

As Senator Baucus said, "Research and development tax incentives are basic to this country's economy because research and development is basic to this country's growth.

# NEWS

## FEDERAL ELECTROTECHNOLOGY R&D BUDGETS FOR FISCAL YEAR 1988 ANALYZED IN IEEE DOCUMENT

More than $67 billion in Federal electrotechnology research and development funding for fiscal year (FY) 1988 is analyzed in a document released by The Institute of Electrical and Electronics Engineers, Inc. (IEEE): **Electrotechnology in the FY 1988 Federal R&D Budget.**

Conclusions reached in the IEEE document about R&D budget requests in the electrical and electronics are:

- The Defense Department's Research, Development, Test and Evaluation (RDT&E) request is $43.719 billion during FY 1988, approximately 18.3 percent above the amount appropriated in FY 1987.

- Air Force RDT&E is budgeted at $18.623 billion for FY 1988, a 20.8 percent increase. Navy has requested a total of $10.49 billion in RDT&E funding. Army is seeking $5.1 billion, a 15.9 percent increase.

- The Strategic Defense Initiative Organization (SDIO) requested $5.22 billion, a 39.5 percent increase.

- NASA is seeking $9.5 billion for FY 88, R&D would exceed $3.6 billion, a 16.8 percent increase. Most of the funds are designated for the Space Station, a total of $767 million, or an 83 percent increase.

- Funding for the National Science Foundation (NSF) is proposed at $1.89 billion, a 17 percent boost. The total for R&D activities could rise to $1.635 billion, a 16 percent boost. The NSF Engineering Directorate could receive the largest increase with $205 million or 26 percent. The Directorate for Engineering, created in 1986, could receive the second largest increase of $143 million or 23 percent.

- Total Department of Energy funding for R&D could rise from about $4.5 billion in FY 1987 to $5.5 billion in FY 1988. According to the IEEE document, "within DOE, funding

more than 30 years in the U.S., the U.S.S.R. and other countries, but the outcome of these field tests was poorly recorded, according to Thomas E. Burchfield of the National Institute for Petroleum and Energy Research (NIPER), a Government-funded facility based in Bartlesville, Okla. Now investigators from NIPER, the U.S. Department of Energy and two private companies—Microbial Systems Corporation and INJECTECH, Inc.—are seeking to gather definitive data by testing the technique in an old, water-flooded oil field near Bartlesville.

The investigators have selected four bacteria: three of them grow in the absence of oxygen (two from the genus *Bacillus* and one from the genus *Clostridium*), and one is a so-called facultative anaerobe, which can grow with or without oxygen (the genus has not been disclosed). In March the bacteria were mixed with molasses, which serves as a nutrient, and were injected into a five-acre field that has 15 wells. Although under the right conditions the microbes can reproduce rapidly—doubling in number every half hour—they are expected to diffuse only slowly through the sandstone that underlies the test site. Some preliminary data should be available within six months, but it will be more than a year before all the results are in, according to Burchfield.

Even if the technique boosts recovery only slightly, he says, its low cost could make it economical for both large oil companies and smaller independent ones. Molasses is very inexpensive and the bacteria under consideration can be cultured at low cost. Moreover, Burchfield points out, once the bacteria have been established in the reservoir, simply feeding them additional molasses should keep them thriving—and working.

## *Technology for Sale*

The Cummins Engine Company, Inc., recently started developing a new diesel engine that employs a ductile form of nickel aluminide, an alloy that has an unusual property: it gets harder as it gets hotter. Cummins was granted an exclusive license to incorporate the new material in heavy-duty diesel engines by the Oak Ridge National Laboratory, which did the original research. Such direct arrangements are currently unusual, but now that economic competitiveness has been sanctioned by President Reagan as the political watchword of 1987 they may become standard.

Federal funds account for about half of the $110 billion spent on research and development each year in the U.S., and yet only one-fortieth of the 120,000 patents issued annually stem from Federal research. This statistic "suggests that we could get more from the Federal investment," Norman J. Latker, director of Federal technology-management policy at the Department of Commerce, told a Senate subcommittee in February. Furthermore, the proportion of Federal patents that find their way to commercial application—about 5 percent—is much less than the equivalent figure for industry patents.

Until recently legal obstacles made it hard for private industry to commercialize research carried out in Federal laboratories. The Government usually owns inventions arising from work it supports. Although an agency may waive title to an invention if a private company is interested in developing it, agencies have not always been prompt to do so.

For example, between October of 1977 and December of 1985, 135 waiver requests were made to the Department of Energy for patent rights to inventions made at contractor-operated facilities. Yet as of December 24, 1985, the department had completed action on only 55 of them; five had awaited a decision for more than two years. Representative John D. Dingell, chairman of the House Committee on Energy and Commerce, wrote in February to Secretary of Energy John S. Herrington that he considered such delays "irresponsible." Ronald W. Hart, director of the National Center for Toxicological Research, says the Public Health Service's inability in the past to grant exclusive patent rights has meant that research "was everybody's property and so nobody's product." Hart says that "many inventions that could have improved public health simply languished."

All of this may be changed by the Federal Technology Transfer Act of 1986, signed into law last year and now being implemented. The statute encourages industry to make better use of Federal research by providing new incentives: for the first time all 700-odd Federal laboratories will be able to enter into collaborative research agreements with private industry and to grant companies exclusive development rights. Individual Federal employees whose inventions are taken up commercially will be awarded not less than 15 percent of the royalties, to a maximum of $100,000 per year. President Reagan is to issue an executive order instructing all Federal agencies to comply with the new act, which extends and clarifies earlier legislation.

The president has also proposed a doubling of the National Science Foundation's budget in the course of the next five years and the establishment of university-based centers for "fundamental science that directly contributes to our nation's economic competitiveness," which are to be funded through the NSF and perhaps through other agencies. Other proposals would accelerate exchanges of personnel among private companies, Federal laboratories and universities, as well as joint projects.

Latker says there is "a lot of pride and turf" that could impede the implementation of the new technology-transfer act. Still, it was only in 1984 that Oak Ridge was designated as a guinea-pig laboratory to see how incentives such as those in the new law might work. According to the laboratory's Jon Soderstrom, the number of patent applications sought by laboratory employees increased by more than 30 percent in two years.

## *Squeeze Me*

Stretch a block of material and its girth contracts; push its ends together and its girth expands. Such behavior would seem to be predictable and universal. Yet Roderic S. Lakes of the University of Iowa has transformed foamy materials that behave as expected under deformation into foams that distend when they are under tension and become thinner when they are compressed.

Lakes reports in *Science* that the process by which he accomplished the transformation is rather straightforward: a specimen of conventional low-density polymer foam is compressed and placed in a mold, where it is heated. The foam that is then extracted from the cooled mold no longer behaves normally; its dimensions change under strain in a way contrary to what one would expect. By means of a similar procedure that involves sequential plastic deformation along each of three perpendicular axes, Lakes also invested normal metal foams with the same peculiar property.

Microscopic examination of the foams reveals the cause of their anomalous behavior: whereas the ribs of the cells constituting normal open-celled foams bulge outward, the cell ribs in Lakes's treated foams protrude inward, forming what Lakes calls reentrant structures. Under tension the reentrant-cell ribs are drawn out and unfolded, thus causing the cell to expand. Conversely, under compression the ribs collapse farther inward, resulting in an overall shrinkage of the cell's volume.

Lakes has found that his reentrant

# Does the Fear Of Litigation Dampen the Drive To Innovate?

By WILLIAM J. BROAD

SOME scientists and legal experts are beginning to argue that fear of safety-related litigation is holding back technical innovation in a variety of fields.

Although the dimensions of the problem are unknown and probably unknowable, experts say the blizzard of liability suits in the past decade has sent a chill through fields as diverse as computer science, food processing and nuclear engineering.

"The legal system's current message to scientists and engineers is: Don't innovate, don't experiment, don't be venturesome, don't go out on a limb," said Peter W. Huber, an attorney and engineer who has written about the problem.

However, some groups concerned with consumer issues question the severity of the problem, saying its new visibility seems part of campaign to weaken liability laws so corporations will have to worry less about public safety and be able to make higher profits.

'It's becoming difficult to get venture capital for new ideas,' said one physicist.

As the debate heats up, legal experts are trying to probe the extent of the problem even though its symptoms — foregone innovations — are by nature difficult to document. The National Academy of Engineering, a branch of the Government-chartered, private National Academy of Sciences in Washington, D.C., recently held a symposium on the subject, and the Rand Corporation in California is organizing a large study.

"There's clearly a chilling effect," said Stephen M. Matthews, a physicist at the Lawrence Livermore National Laboratory in California who has worked on establishing new commercial ventures. "It's becoming difficult to get venture capital for new ideas. People are afraid of potential liability."

Experts have long agreed that risky products and dangerous procedures should be banned from the marketplace. Recently, however, some have begun to argue that increased technical regulation and litigation designed to

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**ART:** A burst of growth in Chic

**BOOKS:** 'The Poems of Lincoln K

# Does the Fear of Litigation Inhibit Innovation?

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promote safety can have hidden costs in the form of stifled creativity and abandoned ideas. The upshot, these experts say, is that products, processes and large-scale technologies may fail to be made as good, cheap and safe as possible. They say innovation can be deterred when either inventors or developers have inordinate fears of being sued over new products and technologies.

"A lot of people are interested in the phenomenon, but no one has hard data on its extent," said Deborah R. Hensler, research director of Rand's Institute for Civil Justice. One example involves researchers who are slowing efforts to test and market computers with artificial intelligence because of potential lawsuits. Their fear is that new types of liability will emerge for computers that diagnose patients, run factories, and perform other complex tasks. "Some of the state-of-the-art applications are not going forward," she said.

Dr. Matthews of the Livermore lab said one of his own efforts to develop an invention with commercial potential had recently failed at least in part because of fears of liability suits.

His idea centered on a powerful particle accelerator that is only about six feet long. Livermore uses a similar device for developing beam weapons. Dr. Matthews proposed modifying the accelerator so it could irradiate food products, killing insects, larvae and parasites that infest freshly harvested fruit and vegetables. Such irradiation could replace the chemicals used on many crops, thus eliminating the chance that poisonous fumigants might cling to produce.

But lawyers told potential investors its development was too risky, he said. "One of the factors they cited was liability," Dr. Matthews recalled. "It was too new, with no precedent to follow in a broad area of technology. They were afraid we might build in a liability that no one was aware of." In this case, liability concern was only one factor; the more general controversy over food irradiation, for example, also played a role.

### Worry for Universities

A different kind of chill has been felt in universities across the country, according to Howard W. Bremer, patent counsel for the University of Wisconsin at Madison, which last year devoted about $230 million in private and Federal funds to scientific research. The fear, he said, focuses on small businesses that want to buy licenses to university patents. If such companies should be sued, plaintiffs might turn to the "deep pockets" of the university that spawned the idea. Mr. Bremer said such fears were causing universities to shy away from licensing patents to small companies. The trend is especially troublesome, he said, since small businesses are usually better than large ones at nurturing innovation.

"There's some sincere questioning of whether we should license to small businesses at all," he said.

**Product liability has forced companies to be more careful, Ralph Nader says.**

Yet another problem can occur, some experts assert, when public safety regulations create incentives to keep bad technologies in the marketplace, hindering innovation. The reason for this, they say, is that the adoption of a new, safer technology implicitly involves acknowledgment that the previous technology was not as safe as possible.

Nuclear reactors provide an example of "encouraged inferiority," some experts assert. For instance, engineers at the University of Texas invented a simple and effective solution for the problem of leaky welds in the pipes of some reactors. It involved a new welding technique in which powerful bursts of electricity are directed into steel pipes that abut one another, fusing them with extremely strong and uniform seams.

But the idea, little known outside of engineering circles, has been ignored by the industry in the three or so years since it was developed.

"If you admit you have a solution, then the regulatory agencies might force you to go back and retrofit," said an engineer familiar with the new technique, who spoke on condition that his name not be used.

### Judging Technology

According to Dr. Huber, who holds a doctorate in engineering from the Massachusetts Institute of Technology and a degree from Harvard University Law School, the current clash of law and science boils down to a fight between technological optimists and pessimists.

"The technical community usually judges that new technologies are safer, cheaper and better for the consumer," he said. "But when you shift into Federal regulation and the law, you get suspicion of change, of innovation, of departures from the status quo. Lawyers tend to see risks, not benefits. The law is basically hostile to change and innovation."

Dr. Huber, a fellow of the Manhattan Institute for Policy Research in New York, a non-profit, private group that conducts economic research, told the conference of the National Academy of Engineering that the clash had been engendered by new interpretations of liability law and new regulatory statutes over the past two decades. "Under the old regime, which prevailed in this country for about a hundred years, the regulator's charter was that of an exorcist," Dr. Huber said. "He identified established hazards and rooted them out. Now the regulator acts as gatekeeper, charged with blocking new technologies not known to be safe and with protecting us from the ominous technological unknown."

To many public-interest groups and activists, this new role for regulators is good since the technological risks of modern life are seen as greater than in the past. Almost everywhere, they say, lurk invisible killers, from radiation to asbestos. They say tragedies such the chemical disaster at Bhopal, India, and nuclear reactor fire at Chernobyl in the Soviet Union must be avoided.

### Rise in Liability Suits

"It's clearly in the corporate interest to limit liability," said Mike Johnson, an analyist for Public Citizen, a comsummer rights organization in Washington, D.C., founded by Ralph Nader. "The principal impact of product liability has been to force companies to be more careful in their products, not to limit innovation."

Indeed, the number of product liability cases filed in Federal courts, for instance, has risen to 13,554 in 1985 from 1,579 in 1975. Although most cases are settled before trial, the number of jury awards has risen over the past decade, and the cost of liability insurance has surged.

Experts have differing ideas about what steps, if any, should be taken to solve the problem. Consumer advocates say that the current system should be kept largely intact, with the possible addition of special regulatory incentives to help move safety-related innovations into the marketplace.

Dr. Huber suggested that Federal regulatory agencies, not the courts, were the right place to weigh risks and benefits of new technologies. "And these agencies should be encouraged to exercise this responsibility through good hindsight, rather than through bad foresight," he said.

David G. Owen, professor of law at the University of South Carolina, told the National Academy of Engineering that one issue will linger no matter what changes take place. "The engineer must now and hereafter give proper respect to safety," he said. "The current problems of product liability law and insurance will in the long run prove manageable for engineers and enterprises who treat safety not as a nuisance, but as an important engineering goal."

MANAGEMENT OF GOVERNMENT-OWNED TECHNOLOGY PRODUCED IN FEDERAL LABORATORIES

The Packard, the Business-Higher Education, and the Energy Research Advisory Board (ERAB) Reports all recommend sweeping improvements in the way Federal laboratories and universities cooperate and collaborate with industry. All reports call for increased transfer of technology resulting from laboratory efforts.

It is Commerce's view that enhanced transfer of technology must begin with establishment of focal points at laboratories with the authority to make "deals" with industry to fund the continued development of new products and processes they have evaluated to have commercial potential.

The optimum laboratory authority should include at least the ability to:

- Identify, evaluate, and protect new technologies,
- Promote commercial use of the new technologies laboratories produce,
- Initiate research and develop limited partnerships,
- Seek venture capital,
- Enter into collaborative research projects,
- Establish policies encouraging employee-inventor startups,
- Share royalties with inventors,
- Assess potential conflicts of interest, and
- Grant patent licenses or assign invention ownership rights as a quid pro quo for private sector guarantees to develop, participate in, or contribute cresouces to further development.

To the extent that the Government has some of these authorities, they have not been delegated to the laboratory management most knowledgeable with the new technology. The centralization of existing authorities have acted as a substantial disincentive to optimum technology transfer.

# How Japan Inc. is cashing in on free U.S. R&D

## Technology transfer between federally funded labs and Japanese firms is flowing only one way — Eastward

It's a familiar scene. Japanese scientists tour U.S. laboratories to visit with their American counterparts and share information. In many cases, however, U.S. industrialists and government officials argue, the sharing is strictly one-sided. The Japanese, they contend, often walk off with innovative technology — for free — and offer little in return. "They recognized early that the U.S. is funding the entire world's basic research," says Norman Latker, director for federal technology management policy in the U.S. Department of Commerce's Office of Productivity, Technology and Innovation.

There is nothing illegal about this. Information on nonclassified research and development at national laboratories has been readily available. So it's no surprise that the Japanese and others have launched concerted efforts to cash in for free R&D. "They would be nuts to pay for research they can get for nothing," says one government official. "And the Japanese are anything but dumb."

What is perhaps more of a surprise is that few U.S. companies have followed suit. Some companies, such as Harris Corp. and Intel Corp., have technology transfer agreements with national laboratories, but U.S. industry in general has kept its distance from federal labs. One reason might be that U.S. companies want guarantees in the form of patents before they will invest heavily to adapt basic research for commercial applications. Until recently, this has been a difficult procedure.

Representatives of Japanese firms, however, point out that there is nothing illegal about picking up technology that is in the public domain. "It is a mistake to single out the Japanese for cleverly taking technology that is freely available to everybody on a nondiscriminatory basis," says H. William Tanaka, an attorney with the Washington, D.C., firm Tanaka-Walders-Rigter, which represents the Electronic Industry Association of Japan.

Furthermore, Tanaka contends, the technology transfer legislation goes against the current trend for companies from different countries to link up to share enormous R&D costs. "It is highly questionable whether this legislation will help American companies develop technology out of federally funded laboratories in the face of structural changes that are forcing companies and countries to pool their resources."

> U.S. companies want guarantees in the form of patents

Nevertheless, new legislation could change the often asymmetrical nature of technology transfer. At the very least, its proponents hope the Federal Technology Transfer Act of 1986 will give U.S. companies a beat on foreign competitors in making the most of U.S.-developed basic research. At best, supporters predict this new method of exploiting technological breakthroughs will give birth to creative Silicon Valley-like communities around many of the labs. "Our economic future depends on encouraging the efficient dissemination of skills and information within our communities," says Senator Patrick J. Leahy (D-Vt.).

Under the new law, national labs

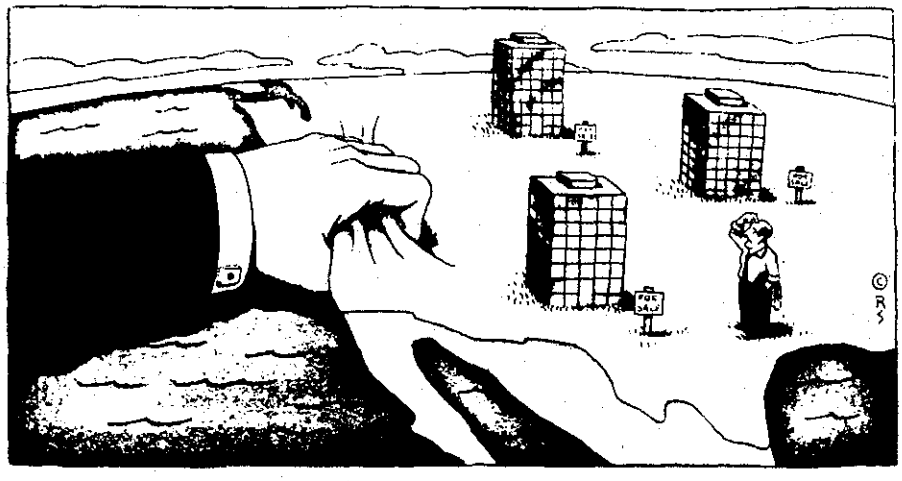
- Allows labs to enter into cooperative research agreements with industry, universities and others, and to negotiate patent licensing agreements
- Directs heads of agencies with large labs to institute cash award programs to reward scientific, engineering and technical personnel
- Requires agencies to give at least 15% of royalties received from licensing an invention to the inventor and distribute the balance of any royalties among its labs
- Creates the Federal Laboratory Consortium for Technology Transfer at the National Bureau of Standards.

**Publish and perish**

The need to make federal labs more responsive to national needs was outlined in a 1983 report by the Packard Panel, headed by David Packard, cofounder of Hewlett-Packard Co. and former deputy secretary of the Defense Department. "The national interest demands that the federal labo- will decide how best to disseminate internally developed technology. They can cut their own deals with interested companies and share the profits. "To improve technology transfer, the federal laboratories need clear authority to do cooperative research and they need to be able to exercise that authority at the laboratory level," states a Commerce Department report. Until recently, such information was routinely published and available to anyone — from the United States or abroad. Now, American companies will get first crack. The law:

ratories collaborate with universities and industry to ensure continued advances in scientific knowledge and its translation into useful technology," the report states.

Although the legislation encouraging such interaction was approved late




Rob Saunders

**CRITICS CONTEND** the Japanese are too aggressive in acquiring U.S. technology

last year, it will be some time before the provisions are routinely enforced, according to Latker. "We're now trying to implement the law," he says. "But first we have to change a significant cultural bias away from the idea of publishing everything."

It might seem naive to some that inventions funded by taxpayers were made equally available to everybody, but that policy reflects the democratic attitude that no individual or company should get preferential treatment. And federal researchers have felt uncomfortable coming down from their ivory towers and hooking up with private companies in commercial ventures. The financial incentives could help change these attitudes. "It [will be] interesting to see the response when the first researcher pulls up in a red Ferrari," says Joseph Allen, technology policy liaison in the Commerce's Office of Productivity, Technology and Innovation.

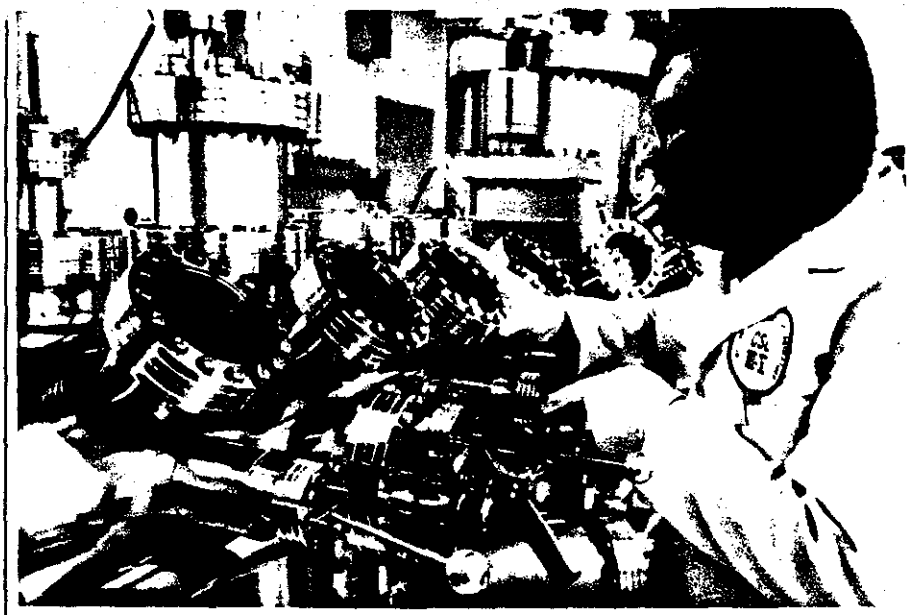
Lab officials are learning the benefits of licensing and cost-sharing arrangements from universities, which lately have expanded their ties with industry. Some particularly aggressive institutions like Stanford University and the University of Wisconsin reportedly have made more than $5 million a year in profits by licensing technology and sharing research costs.

By contrast, the U.S. Treasury made only $2 million on patents in 1985 even though it spent $18 billion — a third of all R&D spending — at about 400 federal labs. The labs do research on everything from thin film and optoelectronics technology to boll weevils, with the heaviest funding going to the relatively large labs for weapons, space science and energy research, medical programs, and physics experiments.

The labs, which employ a total of 185,000, including one-sixth of the country's scientists, have produced 28,000 patents. Only 5% of those patents have been licensed. "This statistic is a reflection both of the fact that many government patents have little or no commercial value and that agencies have made little effort to seek private sector users for even their most important commercial inventions," says E. Jonathan Soderstrom, director of technology applications for Oak Ridge National Laboratory at Martin Marietta Energy Systems in Tennessee.

It is difficult to track the evolution of basic research, so there are no clear-cut examples of U.S. technology that the Japanese have exploited for commercial products. But no one denies that there has been a concerted effort by aggressive foreign companies (and country-sponsored initiatives) to acquire technology from America. In 1983, for example, the Japan Economic Institute reports that the United States transferred to Japan six times as much electronics technology and almost eight times as much machine-tool technology as it acquired from Japan.

In all, 70% of Japan's worldwide technology imports that year came from the United States, according to Senator J.D. Rockefeller IV (D-W. Va.) "This asymmetry in the international flow of knowledge has real repercussions for our country's competitiveness in world markets," says Rockefeller. "If our cutting-edge technology is made fully available to our rival in international trade . . . we stand to lose not only foreign markets but also jobs and income at home."



**SEMICONDUCTOR RESEARCH** at Sandia Labs, where scientists no longer allow routine visits by foreign scientists

## Lab officials are learning the benefits of licensing

It's not that Rockefeller and others want to totally stop technology exchange programs with foreign countries. Rather, they want to guarantee that technology swaps are equal. "It's time we started bartering a little more," says Robert Stromberg, technology transfer officer at Sandia Laboratories in New Mexico. "We want a fair, equal exchange on a tough Yankee-trade basis." Stromberg cites, for example, that Sandia no longer allows routine visits by foreign scientists unless "we are sure they are as good as ours and that any exchange of technology goes both ways."

Allen of the Commerce Department points to the lopsided international scientist exchange programs as one of the most obvious inequities. "The Japanese have been able to place a lot of people in labs here," he says. "But we have a hard time placing them over there." At the National Institute of Health, for example, some 397 Japanese scientists were working in U.S. facilities in fiscal 1985, while only three U.S. NIH scientists were assigned to Japanese labs.

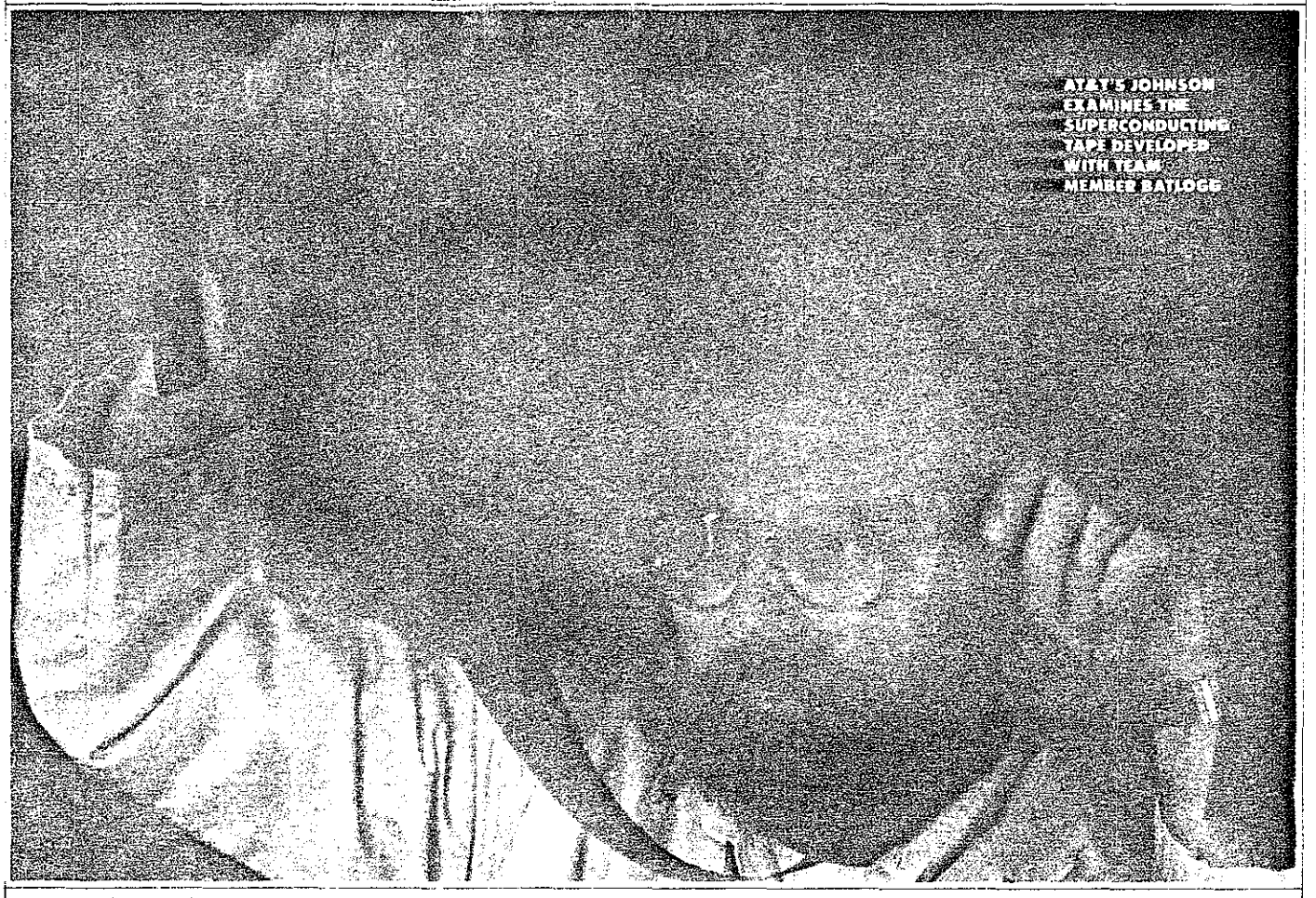
Even without their aggressive attempts to acquire U.S. technology, industry sources contend, the Japanese have a significant R&D advantage. Even though U.S. R&D spending has leveled off at about 2.7% of the gross national product, the Japanese project that, by 1990, R&D expenditures will rise to 3.2% of GNP.

"We're stagnating at 2.7%, much of it for the military, while they keep increasing spending for commercially exploitable R&D," says Ralph Thomson, senior vice president of the American Electronics Association. "Our one remaining competitive advantage was innovation, but we're wrong to believe the Japanese are just copiers. Their emphasis on commercial R&D has got them to the point where they are better than the U.S. in many products."

BETH KARLIN

Joe Allen

# Cover Story



AT&T'S JOHNSON EXAMINES THE SUPERCONDUCTING TAPE DEVELOPED WITH TEAM MEMBER BATLOGG

LAWRENCE BARNS

# 'OUR LIFE HAS CHANGED'

## THE LIGHTBULB, THE TRANSISTOR—NOW THE SUPERCONDUCTOR REVOLUTION

With the poise of Harry Houdini, Bertram Batlogg reaches into his coat pocket. Slowly, he draws out a piece of flexible green tape and holds it aloft. There is silence. Then gasps and exclamations ripple through the crowd. "I think our life has changed," says Batlogg, who heads solid-state materials research at AT&T Bell Laboratories. The 3,500 physicists jamming the ballroom and surrounding hallways at the New York Hilton burst into shouts and applause.

The simple tape that Batlogg brandished at the annual meeting of the American Physical Society on Mar. 18 was indeed the pennant of a technological revolution. Because it can conduct electricity with no power losses to resistance, the tape material promises to have an enormous technological—and economic—impact. Such so-called superconductors could speed the way to a quantum leap in both electrical and electronic technology.

A torrent of developments is pointing to applications ranging from superfast computers to trains that float on magnetic fields, from less costly power generation and transmission to fusion energy. Although it may take 20 years before the full potential of these laboratory discoveries is realized, the economic impact could be enormous. Some scientists compare the importance of these advances in superconductors to the invention of the transistor. But to Jack S. Kilby, co-inventor of the integrated circuit, that's an understatement. "This is much broader," he says. "It could impact almost everything."

The normally staid physicists at the New York meeting apparently agreed. Like rock music fans waiting to get into a concert, the crowd began gathering for what they dubbed the "Woodstock of physics" 2½ hours ahead of time. When the doors opened for a hastily scheduled 7:30 p.m. session on superconductivity, scientists shoved and jostled each other for the 1,150 seats. The rest craned to

hear from the hallways or watched on video monitors outside. "I came to see history," declared one scientist as he elbowed his way to a seat. He wasn't disappointed. More than 50 researchers reported brand-new experimental results. Several revealed information phoned in from their laboratories just hours earlier. With only five minutes allotted to each, the session ran until 3 a.m.

The advances have been a long time coming. In 1911, Dutch scientist Heike Onnes first observed that some metals became superconductive when cooled to almost absolute zero—the point at which all motion of atoms ceases. That opened tantalizing prospects for huge markets. But the only way to get near that ultracold temperature of –459F—or zero on the Kelvin scale that scientists prefer—was cooling with costly liquid helium.

**CHASING THE GRAIL.** So the search began for materials that would exhibit superconductivity at warmer temperatures. The effort, however, was slow and discouraging. In 1941, scientists discovered alloys of niobium that became superconductive at 15K. By 1973 the best superconductor operated at 23K—warm enough to make a few applications, such as magnets for medical imaging, economical. But this was far from the physicists' Holy Grail of "room temperature" superconductors. Many despaired that such materials were even possible.

In just the last four months, however, researchers in the U. S., Europe, Japan, and China churned out a stunning set of discoveries. They created a group of materials that become superconductors at temperatures that can be achieved with inexpensive liquid nitrogen. That made frigid superconductors red-hot. "It's the most exciting development in physics for decades," declares Neil W. Ashcroft, director of the Laboratory of Atomic & Solid State Physics at Cornell University. "The pace of discoveries can hardly be matched." And the dream of room-temperature materials is no longer unthinkable. "We've knocked down barriers and removed our blinders about what's possible," says Paul A. Fleury, director of the physical research lab at AT&T Bell Labs.

No one, least of all K. Alex Müller, a physicist from International Business Machines Corp.'s Zurich research laboratories, expected the barriers to higher-temperature superconductors to tumble so quickly. It was Müller who set off the current research rush a little more than a year ago with the discovery of a superconducting oxide of copper. Hunched in a chair during a lull in the New York meeting, the 59-year-old Müller seems ill at ease with the attention he is getting. "It was so unexpected," he says quietly, stroking his beard.

Müller holds the prestigious post of IBM Fellow, which frees the company's distinguished scientists to pursue projects of their own choosing. With the freedom to explore, Müller took a cue from research in the U. S. and France to examine a little-known group of oxides containing copper and nickel. Normally insulators, the materials had displayed some intriguing metallic properties. So for nearly three years, Müller and his colleague, J. Georg Bednorz, mixed hundreds of compounds and tested them for signs of superconductivity. In January, 1986, they measured superconductivity at a record-breaking 30K in an oxide containing lanthanum, barium, and copper. Müller, who expected a rise of several degrees at best, was incredulous.

Bednorz, a former student of Müller's, was so excited he wanted to report the results immediately. But Müller refused. The history of superconductor research is littered with unsubstantiated claims and the tarnished reputations of the scientists who made them. Fearful that his peers would denounce the results, he insisted on additional tests. "I didn't want to ridiculize myself," he recalls.

Only after they had confirmed their findings did Müller and Bednorz publish a paper. And then many U. S. scientists missed the paper when it was published last April because Müller chose a German journal not widely read in the U. S. Some who did read it doubted the findings. "I just couldn't take the claims seriously," says one physicist who now regrets his skepticism.

**THE COLD RUSH.** By fall, however, a handful of research teams was experimenting with Müller's compound. In December, reports discussed at a Boston scientific meeting created a sensation. Müller's work had been confirmed by a Tokyo University research team led by Shoji Tanaka and another group at the University of Houston headed by physics professor Ching-Wu "Paul" Chu. Immediately, scientists at more than a dozen labs, including AT&T, Argonne National Laboratory, and the University of California at Berkeley, began experiments on the substance.

It was easy to jump on the research bandwagon: The promising oxides can be whipped up in the chemistry lab of any junior college. Simply grind the chemicals with a mortar and pestle and heat them in a furnace. Regrind the result, press it into pellets, and heat it again with oxygen. So by the end of December, researchers at AT&T, the University of Tokyo, the Institute of Physics, Academia Sinica in Beijing, and the University of Houston announced they had cooked up oxides that smashed Müller's record.

The scientists have been at it ever since. Chu and his close-knit team of six pushed the temperature of Müller's ox-

## THE MERCURY SOARS FOR SUPERCONDUCTORS

**–28F (240K)** Now numerous research groups report indications of superconductivity at temperatures a conventional freezer could achieve.

**–284F (98K)** In February, 1987, scientists at University of Houston push the limit beyond the 77K temperature at which semiconductors can be cooled by liquid nitrogen.

**–390F (39K)** By the end of 1986, researchers have developed oxides that push the temperature up by 16F.

**–406F (30K)** In January, 1986, IBM scientists observe superconductivity in a copper oxide.

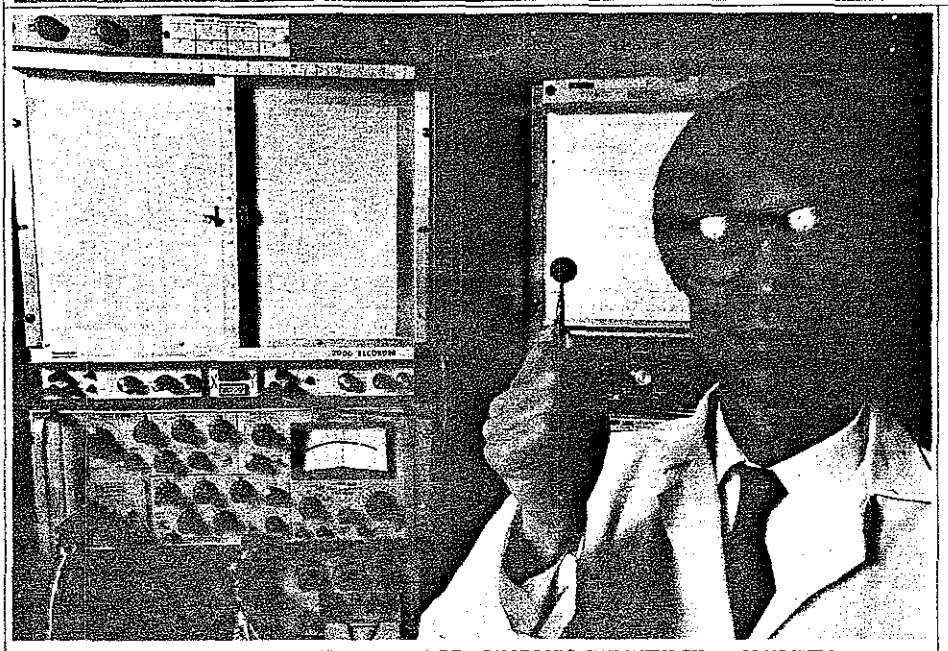
**–419F (23K)** Improvements in niobium alloys raised the temperature by only 14F by 1973.

**–433F (15K)** Limited applications become practical in 1941 with the discovery of a niobium alloy that can be cooled with liquid helium.

**–452F (4K)*** In 1911 scientists observe superconductivity in certain metals at nearly absolute zero.

*On the Kelvin scale, absolute zero is equivalent to –459F

MARY KYLE ROSS



YOU'RE GETTING WARMER: THE UNIVERSITY OF HOUSTON'S CHU WITH SUPERCONDUCTOR

ide to 52.2K. "But I knew we wouldn't go higher unless we found a new material," Chu says.

So he decided to substitute another element, called yttrium, for the lanthanum in Müller's oxide. Working with University of Alabama scientists under Wu-Maw Kuen, the researchers soon recorded signs of superconductivity at a torrid 100K in that oxide. "But we came back the next day, and it had disappeared," recalls the 45-year-old Chu. The researchers began an intense cat-and-mouse game with the material, trying to stabilize the superconducting properties at that high temperature.

The team tested dozens of recipes with little success, but Chu's optimism never flagged. "He always looks on the bright side," says Pei-Herng Hor, one of his Taiwanese-born colleagues. By early February the team scored: The researchers found a stable compound that was superconductive at 98K, well above the temperature at which inexpensive liquid nitrogen could be used for cooling.

**'SCIENCE SUPERSTAR.'** Chu kept mum for two weeks, but rumors quickly lifted the veil of secrecy. Researchers at IBM, AT&T, and the University of California at Berkeley immediately set out to discover the secret ingredient. "Chu ran the four-minute mile in superconductivity," declares James E. Shirber, manager of solid-state physics at Sandia National Laboratory. "He broke the barrier to liquid nitrogen." When the news got out, Chu earned the nickname "Science Superstar" from his staff.

That could prove to be an elusive title. Within weeks Tanaka, Z. X. Zhao from the Institute of Physics in Beijing, AT&T, and IBM were pacing Chu. By substituting still other elements such as calcium and lutetium, they concocted a dozen different oxides that become superconductors above 90K.

With so many teams after the ultimate superconductor and the prizes it might bring—perhaps even a Nobel—the tension among key researchers is becoming almost palpable. At the Physical Society meeting in New York, the scientists assiduously noted the dates when they observed high temperatures, developed compounds, or completed other ground-breaking work. "Everyone is writing history to make themselves look better," observes one physicist.



IBM'S K. ALEX MÜLLER: HIS DISCOVERIES A YEAR AGO KICKED OFF THE RESEARCH FRENZY

At a press conference during the meeting, Tanaka claimed the Japanese were first to experiment on certain compounds. Chu jumped up to add that his lab, too, was working on the same compounds at that date. Such incidents are "just the tip of the iceberg," says Chu. Although Chu and Tanaka used to compare work, the communication stopped once Chu began experiments on yttrium.

"It's frantic, mass hysteria," says Paul M. Grant, manager of magnetism and collective phenomena at IBM's Almaden Research Center in San Jose, Calif. "Everyone's exhausted." Grant, whose weeks of midnight research sessions resulted in the identification of the structure of one of the oxides, has the dark circles under his eyes to prove it. And the research is progressing so rapidly that it has outstripped the usual channels of scientific communication. At *Physical Review Letters*, the leading physics journal, more than 50 superconducting research papers await publication. " 'Recently' in this field now means two days ago," says M. Brian Maple, professor of physics at the University of California at San Diego.

**GETTING PRACTICAL.** The race to push superconducting materials out of the lab has barely begun, however. Just because a substance loses its electrical resistance when it's dipped in a cold, liquefied gas does not mean it will be much good in the real world. To be practical, superconductors have to be fashioned into wires, cores of magnets, and the thin coatings that form the foundation of computer circuits. And the materials, which are basically ceramics, are brittle—and fragile. "It is a long road between discovery and use of the devices," says Robert J. Cava, a chemist at Bell Labs.

But scientists already are pulling off the basic developments that lay the foundation for commercial applications. One key finding is that the materials may make possible the most powerful electromagnets ever built. Tests at Westinghouse and AT&T indicate that the new superconductors can withstand magnetic fields up to 10 times greater than those possible with such materials as niobium. That could open the way to such applications as tiny but extremely powerful electrical motors and higher-resolution medical imaging machines.

By March, both IBM and Stanford University had used techniques common in the semiconductor industry to produce a superconducting thin film that could be used in computers. At Stanford, Theodore H. Geballe, a professor of applied physics, fashioned a film into a prototype device that might be an ultrahigh-speed data pathway between computer

(TOP) CONNOLLY/PICTURE GROUP; (BOTTOM) WALTER P. CALAHAN

chips. An AT&T team that included Bertram Batlogg and ceramist David Johnson used ceramic processing technology to make its tape and small donut-shaped magnets. Japan's Fujikura Ltd. and Sumitomo Electric Industries Ltd. have made prototype superconducting wires.

The prospect of high-temperature superconductors shooting out of the laboratory has scientists lusting nearly as much after potential profits as scientific prizes. Just as semiconductor technology created Silicon Valley, the new superconductors may well create an "Oxide Valley." Already, some researchers are talking about starting companies. And Henry Kolm, who left Massachusetts Insititute of Technology to found a company to develop superconductivity applications a decade ago, believes the new oxides will open the door to venture capital. "People didn't consider helium practical," he says. Liquid nitrogen cooling, however, "is not far from frozen-food technology."

But just who owns the rights to the new technology promises to be a major muddle. The U.S. Patent Office is already sifting through dozens of applications on everything from the structure of oxides to manufacturing processes and devices. IBM and AT&T both contend they have claims for broad patent protection, but "it may be some time before we find out who has what rights," admits George Indig, a patent attorney at AT&T. Observers are predicting messy shootouts in the courts.

The rush of discoveries also leaves physicists with some loose ends. For one thing, they can't fully explain why the oxides are such superior superconductors. "It may be several years before we know what's going on, but there may be no theoretical limit to how high the temperature can go," says Robert Schreiffer, a professor at the University of California at Santa Barbara who won a Nobel for developing a theory of superconductivity. Indeed, by the time the New York meeting broke up, labs in the U.S. and Europe had reported signs of superconductivity well above 100K.

Such reports are spurring a frenzy of activity in Chu's Houston laboratory. Shoes are scattered under desks, and jackets and shirts are hung in corners, as the researchers work around the clock. The full-sized refrigerator is crammed with Chinese take-out food. "When you are No. 1, you always have to work to keep it," says Hor. "You hardly sleep." And Chu has his sights clearly on another record—125K. By mid-March rumors were circulating that he might be close. "Will history repeat itself? Who can tell," says Chu grinning.

*By Emily T. Smith in New York, with Jo Ellen Davis in Houston and bureau reports*

## THE U.S. HAS THE ADVANCES, BUT JAPAN MAY HAVE THE ADVANTAGE

When a Houston laboratory announced a major advance in superconductivity research in February, Japan Inc. wasted no time. Its Ministry of International Trade & Industry immediately began assembling a consortium of government, industry, and university researchers. A MITI official describes the ministry's goal with missionary zeal: to exploit the "fantastic world of future industries" promised by new materials that conduct electricity with virtually no loss of power.

Both leading U.S. universities and major industrial companies such as International Business Machines Corp. and American Telephone & Telegraph Co. are playing a pioneering role in the spectacular scientific advances. But some experts fear that the Japanese ability to organize their research into a program with strong commercial goals could give them the edge in moving the research out of the laboratory.

At the moment, declaring a winner in the superconductivity race is premature. But leaders of the nation's science Establishment marvel at the speed of MITI's action. "I wouldn't call what they have done ominous, but it certainly is a sign of intensifying aggressiveness," says Roland W. Schmitt, General Electric Co.'s chief scientist and chairman of the National Science Board. Adds Carl H. Rosner, president of Intermagnetics General Corp.: "The Japanese have long recognized the tremendous potential of superconductivity, whereas the people in this country have been very shortsighted."

**HEAD-SCRATCHING.** No one government agency coordinates U.S. attempts to exploit the new science. Nor does anyone know precisely how much the U.S. spends on superconductivity research. But the National Science Foundation, which funded much of the recent U.S. research, estimates that federal agencies are funneling at least $8 million a year to universities.

American scientists and industrialists share the assumption that, as in the past, the U.S. system doesn't need a push from the government to bring innovative technologies to market. "The discoveries have been so spectacular that the level of activity is enormous in every laboratory in the U.S. with any capability in superconductivity," argues Schmitt. And Frank Press, president of the National Academy of Sciences, notes that a surprising amount of the academic work is aimed at applications of the new knowledge, such as thin superconducting films for computer chips.

But not everyone is satisfied. Ching-Wu "Paul" Chu, the University of Houston physicist who is the leading U.S. superconductivity researcher at the moment, thinks more action is needed to meet the combined weight of Japan's governmental, financial, and industrial resources. "We cannot afford not to move the same way as the Japanese," he says. "We really have to have a coordinated effort this time." In between those standing pat and the activists, there are a lot of people just scratching their heads. "Maybe," says one official half-jokingly, "what we ought to do is have some kind of conference to see what we ought to do."

**FIRST WIDGET.** But one aggressive government science administrator is not waiting. James A. Ionson, the astrophysicist who heads the Office of Innovative Science & Technology for the Pentagon's Strategic Defense Initiative Organization, is already busy forming his own consortium. He has lined up an unnamed university, a federal research laboratory, and a handful of small companies. Ionson's consortium will have a specific target: vastly improved space-based infrared sensors for detecting enemy missiles. "My concern is that if we don't pull the science into a technology fast, we're going to be beaten to the punch," says Ionson. "I think we've got to build the first widget."

Early proof that the science can be converted into a product might, as Ionson hopes, be enough to spur vigorous development. But there are no guarantees. Even in the basic science, the international competiton is fierce, and other nations are already scrambling hard for products because the potential payoffs appear to be so great. Furthermore, there are signs that the time from discovery to application may be exceptionally short.

Superconductivity is likely to be a severe test of the highly individualistic American system. Even as basic findings are still pouring out of the laboratories, the stark reality of the competitive marketplace looms. And Ionson's embryonic consortium is no match for MITI's directed Japanese effort. In this case, the U.S. may have to consider imitating Japan for a change.

*By Evert Clark in Washington*

# THE NEW WORLD OF SUPERCONDUCTIVITY

## Technologies and products once only dreamed of are suddenly coming within reach

Inexhaustible, cheap energy from fusion, desktop computers as powerful as today's number-crunchers, trains that fly above their rails at airplane speeds—all suddenly have taken a giant step closer to reality. But while scientists developing a new breed of "warm" superconductors are planting the seeds of an almost Utopian tomorrow, it will be up to engineers to reap the harvest.

That won't happen overnight. The novel materials that researchers are churning out in laboratories still have to be transferred to the factory floor. Significant hurdles must be cleared before an experimental circuit for a superconducting computer can be turned into mass-produced chips. A small sample of wire is a long way from cables that will span the nation.

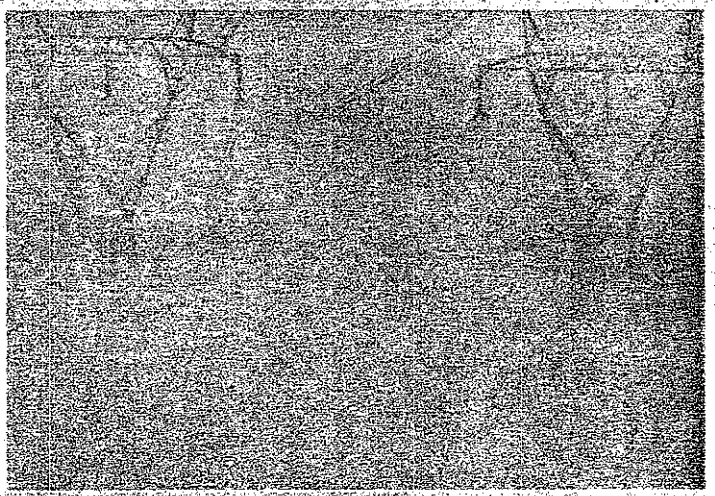
Even in the fleet-footed electronics business, it will probably be 1990 before full-fledged products show up. For electrical utilities, it could take 10 to 20 years before the revolutionary new superconductors make a meaningful impact on power distribution. The challenge of scaling up lab results "could be formidable," cautions Paul M. Grant, manager of magnetics research for International Business Machines Corp.

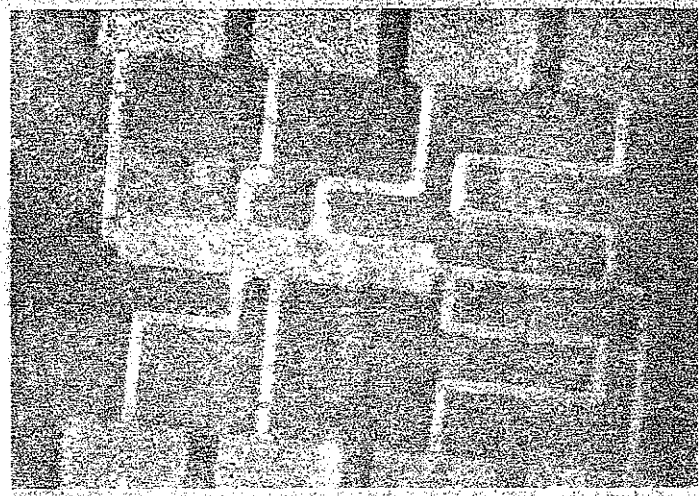
**SCOTCH AND WATER.** Until now, superconductivity has been limited to a few applications because the materials available had to be cooled to extraordinarily frigid temperatures with expensive liquid helium. "Liquid helium costs about the same as Scotch," says Walter L. Robb, senior vice-president for corporate research and development at General Electric Co. Liquid nitrogen is 10% as costly—roughly on a par with bottled water. And even with complicated and very expensive insulation systems, liquid helium escapes far more rapidly than liquid nitrogen, which can be protected with simple plastic-foam insulation.

The idea that it may soon be economically feasible to put superconductivity to work in myriad uses is sparking development projects at hundreds of companies worldwide. The payoffs would be enormous. And if room-temperature superconductors are ultimately discovered, the world could be transformed. Such "hot" materials could provide new tools for every technology related to electricity. But just the prospect of superconductivity at liquid-nitrogen temperatures is enough to excite most industrial engineers.

Practical nitrogen-cooled superconductors could save the utilities billions—

## FOUR TECHNOLOGIES THAT WILL BE





**POWER SYSTEMS** If electricity can be transmitted vast distances without loss, the country's electrical demands could be met by burning less fuel. As it is, copper wires waste enough power to light up the West Coast. Power plants will become more efficient by using generators made with superconducting electromagnets. And giant electromagnets could even be used to store electricity for use during peak hours. Smaller and more powerful superconducting electric motors will cut industrial power bills.

**ELECTRONICS** Nothing since the transistor promises to overhaul computer science as drastically as superconductivity. The experimental superchip above, produced by International Business Machines Corp., heralds the dawn of a new age in electronics. Tomorrow's electronic systems will pack 100 or more times as much information-crunching power in smaller boxes. With powerful magnets and more sensitive detectors, medical imaging systems will give doctors dramatically sharper pictures.

and save enough energy to put 50 or more power plants in mothballs. Copper wires may be the conductor of choice now, but they lose a lot of power. The copper soaks up 5% to 15% of the electricity flowing through long-haul transmission lines, and still more disappears in local distribution lines. For Pacific Gas & Electric Co., these losses amount to $200 million a year—"plenty of incentive to use a new conductor," says Virgil G. Rose, PG&E's vice-president for operations.

With so much at stake, there has been interest in developing transmission lines and power generators even with existing superconducting technology. Research began in the late 1960s but eventually ground to a halt as the energy crisis faded and the cost of cooling with liquid helium stayed stubbornly high. One line was actually built in the U. S., a 300-ft.-long test installation at Brookhaven National Laboratory. It showed that the technology could not compete with a conventional system unless all the power needs of a city were fed through one line to minimize cooling costs, says Carl H. Rosner, president of Intermagnetics General Corp. But because of the inherent unreliability of such a system, no city would dream of putting all of its watts into one cable. If the new superconducting carriers can be fashioned into cable that can stand up to high power loads and alternating current, 10 or 12 "feeder" lines might be affordable.

Interest in using powerful superconducting magnets to build high-speed trains that levitate above their tracks has also flagged in the U. S., because of high capital costs. That interest, too, could be reviving. But the eventual builders of these so-called maglev trains are more likely to be in either West Germany or Japan, which have continued to fund serious research, or Canada, which still supports a modest effort.

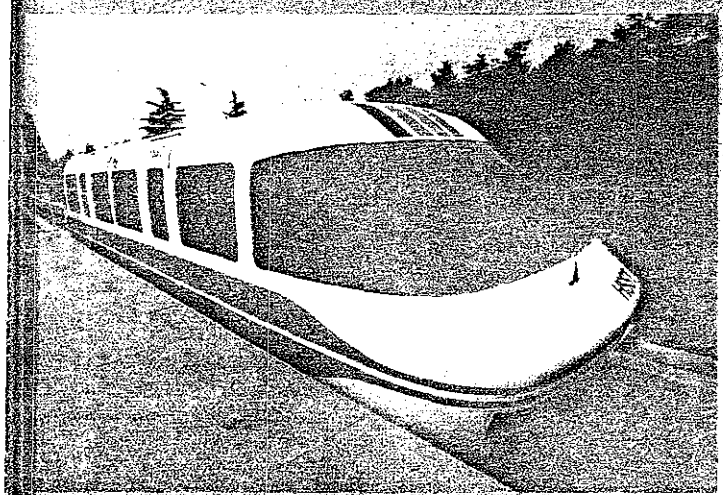
William F. Hayes, a senior research officer with Canada's National Research Council and a maglev believer, bubbles over with anticipation. The new superconductors will have "a tremendous impact on maglev," says Hayes. "The major problems were refrigerating units and reliability. All that's eliminated now." And trains aren't the only vehicles that could benefit. Hayes predicts that superconducting motors one-half to one-third the size of normal motors will one day power ships. They could also help eliminate urban air pollution by making electric cars practical.

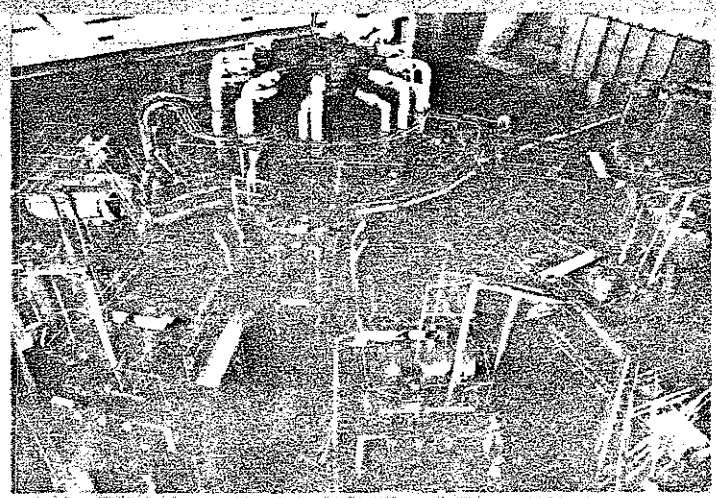
America's best shot at exploiting the new technology is probably in electronics. There, superconductivity will usher in what Sadeg M. Faris calls "the third age of electronics," after vacuum tubes and transistors. Faris worked on superconducting microchip devices known as Josephson junctions at IBM. When Big Blue decided in 1983, after 14 years of work, that the technology was a no-go, Faris left and founded Hypres Inc. In February, less than four years later, Hypres unveiled the first system based on Josephson junctions. Now, Faris asserts that Hypres will be the first to build chips using the new materials, because "no one else in the world has a manufacturing line producing JJ chips."

**SUPERCHIPS.** That distinction isn't likely to last long. Major electronics companies, from IBM to Varian Associates, are racing to explore the new superconductors. "Guys are working like maniacs," says John K. Hulm, director of corporate research at Westinghouse Electric Corp. "I haven't seen anything like this in years." Westinghouse wants to use Josephson junctions, which are up to 1,000 times faster than conventional silicon transistors, to build radar systems it believes would outperform any now available. At Varian, a leading maker of equipment used in semiconductor fabrication, a crash effort is under way to verify the work on superconducting thin films being done at nearby Stanford University. Such films could be the starting point for tomorrow's superchips.

Health care is another area where su-

## THE FIRST TO FEEL THE IMPACT





**TRANSPORTATION.** Trains could get a big lift from superconducting magnets that levitate above the tracks. Such magnets could also power ships, such as the experimental Japanese vessel above, and could help eliminate air pollution from cars by making electric power practical. Japan's Nippon Kokan K.K. is one of the companies trying to develop superconducting motors for ships and electric cars.

**SCIENCE.** In their never-ending quest for knowledge, physicists want to smash atomic particles into smaller constituents or, conversely, to fuse atoms together and imitate the energy-generating furnace inside the sun. To "bottle" an ultrahot fusion reaction in a so-called tokamak device such as the one at Princeton University, magnets more powerful than any now available will be needed. Magnets made with the new materials could also boost the power of future atom-smashers.

# Chip Sense and Nonsense

By George Gilder

This is the economic landscape that stares at Malcolm Baldrige through his window at the Commerce Department: The U.S. has created 14.4 million jobs over the past five years with rising per capita incomes. We have been increasing employment far faster than any other major industrial country, including Japan. We have enjoyed the second-longest economic recovery of the postwar period.

In 1986, U.S. companies produced some $188 billion of electronics goods, more than twice that produced in all of Asia. American companies hold about 70% of the world computer market and produce about 57% of the world's semiconductors when you consider the huge output for in-house use at a handful of major U.S. firms. Value added in the computer industry is shifting toward small computers that are now about 90 times more cost effective than mainframes and toward software. The U.S. lead is largest in desk-top computers, and over the past decade we have increased our market share in software from under two-thirds to more than three-quarters.

For the past five years the U.S. has enjoyed a surge of microchip imports from Japan. The resulting trade gap resulted chiefly from a key strategic decision by the world's largest chip maker, IBM, which produced about $3 billion of advanced semiconductors in 1986. Faced with an unexpectedly large but unpredictable market for its personal computers, IBM resolved to import huge volumes of basic memory chips from Japan rather than invest in special plants to build these commodity items in the U.S.

### Driving Down the Prices

The IBM decision was a brilliant success. The Japanese plus Texas Instruments' Miho facility produced huge volumes of chips and within two years drove down the price from about $8 to around 50 cents for 64K Dynamic Random Access Memories; then they proceeded to launch production of 256K (four times the memory capacity) and one megabit (four times again the memory) generations. Since memory chips constitute about a third of the manufacturing cost of personal computers, the Japanese chips allowed IBM and other U.S. firms to drive the price of computers to new lows and expand the market at a pace of about 30% a year.

Nonetheless, the U.S. did not fall behind in memory-chip technology. According to McKinsey & Co., Texas Instruments became the most profitable semiconductor producer in Japan and introduced a prototype 4-megabit DRAM at about the same time as the Japanese producers. (The 4-megabit design would permit all the working memory in a typical personal computer to be put on one chip.) Most significant of all, IBM probably became the world leader in the technology. Today, in Essex Junction, Vt., it is pioneering the production of very fast one-megabit chips on eight-inch wafers (increasing the chip yield nearly 40% over Japan's best six-inch wafers), and at the recent International Solid States Circuits Conference, IBM introduced an impressively manufacturable 4-megabit design. The company thus is poised to reenter mass production of basic chips should that be strategically desirable in the future.

Because IBM decided not to mass produce 64K or 256K DRAMs, the company—and the U.S.—may have increased its lead in semiconductor technology over the past four years. While the Japanese chip revenues are puffed with money-losing commodity semiconductors, U.S. production totals, including IBM, are dominated by more complex and ambitious designs.

Here's the rub. The figures constantly cited by the Semiconductor Industry Association and by U.S. government officials do not include IBM, AT&T and a few other big in-house producers. To the Japanese, these numbers resemble auto market-share figures that leave out Toyota and Nissan.

In any case, reacting to a catastrophe theory of American semiconductor market share that left out IBM, U.S. trade officials imposed a pricing agreement on Japan. In an act of stupidity unparalleled since Smoot-Hawley, the U.S. forced Japan to more than double the price of its commodity memories. According to a concept of "fair market value" apparently cribbed from some primitive East European pricing guide, the Commerce Department declared war on the U.S. computer industry, effectively excepting IBM. According to the pact with Japan, U.S. computer firms would have to pay twice as much for memory chips as their Japanese competitors that make the chips in-house.

The computer industry is what the contest is all about. The Japanese do not make chips for their health; they make them for their computers and other electronic products. To attack the U.S. computer industry in order to save the U.S. semiconductor industry is simply crazy. Obviously, the U.S. computer firms rushed to circumvent the agreement any way they could, resorting to the gray market and Korea, and making plans to move manufacture of U.S. computers offshore as fast as possible.

Therefore, the agreement broke down. In the interests of U.S. competitiveness, it had to break down. Even the various provisions about increasing the U.S. share of the Japanese chip market became unenforceable because of a recession in the computer industry and because U.S. companies do not supply the chips needed by still thriving Japanese producers of consumer electronics.

Meanwhile, the three U.S. semiconductor companies that may have benefited in the short run from the agreement began to complain of Japanese "violations." Democratic politicians, who lacked telling objections to economic conditions under the Reagan administration, began carping about the "trade gap." Spurning advice from economists who could refute the mercantilist superstitions of trade balance and lacking advisers who understood the technological complexities, the Reagan administration collapsed.

*The U.S. government has become the chief obstacle to American competitiveness in electronics.*

Jeopardizing thousands of relationships between U.S. and Japanese electronics firms, the administration has made it far more difficult for U.S. semiconductor firms to penetrate the Japanese market except possibly on the basis of forced quotas. But semiconductors, critical to the production of end products, can be purchased in the long run only on a basis of trust and predictability, with just-in-time delivery and fail-safe reliability. By constantly imposing special export controls for nonsensical national security concerns and changing policy from month to month in response to utterly spurious emergencies, the U.S. government has become the chief obstacle to U.S. competitiveness in electronics.

Herbert Stein on this page recently stripped away the layers of illusion and superstition surrounding the theory of the balance of payments. In a world with global money markets on line 24 hours a day, there is no more reason for a trade balance between any two countries than between any two American states or companies. The U.S. currently is dominating world electronics markets because it is following a global strategy consistent with the increasing integration of world information technology.

This means that like every other major nation we will have to be dependent on foreign producers for many critical parts and materials. As long as we teach more students sex education and cooking than physics and calculus, we must depend on immigration for key technical personnel. The alternative is a real decline in U.S. competitiveness. We cannot do it alone.

Although the Japanese need to reform their increasingly restrictive tax rates and monetary policies, Japan is not a problem for the U.S. It is a supreme and precious asset of world capitalism. Not only do superb Japanese manufacturers supply the U.S. with crucial goods and technologies, but they supply the U.S. economy with an indispensable flow of investments. Not only did Japan save the U.S. economy by tripling auto gas mileage when OPEC tripled the price of oil, Japan also has spurred tremendous creativity and resourcefulness in U.S. electronics.

Some analysts believe the U.S. is becoming excessively dependent on Japan for vital supplies of capital equipment. This is a minor problem that can be quickly solved by IBM and the Pentagon, if they insist, without wrecking the international trade system. But the key ingredients in electronics are not machinery or materials, but ideas and inventions. To imagine the Japanese will dominate the age of information because they have the purest silicon and industrial gases is like predicting the Canadians will dominate world literature because they have the tallest trees.

### Useful Roles for Government

If the government wants something to do, there are plenty of useful roles. It could begin with a defense education act that helps the schools teach math and science. (Opening a DRAM plant in North Carolina, Mitsubishi discovered that it had to use graduate students to perform statistical-quality control work done by line workers in Japan.) Then the government could reform immigration law to allow admission of workers to support our increasingly gargantuan entitlement-state, and technical personnel to man our high-tech and defense industries. Finally, the government could expend its trade powers defending U.S. patents, copyrights and other intellectual property against Asian nations that let their citizens steal it. Thus the government could reward U.S. achievement rather than protect U.S. sloth.

With recent breakthroughs in superconductivity, bioengineering, computerized chip design, parallel processing, and artificial intelligence, we are entering an era of limitless opportunities. The politicians, however, continue to live in a 19th-century fog of territorial fears and mercantilist fantasies. Peter Drucker tells us, "Don't solve problems, pursue opportunities." That is the supreme message of the day in electronics.

*Mr. Gilder is finishing a book on the computer industry for Simon & Schuster.*

# For Many Criminals, Incarceration Is Not the Answer

By Latique A. Jamel

Prisons are bursting at the seams. New York and other states are spending millions to expand existing facilities and build new ones. The number of men and women being put in cells each month far exceeds the number released. But need this be done in order to maintain public safety?

State prisons, for both moral and economic reasons, should house not marginal, nonviolent criminals, but only those felons who pose a genuine threat to the community. The evidence in New York, at least, is that a wider net is being cast.

Not all of these felons should have gone to prison, and many of them would be better off in community rehabilitative programs. Fined totals a staggering $468 million. Take the annual cost of confinement for each prisoner (a figure identified by both the New York studies as $26,000 a person) and multiply it by 4,680 and you come up with an additional $121.7 million a year.

(Some might argue that a home burglar, armed or not, is the sort of person society would want confined. Even removing all burglars from the total above and cutting the number of inmates to be released to 6%, however, would still permit a saving in New York state alone of $234 million in construction costs and $60.8 million a year in confinement costs.)

But there is a more important noneconomic reason for committing fewer felons to prison. Contrary to the conventional wisdom that the certainty of punishment is a deterrent to crime, and that the longer the sentence of prisons, some criminologists believe time in prison tends to increase the level of violence perpetrated by a repeat offender and increases his propensity to commit criminal acts. The number of inmates who undergo marked character improvement during imprisonment is low; this is borne out by recent studies of recidivism rates among released criminals.

Younger inmates often have committed such crimes as car theft and possession of stolen property. In some cases, being sent to prison serves to deter young criminals from committing new, more severe crimes upon release. However, in an alarming number of instances, prison is a graduate school with older, more hardened crimi-

Those who would have us believe that the best, if not only, response to crime is to "get tough" on all criminals ought to consider that according to the Bureau of Justice Statistics, at least 20% of all inmates in New York state are released within three years, and more than 90% of all prisoners return to the communities in which they lived before incarceration, and often this means returning to the community in which they committed their original crimes.

One would hope that citizens would prefer to have nonviolent criminals—who will come back to their communities and share their schools and work places—punished in a manner that will reinforce respect for so-

# The Rise and Fall of the Blue-Collar Worker

By Peter F. Drucker

Whether high-paying jobs are growing or declining in the American economy is being hotly debated. But as important as the numbers is the fact that the new high-paying jobs are not where the old ones used to be.

For 30 years, from the end of World War II to the mid-1970s, high-paying jobs in all developed countries were concentrated in unskilled blue-collar work. Now a majority of the new high-paying jobs are in knowledge work: technicians, professionals, specialists of all kinds, managers. The qualification for the high-paying jobs of 20 years ago was a union card. Now it is formal schooling. The long and steep rise of the "working man"—in numbers, in social standing, in income—has turned overnight into fast decline.

There is no parallel in history to the rise of the working man in the developed countries during this century. Eighty years ago American blue-collar workers, toiling 60 hours a week, made $250 a year at most, or one-third the price of that "low-priced miracle," Henry Ford's Model T. And they had no "fringes," no seniority, no unemployment insurance, no Social Security, no paid holidays, no overtime, no pension—nothing but a cash wage of less than one dollar a day. Today's employed blue-collar worker in a unionized mass-production industry (steel, automotive, electrical machinery, paper, rubber, petroleum) working 40 hours a week earns about $50,000 a year—half in cash wages, half in benefits. Even after taxes, this equals seven or eight new small cars, such as the South Korean Excel, or 25 times the worker's 1907 real income (if food were used as the yardstick, the increase would be even larger). And the rise in social standing, and especially in political power, has been greater still.

## Society's Stepchildren

And now it is suddenly all over. There also is no parallel in history to the abrupt decline of the blue-collar worker during the past 15 years. As a proportion of the working population, blue-collar workers in manufacturing have already decreased to less than a fifth of the American labor force from more than a third. By the year 2010—less than 25 years away—they will constitute no larger a proportion of the labor force of every developed country than farmers do today—that is, a 20th of the total. The decline will be greatest precisely where the highest-paid jobs are. Blue-collar automobile employment in the U.S., 15 or 20 years hence, will hardly be more than half of what it now is, even if there are no imports at all—and automobile blue-collar employment is already down 40% from its peak, less than 10 years ago. No wonder the unions do not regard the fast growth of high-paying knowledge jobs as a compensation for the steady decline in the numbers, power, prestige and income of their constituents. Yesterday's blue-collar workers in manufacturing were society's darlings; they are fast becoming stepchildren.

This transformation was not caused by a decline in production. U.S. manufacturing output is steadily expanding, growing as fast as gross national product or a little faster. The decline of the blue-collar worker is not a matter of "competitiveness," of "government policies," of the "business cycle," or even of "imports." It is structural and irreversible.

There are two major causes. First is the steady shift from labor-intensive to knowledge-intensive industries—e.g., a drop in pouring steel and a steady rise in making pharmaceuticals. All the growth in U.S. manufacturing output in the past two decades—and it has about doubled—has been in knowledge-intensive industries. Equally important is the world-wide spread in the past 40 years of two American inventions (or discoveries), "training" and "management." In a complete reversal of all that economic history and theory had taught, these two methods enable a country with the labor costs of an "underdeveloped" economy to attain, within a very short period, the productivity of a fully "developed" one.

The first to understand this were the Japanese after World War II. By now everybody does—the South Koreans, for instance, or the Brazilians. The most telling example are the "maquiladoras," the plants on the Mexican side of the U.S.-Mexican border, where unskilled and often illiterate people produce labor-intensive parts and goods for the U.S. market. It takes three years at most for a maquiladora to attain the labor productivity of a well-run American or Japanese plant even in turning out highly sophisticated products—and it pays workers less than $2 an hour.

This means that manufacturing industry in developed countries can survive only if it shifts from being labor-intensive to being knowledge-intensive. Machine operators getting high wages for doing unskilled, repetitive work are being replaced by knowledge-workers getting high wages for designing, controlling and servicing process and product, or for managing information. This shift also fits in with demographics. In every developed country more and more young people, and especially young males, stay in school beyond the secondary level and are no longer available for blue-collar jobs, even for well-paying ones.

These are changes so sharp and so sudden as, for once, to deserve being called "revolutionary." Yet their impact is different from what everyone expected, and different also from what economic and political theory had taught.

This applies particularly to U.S. unemployment. In Britain and Western Europe the decline in blue-collar jobs in manufacturing has indeed, as unions predicted, resulted in stubborn unemployment. But in the U.S. the decline has had marginal effects at most. Even the massive job losses in the steel and automotive industries have barely left a trace in national unemployment rates. To be sure, the current 6½% unemployment rate for both adult men and adult women is probably somewhat above the rate of "natural unemployment" (the rate needed for normal job changes)—but not by much, considering the age structure of the working population. And the 4½% unemployment rate for married men is, if anything, below the natural rate and constitutes virtual "full employment." "Hidden unemployment"—that is, people who have given up looking for a job—is very big in union propaganda but probably quite scarce outside of it. A larger proportion of American adults than ever before in peacetime history—almost two-thirds—is in the labor force and working. One explanation for the low unemployment rates is surely that American workers are singularly adaptable and mobile—far more so than anyone would have thought possible. But, equally significant, blue-collar labor in manufacturing may also have already shrunk to a point where it only marginally affects total employment and unemployment rates, consumer spending, purchasing power and the economy as a whole. This would mean that we should stop looking at manufacturing employment as the economy's bellwether and should look at manufacturing output instead; as long as its volume continues to rise, the industrial economy is healthy almost regardless of employment.

Equally novel is the behavior of wage costs in the U.S. That unions give priority to the maintenance of nominal wages rather than accept lower wage rates to gain higher employment has been one of the axioms of modern economics. It still holds in Europe. But America's unions have shown an amazing willingness to make sizable concessions on wages—and even on work rules—to prevent plant closings and massive layoffs. In the U.S., at least, the principal cost-rigidity inhibiting the "self-correction" of a market economy surely no longer lies in wage costs (as economics has assumed since Keynes) but in the cost of government.

Every labor economist and every labor leader would have expected the decline of the blue-collar worker to lead to "labor militancy" on a grand scale. Some politicians still expect it—for instance, the Rev. Jesse Jackson in the U.S., the "Militants" in the British Labor Party and the "Radicals" among the German Social Democrats. But so far there has been labor militancy in only one developed country: Canada. Elsewhere there is much bitterness among the rank and file. But it is the bitterness of resignation, of impotence rather than of rebellion. In a way, the blue-collar worker has conceded defeat.

And this may underlie the most startling, and least expected, development: the political one. It is almost an axiom of politics that a major interest group actually increases its political clout for a long time after it has begun to lose numbers or income. Its members join ranks, learn to hang together lest they hang separately, and increasingly act and vote in concert. The way in which farmers in every developed country have maintained political power and increased their subsidies despite their rapid decline in numbers since World War II is a good example.

## Political Strength Eroded

But though it is only 10 or 15 years since the decline of the blue-collar workers first began, their political strength has already been greatly eroded. In the midst of World War II, John L. Lewis of the United Mine Workers defied the country's most popular president—and won. Thirty years later, another coal miners' leader—this time in Britain—forced a prime minister to resign. But in 1981 President Reagan broke the powerful and deeply entrenched air traffic controllers union; and a few years later British Prime Minister Margaret Thatcher broke the union that had driven her predecessor into political exile. And both President Reagan and Prime Minister Thatcher had overwhelming popular support. The labor vote may still be needed for a "progressive" candidate to be nominated. But then, in the election, labor's endorsement has become a near-guarantee of defeat, as shown by Walter Mondale's debacle in the U.S. presidential election of 1986, by the German election this January and by numerous British by-elections.

In little more than a decade before World War I, the blue-collar worker rose from impotence to become a dominant economic and social power in Western Europe, and his party the largest single political factor. The U.S. followed suit 10 years later. This transformed the economy, the society and the politics of every developed country, transcending even two world wars and tyrannies beyond precedent. What then will the decline of the blue-collar worker—and its counterpoint, the rise of the knowledge-worker—mean for the rest of this century and the next one?

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*Mr. Drucker is Clarke professor of social sciences at the Claremont Graduate School.*

## *Drucker on Management*

*There has been labor militancy in only one developed country: Canada. Elsewhere there is much bitterness among the rank and file. But it is the bitterness of resignation.*

# How Japan Inc. is cashing in on free U.S. R&D

## Technology transfer between federally funded labs and Japanese firms is flowing only one way — Eastward

It's a familiar scene. Japanese scientists tour U.S. laboratories to visit with their American counterparts and share information. In many cases, however, U.S. industrialists and government officials argue, the sharing is strictly one-sided. The Japanese, they contend, often walk off with innovative technology — for free — and offer little in return. "They recognized early that the U.S. is funding the entire world's basic research," says Norman Latker, director for federal technology management policy in the U.S. Department of Commerce's Office of Productivity, Technology and Innovation.

There is nothing illegal about this. Information on nonclassified research and development at national laboratories has been readily available. So it's no surprise that the Japanese and others have launched concerted efforts to cash in for free R&D. "They would be nuts to pay for research they can get for nothing," says one government official. "And the Japanese are anything but dumb."

What is perhaps more of a surprise is that few U.S. companies have followed suit. Some companies, such as Harris Corp. and Intel Corp., have technology transfer agreements with national laboratories, but U.S. industry in general has kept its distance from federal labs. One reason might be that U.S. companies want guarantees in the form of patents before they will invest heavily to adapt basic research for commercial applications. Until recently, this has been a difficult procedure.

Representatives of Japanese firms, however, point out that there is nothing illegal about picking up technology that is in the public domain. "It is a mistake to single out the Japanese for cleverly taking technology that is freely available to everybody on a nondiscriminatory basis," says H. William Tanaka, an attorney with the Washington, D.C., firm Tanaka-Walders-Rigter, which represents the Electronic Industry Association of Japan.

Furthermore, Tanaka contends, the technology transfer legislation goes against the current trend for companies from different countries to link up to share enormous R&D costs. "It is highly questionable whether this legislation will help American companies develop technology out of federally funded laboratories in the face of structural changes that are forcing companies and countries to pool their resources."

> U.S. companies want guarantees in the form of patents

Nevertheless, new legislation could change the often asymmetrical nature of technology transfer. At the very least, its proponents hope the Federal Technology Transfer Act of 1986 will give U.S. companies a beat on foreign competitors in making the most of U.S.-developed basic research. At best, supporters predict this new method of exploiting technological breakthroughs will give birth to creative Silicon Valley-like communities around many of the labs. "Our economic future depends on encouraging the efficient dissemination of skills and information within our communities," says Senator Patrick J. Leahy (D-Vt.).

Under the new law, national labs

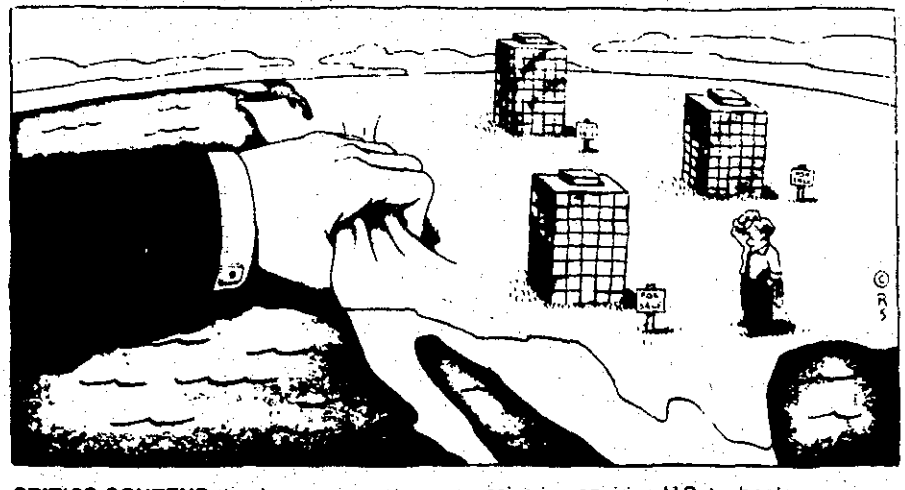
- Allows labs to enter into cooperative research agreements with industry, universities and others, and to negotiate patent licensing agreements
- Directs heads of agencies with large labs to institute cash award programs to reward scientific, engineering and technical personnel
- Requires agencies to give at least 15% of royalties received from licensing an invention to the inventor and distribute the balance of any royalties among its labs
- Creates the Federal Laboratory Consortium for Technology Transfer at the National Bureau of Standards.

**Publish and perish**

The need to make federal labs more responsive to national needs was outlined in a 1983 report by the Packard Panel, headed by David Packard, cofounder of Hewlett-Packard Co. and former deputy secretary of the Defense Department. "The national interest demands that the federal labo- will decide how best to disseminate internally developed technology. They can cut their own deals with interested companies and share the profits. "To improve technology transfer, the federal laboratories need clear authority to do cooperative research and they need to be able to exercise that authority at the laboratory level," states a Commerce Department report. Until recently, such information was routinely published and available to anyone — from the United States or abroad. Now, American companies will get first crack. The law:

ratories collaborate with universities and industry to ensure continued advances in scientific knowledge and its translation into useful technology," the report states.

Although the legislation encouraging such interaction was approved late



Rob Saunders

**CRITICS CONTEND** the Japanese are too aggressive in acquiring U.S. technology

last year, it will be some time before the provisions are routinely enforced, according to Latker. "We're now trying to implement the law," he says. "But first we have to change a significant cultural bias away from the idea of publishing everything."

It might seem naive to some that inventions funded by taxpayers were made equally available to everybody, but that policy reflects the democratic attitude that no individual or company should get preferential treatment. And federal researchers have felt uncomfortable coming down from their ivory towers and hooking up with private companies in commercial ventures. The financial incentives could help change these attitudes. "It [will be] interesting to see the response when the first researcher pulls up in a red Ferrari," says Joseph Allen, technology policy liaison in the Commerce's Office of Productivity, Technology and Innovation.

Lab officials are learning the benefits of licensing and cost-sharing arrangements from universities, which lately have expanded their ties with industry. Some particularly aggressive institutions like Stanford University and the University of Wisconsin reportedly have made more than $5 million a year in profits by licensing technology and sharing research costs.

By contrast, the U.S. Treasury made only $2 million on patents in 1985 even though it spent $18 billion — a third of all R&D spending — at about 400 federal labs. The labs do research on everything from thin film and optoelectronics technology to boll weevils, with the heaviest funding going to the relatively large labs for weapons, space science and energy research, medical programs, and physics experiments.

The labs, which employ a total of 185,000, including one-sixth of the country's scientists, have produced 28,000 patents. Only 5% of those patents have been licensed. "This statistic is a reflection both of the fact that many government patents have little or no commercial value and that agencies have made little effort to seek private sector users for even their most important commercial inventions," says E. Jonathan Soderstrom, director of technology applications for Oak Ridge National Laboratory at Martin Marietta Energy Systems in Tennessee.

It is difficult to track the evolution of basic research, so there are no clear-cut examples of U.S. technology that the Japanese have exploited for commercial products. But no one denies that there has been a concerted effort by aggressive foreign companies (and country-sponsored initiatives) to acquire technology from America. In 1983, for example, the Japan Economic Institute reports that the United States transferred to Japan six times as much electronics technology and almost eight times as much machine-tool technology as it acquired from Japan.

In all, 70% of Japan's worldwide technology imports that year came from the United States, according to Senator J.D. Rockefeller IV (D-W. Va.) "This asymmetry in the international flow of knowledge has real repercussions for our country's competitiveness in world markets," says Rockefeller. "If our cutting-edge technology is made fully available to our rival in international trade . . . we stand to lose not only foreign markets but also jobs and income at home."



**SEMICONDUCTOR RESEARCH** at Sandia Labs, where scientists no longer allow routine visits by foreign scientists

## Lab officials are learning the benefits of licensing

It's not that Rockefeller and others want to totally stop technology exchange programs with foreign countries. Rather, they want to guarantee that technology swaps are equal. "It's time we started bartering a little more," says Robert Stromberg, technology transfer officer at Sandia Laboratories in New Mexico. "We want a fair, equal exchange on a tough Yankee-trade basis." Stromberg cites, for example, that Sandia no longer allows routine visits by foreign scientists unless "we are sure they are as good as ours and that any exchange of technology goes both ways."

Allen of the Commerce Department points to the lopsided international scientist exchange programs as one of the most obvious inequities. "The Japanese have been able to place a lot of people in labs here," he says. "But we have a hard time placing them over there." At the National Institute of Health, for example, some 397 Japanese scientists were working in U.S. facilities in fiscal 1985, while only three U.S. NIH scientists were assigned to Japanese labs.

Even without their aggressive attempts to acquire U.S. technology, industry sources contend, the Japanese have a significant R&D advantage. Even though U.S. R&D spending has leveled off at about 2.7% of the gross national product, the Japanese project that, by 1990, R&D expenditures will rise to 3.2% of GNP.

"We're stagnating at 2.7%, much of it for the military, while they keep increasing spending for commercially exploitable R&D," says Ralph Thomson, senior vice president of the American Electronics Association. "Our one remaining competitive advantage was innovation, but we're wrong to believe the Japanese are just copiers. Their emphasis on commercial R&D has got them to the point where they are better than the U.S. in many products."

BETH KARLIN

## Business and universities

# Brain gain

Each year Britain's universities spend about £2 billion and turn out 76,000 graduates. Of these, 33,000 have studied vocational subjects such as science, engineering, technology or management. Yet unease persists that somehow British industry fails to capitalise on the treasures of scientific knowledge that lie buried on campuses. Government tightens the financial squeeze on universities and hopes that somehow the private sector will plug the gap: the theory is that this should not only save public money, but make university research more "relevant"; to the needs of industry, that is.

Big British companies think otherwise. They reckon it is unrealistic to expect the private sector to put up enough money to replace what is no longer forthcoming from government, either through the University Grants Committee (which pays salaries and overheads) or the research councils (which finance specific research work). Last week ICI's chairman, Sir John Harvey-Jones, accused politicians of "living in dreamland" if they thought that would happen.

In the main, British industry wants universities to carry on developing new scientific knowledge and turning out well-trained minds, rather than being forced to become academic annexes to corporate research labs. For their part, the universities fear that the more money they get from industry the less they will get from government. That has been the fate of Salford University, in Lancashire, which pioneered industry links and financing, only to have the state tourniquet tightened to the point where it has to charge high fees for its services to industry.

Yet industry and universities are growing closer in down-to-earth ways, partly spurred by the government's tight-fistedness. In 1981-82, companies spent £26m on university research. By 1984-85 that had grown to £47m. The 1985-86 figure looks like turning out around £70m, and the current year is expected to see another 50% rise to about £100m.

There is more to this new togetherness than money. The universities are now hustling companies for business. At the Techmart (new technology) exhibition at the National Exhibition Centre near Birmingham this week, 33 universities have been showing off what they can offer and the ways they are prepared to link with industry. No university today seems to be without an industrial liaison officer. There are now 26 campus science parks around Britain, housing 380 companies.

This increasing supply means that companies face a buyer's market for fairly ordinary research not needing rare talent. But the universities are not a pushover. Some, such as Manchester, have formed their own companies to handle licensing of patents and to nurture small businesses based on ideas developed in their labs. Nor are universities always ready to sell their intellectual property to the first buyer who comes along. Manchester is sitting on a valuable innovation that can detect the Aids virus rather well; but the university will not license its idea until it has an idea how much money the buyer will make out of it, so that it can pitch for a good price.

Although most of the research financed by big industrial companies is long-term, ICI is in addition now using Manchester's chemistry department to speed up its search for products using liquid crystals to sell to the electronics industry. It is looking for fast results, not blue-sky research.

For a long time companies have financed chairs or paid for fancy buildings out of a vague sense of corporate civic responsibility. Now they are getting more practical in their links. Plessey wanted a supply of graduates who would be equally at home designing computers and programming them. So it paid for a new lab at the University of Manchester Institute of Science and Technology. Plessey's scientists helped design the curriculum; soon other firms joined in supporting the new course, which has been swamped with applicants.

BTG - Picking winners + losers - where does money come from

Inherent defect

NTIS
Research Corp.
University Patent Inc. (ferrets)
Technology Transfer Inc. (ferrets)
To far down innovation scale.

U. of Maryland
Georgia Tech.
U. of Vermont.

## Semiconductors

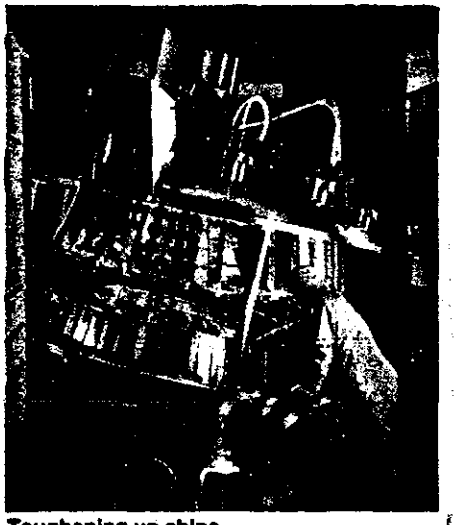
# Cheaper than sapphire

The more chips shrink, the more their switches interfere with each other. Strong electric currents are prone to leak from one part of the circuit to another through the silicon base in which the circuits are etched. Chips in space are especially at risk because they are exposed to cosmic rays that do not penetrate the atmosphere; on a chip they cause havoc by making electrons jump between parts of the circuit. A burst of electromagnetic radiation from a nuclear explosion has the same effect.

Protecting chips from radiation and cross-talk is not hard, but it is expensive. One way to produce chips that are, in the jargon, rad-hard, is to create an insulating layer just beneath the surface of the silicon, a process known as silicon-on-insulator. A slab of sapphire works well as the insulator, but silicon dioxide, better known as sand, tends to be cheaper. Simply heating a piece of silicon in oxygen will produce the oxide. The snag is that oxide is formed on the surface of the silicon and not below it, where the insulating layer is required.

The answer is to inject oxygen ions (atoms that are electrically charged and accelerated into a beam) under the surface of the silicon to form the oxide layer. A British team reckons it has put together a commercial oxygen-implantation process with a prototype machine called OXIS 100. It was jointly developed by VG Semicon of East Grinstead, Surrey, and the Culham and Harwell laboratories of the Atomic Energy Authority.

OXIS produces silicon-on-insulator wafers, the standard silicon discs on which hundreds of individual chips are made in a conventional manner. The machine is designed automatically to produce 800-2,000 four-inch wafers a week—about the whole of the world's production of buried oxide wafers two years ago. Its nearest competitor makes 500 wafers a week.



**Toughening up chips**

Increasing the power of the ion beam is the key. Conventional ion-implanters produce a beam with a current up to 10 milliamps. The OXIS machine produces a beam of 100 milliamps with an energy of 200 kilovolts. The effect of the bigger beam is to drive oxygen ions more efficiently into the silicon. The wafers are processed in a vacuum at 400-750°C, which maintains the crystal structure at the surface of the silicon. An automated handling system is used to load and unload wafers from cassettes, which are sealed to provide the ultra-clean conditions needed to keep out any impurities.

Batches of more than 100 wafers can be processed at a time. Dr Steve Moffatt, the system manager, estimates that a 5 milliamp implanter would produce 100 millimetre wafers at a cost of $570 each, compared with an OXIS cost of $58 (including $15 for the untreated wafer to begin with). That, says Dr Moffatt, works out a few cents per chip to provide silicon-on-insulator. Costs could fall further. The team is already looking to turn up the power to 200 milliamps, which would reduce the cost to $28 a wafer.



THE ECONOMIST NOVEMBER 15 1986

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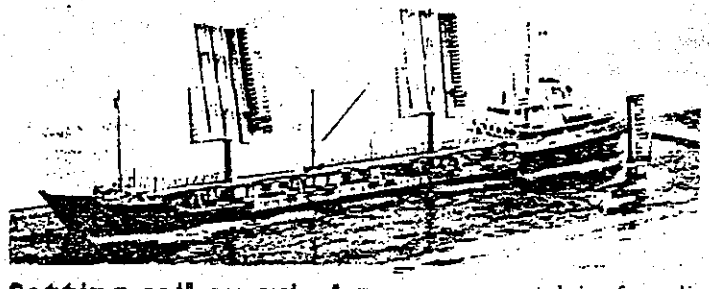

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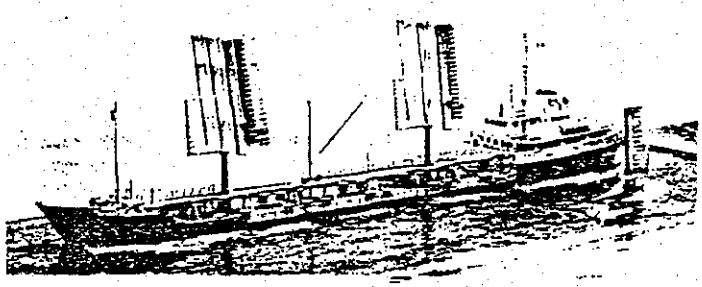

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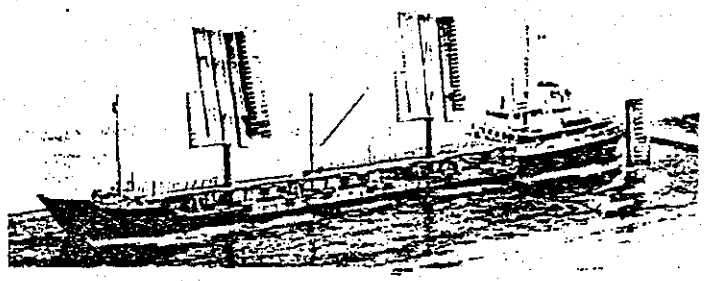

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# COMMENT

## Free the campus entrepreneurs

BREATHLESS PHONE calls first thing in the morning; indecipherable typescripts bristling with spidery illustrations; wild-eyed magnetic levitationists turning up at reception—*New Scientist* has dealt with the British inventor in his most extreme forms. Lone inventors are by no means all nutters, but we can sympathise with anyone who has to deal with them all the time. That is one of the jobs of the British Technology Group (BTG), which the government created in 1980 by merging the National Enterprise Board with the National Research Development Corporation. The BTG's job, according to its latest annual report, is "to promote the development of technology throughout British industry and to advance the use of British technology throughout the world". To achieve this goal, the BTG has a priceless asset: a "first bite" at the patent rights and market opportunities of any invention developed in Britain's universities and government research laboratories.

Now the departments of education and industry—against the wishes of the Treasury—want to take away that first bite. They plan to give university researchers the chance to patent and exploit their own inventions (This Week, p 141). Such a move will provoke howls of rage within the BTG—"Britain will lose the fruits of its research", "where will inventors turn to for impartial advice"—and so on. But for once, the government is right in this move to "privatisation". Although it has mended its ways in recent years, the NRDC deserves some of the criticism that has come its way. It has been too complacent in collecting large sums of money from a few lucrative inventions, such as the cephalosporin antibiotics, and has not taken on enough risky new ventures. Indeed, its method of taking decisions is inherently biased toward caution. As one vice-chancellor said to *New Scientist* this week, "a government scientist does not stand to gain anything by backing a successful idea. But if he recommends support for an idea that does not work, he will hear all about it." Caution and innovation do not mix.

So what can be done? First, the government should not abolish the BTG. If anything, like the Patent Office, it probably needs more staff to deal properly with new ideas and to advise inventors. Most importantly, it needs to be able to tackle the "pre-development gap"—the time between an idea and a prototype. To develop ideas at this stage means taking risky decisions, so the BTG must have the cash to throw after promising ideas. And it must be prepared to lose a few million pounds in the process.

Where does this leave scientists at universities? Some innovation-inclined institutions, such as Salford and Heriot-Watt, already have the expertise to put inventions on the market. Others will have to learn, and some will get their fingers burned. Without the NRDC to blame, academics will have to take the task of innovation more seriously. The British Technology Group should be there to support them—but it should not have a monopoly on Britain's brains. □

## The shadow of Zeta

TWENTY-FIVE years ago Zeta was heralded as proof that science had tamed the process that powers the hydrogen bomb—fusion. Cheap electricity would soon be issuing forth from reactors fed by an inexhaustible resource—seawater. It did not work out like that, and the world still awaits that scientific proof (this issue, p 166). The scientists involved blame the press and its lurid headlines for giving people the wrong impression about Zeta. But if the project's scientists—and the intellectual giants who ran Britain's nuclear programme at the time—weren't all that sure about the measurements, why did they call large press conferences (on 23 January, 1958) and flood the scientific press with detailed descriptions of the work? The answer to these questions lies in the intense international rivalry to be first with fusion, a rivalry that persists to this day. Also still with us is the "imminent" proof that fusion will work, not to mention the hyperbolic headlines. "Scientists achieve nuclear fusion", "US triumph in race to tame nuclear fusion", they said when Princeton turned on its large new experiment (*New Scientist*, 6 January, p 8). Well, not quite. Maybe next year, or the year after. In the meantime we can mark the anniversary of Zeta. It isn't rewriting history to say that the project was a successful one, albeit less spectacular than first thought. Perhaps next time. □

# Politics of the Genome

Since the initiative to sequence the human genome first became exposed to public discussion, which effectively began at last summer's Cold Spring Harbor Symposium, enthusiasm for embarking in the near future on a full-scale sequencing effort has waned in favor of the more modest short-term goal of genetic and physical mapping of the genome. In the public domain at least, that trend continues, as evidenced by the discussions at the second meeting of the National Academy of Sciences (NAS) committee on the genome project. However, one notable absence from the gathering was Walter Gilbert, who recently resigned from the committee in order to pursue his plans to establish a private company, Genome Corporation, that would push ahead rapidly with both mapping and sequencing. Gilbert, who is at Harvard and was for a time chairman of Biogen, hopes to combine this joint experience in a venture that would, he said, be selling genetic information.

Gilbert's departure from the NAS committee has, for many people involved, produced a more balanced approach to the committee's stated objectives, in which a complete sequence of the genome's 3 billion bases is described as "a subsidiary goal." For more than a year Gilbert has been attempting to raise private funds to establish what he termed the "Human Genome Institute," whose activities would include development of new technologies but would be aimed at both mapping and sequencing in the short term. He plans to have a physical map within a year of start-up and major regions sequenced within 3 years.

These figures caused raised eyebrows at the Academy's gathering, being considered to be rather optimistic. By contrast, the committee was talking in terms of a genetic map (which is related to the physical map) being produced over a period of 5 years, and at a cost of $100 million. And major forays into sequencing are thought best delayed until faster and cheaper methods have been developed.

As the technical debate is being honed, so too is political sensitivity, both in terms of potential congressional response to the project and the interagency tensions that are developing over how funding for the various components of the project might be organized. James Wyngaarden, director of the National Institutes of Health (NIH), told the NAS committee that during hearings on the institute's current budget proposals, positive comments are already being made about the scope of the human genome project, both in terms of benefits and costs. And Robert Cook-Deegan, who is heading an Office of Technology Assessment report on the genome project, said that some congressmen are interested in the project as a potential boost to American competitiveness in biotechnology.

Biologists can be encouraged by these sentiments, said Cook-Deegan, but, he warned, the process of going to Congress with major initiatives in science is extremely unpredictable, no matter how meritorious the project may be. A great fear, repeatedly expressed, is that Congress will warmly embrace the proposal but will not appropriate sufficient new funds to cover it: funding agencies, particularly NIH, might then be left with no political option but to squeeze existing projects to pay for genome mapping and sequencing. Nevertheless, it is not at all clear that sufficient enthusiasm has yet been engendered in Congress to ensure successful passage for a human genome proposal, quite apart from the vagaries of the system.

A second fear, expressed strongly by David Botstein of the Massachusetts Institute of Technology, and James Watson of Cold Spring Harbor Laboratory, concerns the quality of the work that might be funded. Specifically, although participants said that they were comfortable with the peer-review system that operates for NIH research grants, they were less sanguine about quality control for work funded by the Department of Energy (DOE) and carried out in its laboratories. The DOE, although it is the chief instigator of the current genome project and has already committed considerable funds to it, is seen by some members of the biological community as having strayed into their territory. Tensions over academic standards will therefore add to the already established turf battles between the two major agencies. If, as seems likely, the genome project does proceed as some kind of coordinated, interagency venture, then the disparity in the different systems that are in place at NIH and DOE for assessing research proposals and research contracts will probably be modified. ■ ROGER LEWIN

this explanation would suggest at a minimum that industries are supporting faculty who are very important to their parent institutions.

In this respect, it is interesting to note that faculty involved in UIRR's seem capable of commercial as well as academic productivity. This lends support to the anecdotal observation that individuals who are highly successful in one dimension, such as scholarship, seem also to be capable of success in rather different dimensions, such as the production of intellectual property with potential commercial value. It should prove reassuring to universities that the commercial accomplishments of faculty involved in UIRR's do not seem to diminish their commitments to publication, teaching, or other forms of service to the university or scientific community, at least by the measures employed in our survey. This finding is consistent with other research showing that faculty who consult to outside agencies do not show diminished productivity in their university roles (*11*).

Another possible explanation for the observed productivity of faculty involved in UIRR's is that industrial support enhances their performance along some or all of the dimensions we examined. It would seem perfectly plausible that contact with industrial sponsors, even through agreements that support basic research, would increase the commercial productivity and the earnings of university faculty. Less obvious, but equally plausible, is the possibility that UIRR's could increase the scholarly productivity of faculty, either through adding to their research support, or through exposing them to new perspectives on their work. A considerable body of scholarly work suggests that interaction between scientists doing applied and basic research may enhance the work of both groups (*12, 13*).

A critical question, of course, is whether these apparent benefits of UIRR's in biotechnology for universities and their faculties are associated with any risks to traditional university values or practices. Our data strongly suggest that such risks exist.

One of the most important is an apparent tendency toward increased secrecy among faculty supported by industries. Other risks include an apparent tendency, worrisome to the great majority of respondents, for UIRR's to shift university research in more applied directions and the frequency with which industries seem to place restrictions on publication beyond requiring simply that they be allowed to review papers prior to submission. In previous work, we also reported that students and fellows supported by industry funds often face obligations to work on projects identified by industry, or to work for industries when their training is completed—conditions not imposed by governmental sponsors (*1*).

In some respects, however, even our findings concerning the risks of UIRR's in biotechnology are reassuring. Only a tiny minority of biotechnology faculty in our sample report that they hold equity in companies supporting their university research. Some observers may even find reassuring the frequency with which faculty report that they are concerned about the risks posed by industrial support of biotechnology research. These figures offer some evidence that, at least at current levels of involvement with industry, faculty remain sensitive and committed to traditional university values and practices. Although not a guarantee against erosion of these values, such faculty attitudes may indicate that they retain a capacity to police their own relationships with industrial sponsors. Those whose major interest is the field of biotechnology may also find it reassuring that biotechnology faculty are still much less likely than chemists and engineers to have connections with industry, though this, of course, may change over time.

In assessing the risks of UIRR's, however, the limits of our study should be kept in mind. Because faculty may have been unwilling to report certain behavior, we may have underestimated the prevalence of certain worrisome situations. Our quantitative measures of faculty productivity could have missed important qualitative effects of industrial support on their work. A survey of faculty inevitably fails to explore adequately the full effects of UIRR's on students. Such effects remain to be explored more thoroughly.

Table 4. Risks reported by biotechnology faculty.

| Question | "To some extent or to great extent" (%) | |
|---|---|---|
| | Industry support | No industry support |
| To what extent does industry research support pose the risk of | | |
| Shifting too much emphasis to applied research | 70 | 78* |
| Creating pressures for faculty to spend too much time on commercial activities | 68 | 82† |
| Undermining intellectual exchange and cooperative activities within departments | 44 | 68† |
| Creating conflict between faculty who support and oppose such activities | 43 | 61† |
| Creating unreasonable delays in the publication of new findings | 40 | 53† |
| Reducing the supply of talented university teachers | 40 | 51* |
| Altering standards for promotion or tenure | 27 | 41† |

*Significantly different from faculty with industry support ($P < 0.05$); †Significantly different from faculty with industry support ($P < 0.01$).

In addition, even the small probability of certain devastating occurrences is sufficient to engender caution. Of greatest concern may be Krimsky's (*14*) suggestion that UIRR's, precisely because they involve very talented and productive faculty, could threaten the collective judgment or ethics of scientists in a field of research. The worry here is that researchers with industrial support or other types of involvement in commercial enterprises may be influenced by their personal financial interests in judging the merits of proposals submitted for peer review to funding agencies or in commenting on public policy problems. Another related concern is that junior faculty without commercial involvements may be reluctant to speak out on certain policy issues because they fear displeasing senior faculty whose financial interests might be adversely affected.

Another difficulty in comparing the benefits and risks of UIRR's in biotechnology or other fields is that the long-run implications of current findings are hard to estimate. Furthermore, the trade-off depends on how society values the various consequences of UIRR's. Any losses to science or to university values that result from marginal increases in the level of secrecy in universities may be more than offset by net additions to knowledge that result from the infusion of industry funds into the labs of talented faculty. Marginal shifts in the direction of university work toward more applied and commercially relevant projects may have benefits for human health and economic growth that far outweigh the risks to scientific progress. In the long run, the continued well-being of universities and university science depends importantly on the health of our economy and on public perception that supporting university research contributes directly to practical results.

Though much remains to be learned, our data at least suggest some ways in which universities and government can reduce any risks that industrial support poses for involved academic institutions. First, universities should carefully monitor their relationships with biotechnology companies. Universities may want to make clear to faculty and companies that they are opposed to the protection of trade secrets resulting from industrially supported research and that the right to publish research results (with modest delays for companies to file patents) must be protected. Past research has also

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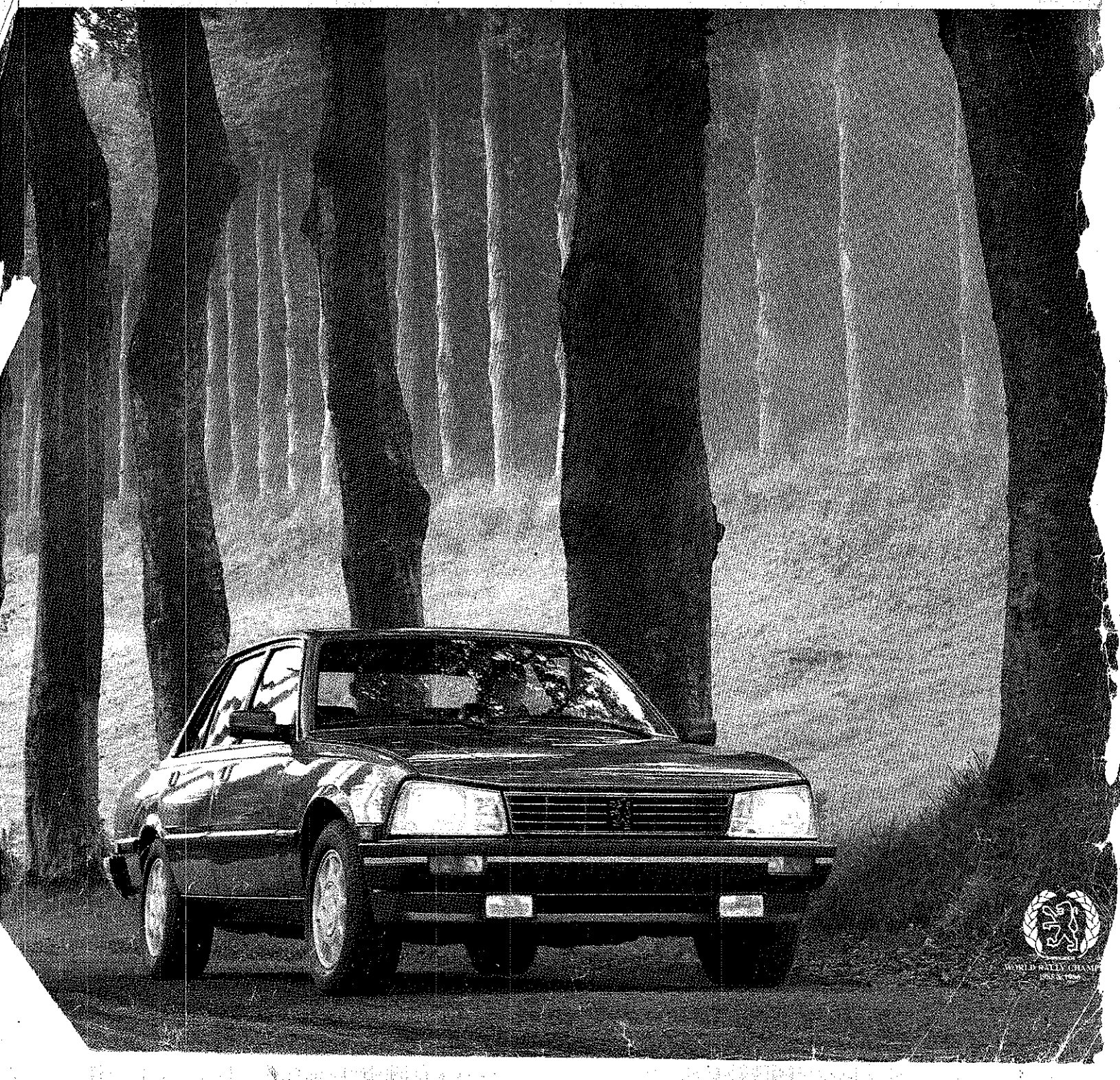

participate in time-consuming chores, such as consulting, that will compete with university activities.

To assess whether such shifts in behavior are occurring among biotechnology faculty who are involved in UIRR's, we asked respondents to tell us how many articles they had published in refereed journals during the last 3 years, how many hours of contact they had weekly (including laboratory supervision) with students or postdoctoral fellows, and whether they had served in any of several professional roles within or outside the university in the last 3 years (*7*).

Compared with colleagues doing biotechnology research, faculty receiving industry support in biotechnology reported significantly more publications and involvements with other professional activities but no statistically significant differences in teaching time (Table 2). However, such simple comparisons of faculty with and without industry support could be misleading. In order to be classified as receiving industry support, faculty in our sample had to be principal investigators on at least one industrial grant or contract. In contrast, the group without industry support includes some faculty who are not PI's on projects of any sort and may be less senior than or differ in other ways from principal investigators on industry projects.

To correct for such confounding effects, we performed multivariate analyses that examined the association between key faculty behaviors and industry support while controlling for the faculty member's academic rank, the number of years since completing his or her highest degree, the faculty member's total research budget from all sources, his or her involvement in consulting or other relationships with industry, and a variety of other characteristics of faculty and the universities in which they work. In taking account of sample faculties' research budgets from all sources, we effectively controlled for whether they were PI's on at least one externally funded grant or contract. Because of the way our questionnaire was constructed, faculty could report receiving research funds only for projects on which they were PI's. These multivariate analyses confirmed the significance and direction of the associations reported in Table 2.

It is possible that faculty with industry funds are publishing less than they did before they began receiving industry support, even though they still compare favorably along this dimension with faculty not participating in UIRR's. To examine this possibility, we asked faculty how many papers they had published in refereed journals during their professional careers and then compared their publication rates for an average 3-year period with their reported rates during the last 3 years (*8*). As Table 2 shows, biotechnology faculty with and without industry support reported publishing more in the last 3 years than they did during an average 3-year period. Faculty with industry support reported a greater increment in their publications than did other faculty. However, the difference was not statistically significant ($P = 0.14$), a finding confirmed in multivariate analysis.

Faculty who receive a large proportion of their research support from industry, or combine such heavy support with other types of industrial relationships, may be more affected by industrial support of university research than faculty with lesser levels of involvement with industry. To see whether this might be the case, we examined the reported behavior of several subgroups of biotechnology respondents: faculty who received more than 50% of their biotechnology research support from industry; faculty who received more than 50% of their research support from industry and also added at least 20% to their base salary from consulting to a for-profit company; faculty with more than 50% of their support from UIRR's who also consulted exclusively for one biotechnology company; faculty who received more than 80% of their research support from industry; and a series of other combinations of characteristics that might signal heavy involvement with industry. Controlling for other factors, these heavily involved groups reported publication rates, hours of student or postdoctoral contact, and involvements in other professional activities that did not differ significantly from (and in some cases exceeded) those of other faculty.

Table 2. Selected measures of behavior among biotechnology faculty. Publications refers to publications in refereed journals during the previous 3 years. Teaching time refers to the average number of hours of contact per week with graduate students or postdoctoral fellows. Activities refers to the number of activities in universities or professional roles (university administration, professional journals, and officer in professional association). Publication trends refers to the difference between the number of refereed publications during last 3 years and number of publications for an average 3-year period during a faculty member's career.

| Status | Publications | Teaching time | Activities | Publication trends |
|---|---|---|---|---|
| No industry support | 11.3* | 20.3 | 1.1* | 2.2 |
| Industry support | 14.6* | 22.2 | 1.4* | 3.3 |

*Differences were statistically significant ($P < 0.05$).

The measures used here to assess the relation between faculty behavior and industrial support of their research have obvious limitations. Simple figures on publication rates and teaching time could have missed differences in the quality or nature of publications or teaching among biotechnology faculty with and without industrial support. By lumping classroom teaching together with laboratory supervision, we could have missed differences in the way faculty with and without industry funds distribute their time among these very different types of educational activities. Nevertheless, the findings should on balance prove reassuring to the university community. Certainly, our data on selected indicators provide no evidence that industrial support of faculty research in biotechnology is associated with decreased faculty productivity. If anything, the opposite seems the case.

*Commercial productivity among faculty.* One of the possible benefits of UIRR's in biotechnology and other fields is that they may encourage faculty to commercialize their research findings more readily than faculty without industrial research support. Such a tendency could result in greater income for the university and benefits to society through increasing the rate at which research results are transferred into practical application.

To examine this hypothesis, we asked biotechnology faculty in our sample whether their university research had resulted in any patent applications, patents, or trade secrets. Faculty with industry support were more than twice as likely (37 versus 17%, $P < 0.001$) as faculty without such support to answer affirmatively.

These data do not establish that industrial support actually increased the commercial productivity of faculty. It may be that industry successfully seeks out faculty whose work seems likely to have commercial application. However, faculty seem to feel that industrial support is helpful in producing commercially useful results from their research. Among biotechnology faculty participating in UIRR's who reported patent applications, patents, or trade secrets, 48% said that industry support had contributed significantly to the work that led to these commercialization efforts. When asked about the benefits of industrial support of university research, a majority of faculty with and without industry research funds agreed that UIRR's increase the rate of applications from basic research to some extent or a great extent (Table 3).

Involvement in UIRR's may also offer faculty opportunities to increase their personal income through royalties from licensed patents, consulting to industry, and other means. Such additional earnings may reduce pressures on universities to increase faculty

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# University-Industry Research Relationships in Biotechnology: Implications for the University

DAVID BLUMENTHAL, MICHAEL GLUCK, KAREN SEASHORE LOUIS, MICHAEL A. STOTO, DAVID WISE

**The growth of university-industry research relationships in biotechnology has raised questions concerning their effects, both positive and negative, on universities. A survey of over 1200 faculty members at 40 major universities in the United States reveals that biotechnology researchers with industrial support publish at higher rates, patent more frequently, participate in more administrative and professional activities and earn more than colleagues without such support. At the same time, faculty with industry funds are much more likely than other biotechnology faculty to report that their research has resulted in trade secrets and that commercial considerations have influenced their choice of research projects. Although the data do not establish a causal connection between industrial support and these faculty behaviors, our findings strongly suggest that university-industry research relationships have both benefits and risks for academic institutions. The challenge for universities is to find ways to manage these relationships that will preserve the benefits while minimizing the risks.**

## I.

UNIVERSITY-INDUSTRY RESEARCH RELATIONSHIPS (UIRR's) in biotechnology have grown increasingly important for both industries and universities in the United States. Recent research indicates that nearly half the firms conducting or supporting research in biotechnology are involved in UIRR's. Their funds may account for 16 to 24% of all external support for university research in biotechnology (*1*).

The growth of UIRR's in biotechnology and other fields, however, has raised critical questions concerning their effects on institutions of higher education. Do such relationships affect the scholarly or commercial productivity of university faculty? Do UIRR's influence the commitment of faculty members to teaching or their participation in the time-consuming, sometimes tedious administrative activities so essential to the health of universities or a field of science? Do industrial research relationships encourage secrecy among scientists, disrupt relationships among scientific colleagues, or lead faculty to shift the direction of their research toward applied or commercially oriented projects?

From a survey of over 1200 faculty members in 40 of the most research-intensive U.S. universities, we report on the effect of UIRR's on faculty whose work involves the "new biotechnologies" (*2*). These fields include recombinant DNA technology, monoclonal antibody techniques, gene synthesis, gene sequencing, cell and tissue culture techniques, large-scale fermentation, and enzymology. The expansion of UIRR's in these scientific fields has been especially dramatic in recent years. UIRR's in the new biotechnologies, therefore, provide an intriguing case study for exploring both the potential risks and the potential benefits of UIRR's generally for academic institutions.

## Study Design

The analysis presented here is based on a survey of university faculty conducted in the winter of 1985. A sample of 1997 faculty was selected in a two-step process. First, we selected 40 universities from among the 50 schools that receive the largest amounts of federal research funds in the United States (*3*).

Second, for those 40 universities, we developed a list of 3180 life science faculty members (instructors, lecturers, assistant professors, associate professors, and full professors) included in published catalogs as members of the departments of biochemistry, molecular biology, genetics, microbiology, biology, cellular biology, or botany (*4*). We selected these departments because we judged them to be most likely to contain faculty conducting research involving the new biotechnologies. From this list, we randomly selected 1594 individuals. A comparison group of 403 nonlife scientists was drawn from a list of 1211 faculty in departments of chemistry and engineering from the same institutions. We sought such a comparison group in order to assess the relative prevalence of UIRR's in biotechnology and in other fields known to have a long history of involvement with industry.

Each of the 1997 faculty in our sample was mailed an eight-page questionnaire dealing primarily with his or her research activities and involvement with industry. If the questionnaire was not returned within 3 weeks, a second mailing was sent. One hundred fifty-six respondents were ineligible (deceased, retired, no longer associated with the university, or incorrectly reported as a faculty member in the catalog). Of eligible respondents, 69% (993) in the life sciences and 65% (245) in chemistry and engineering returned completed questionnaires. Table 1 summarizes pertinent characteristics of respondents.

Among life science respondents, 800 of 993 (81%) did research involving the new biotechnologies. In the body of the article, we refer to these respondents as "biotechnology" faculty and to the remaining 193 life science respondents as "other life science" faculty. Unless otherwise indicated, our analyses concern respondents in our biotechnology group. In comparing groups within our sample, we

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BY WALTER KIECHEL III

# HOW TO GIVE A SPEECH

## You should come across like your own sweet self. This usually takes a lot of preparation.

■ Looking for an easy way to reduce even a strong, self-confident manager to a nail-biting mass of insecurities? Just ask him to give a speech to an unfamiliar audience. If he can't get out of accepting, he'll probably devote several sweaty hours to writing out his remarks or, if he is senior enough, delegate the awful task of composition to some underling. When the hour of execution arrives, he will stride manfully to the podium, assume a quasi-fetal stance, and proceed to read his text word by droning word. Not for nothing does pop research indicate that the average American fears speaking before a group more than he fears death. As Paul Nelson, dean of Ohio University's college of communication, observes, "Death is faster."

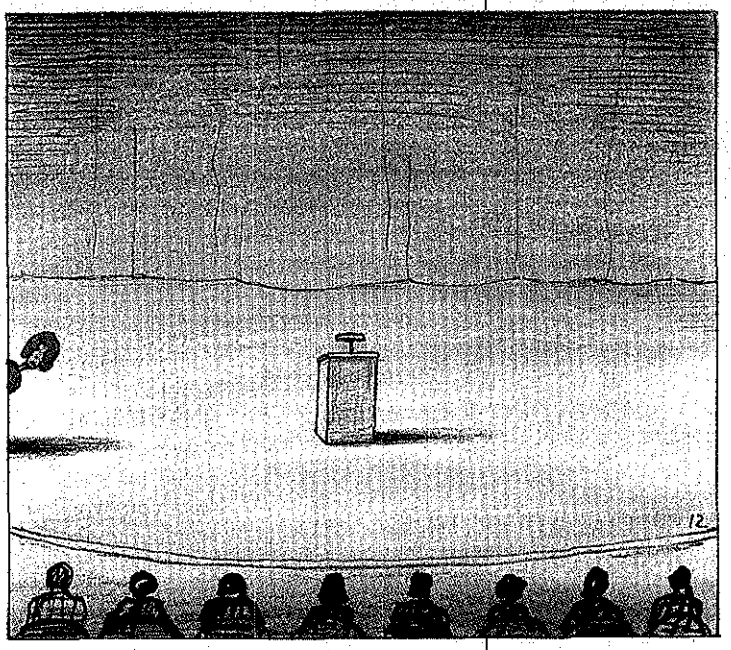
Choose life, even if it means working to become a better speaker. Why don't more managers take up the challenge? "Most businessmen are worried that they're going to come across like someone else," argues Charles Windhorst, co-founder of Communispond. It's a firm that teaches executives that the trick in fact is to have all the mechanical stuff down so pat that the authentic, worth-listening-to you comes through undistorted. Learn the basics and get out of your own way.

The basics begin when you're invited to speak. While the folks asking may have a foggy idea of what they want you to talk on, their none-too-clear guidelines probably leave you ample room to set your own topic. Don't be in a hurry here. First, the experts universally advise, you should find out as much as you can about your audience.

Who are these people—what age, sex, and line of work—and why will they be assembled? If they're mostly women, you will want to use more examples that feature you know whom. Are they coming to hear you more or less voluntarily, or is their attendance required? Captive audiences are harder to grab. When are you supposed to talk to them? If it's right after a meal or at the end of the day, expect Coma City; leading off in the morning often means that you'll lose 15 minutes to your hosts' unavailing attempts to start on time. Maybe most important, why do they want to hear from *you*, of all people?

Much of this dope you can get by grilling the person who had the temerity to invite you. For the ultimate in analysis, though, nothing beats spending a little time with your prospective audience. Robert Waterman Jr., whose co-authorship of *In Search of Excellence* propelled him into big-time speakerdom, finds that if he's to exhort some company's troops, for example, it helps a lot to poke around the corporation for a day or so beforehand talking to everybody he can. He can then address their specific concerns.

Once you have a feel for your audience, consult your mental inventory of what interests you these days. Not just what you know or can amass facts on, but what you care about. Dale Carnegie said it 70 years ago, and the experts are still saying it: If you're not excited about your subject, you won't be able to excite your audience about it either. To find your topic, look for where your concerns intersect with their wants and needs. Decide on your purpose—whether to inform, persuade, or entertain. Then give your impending address what Max Wortman, a management professor at the University of Tennessee and a popular speaker, calls a "schmaltzy" title. Not "Current Realities and Future Trends in the Brake Shoe Industry";



**Pop research indicates that the average American fears speaking before a group more than he fears death.**

ILLUSTRATIONS BY MARC ROSENTHAL

# Germany's 75 Years of Free Enterprise Science

*The Max-Planck-Society has celebrated its 75th birthday with its third Nobel Prize in 3 years and bright prospects, but tensions remain over its relationship to German universities*

*Munich*

THE core idea of the modern research university—that teaching and research thrive best if carried out in close proximity—was conceived by the German scientist Wilhelm von Humboldt in the early 19th century. It is therefore ironic that Germany's foremost organization for the support of basic research, the Max-Planck-Society (MPG), was created deliberately to free scientists from the heavy burden of teaching and administration that the pursuit of Humboldt's ideals had imposed on universities.

Currently celebrating its 75th birthday, the Max Planck's network of independent research institutes remains the envy of scientists throughout the world. Although the society has been contending with serious budget difficulties and tensions in its relations with German universities in recent years, it enjoys what research institutions in few other countries have been able to achieve: substantial public funding with almost complete scientific and administrative autonomy.

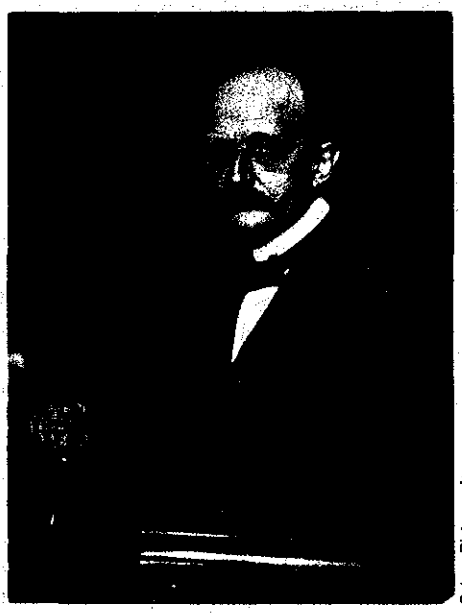
The society's scientific reputation was reconfirmed last month by the award of the Nobel Prize in physics—shared with Gerd Binnig and Heinrich Rohrer of IBM—to Ernst Ruska, the 79-year-old inventor of the electron microscope and formerly the director of MPG's Fritz-Haber-Institute in Berlin. Ruska is the MPG's 23rd Nobel prizewinner since its foundation, and the third in three successive years.

The publicity that has surrounded both this string of successes and the current birthday celebrations will, it is hoped, help break a funding deadlock that has held the Max-Planck-Society's budget constant at about $500 million a year for more than a decade. At the beginning of October, the länder (state) governments, which provide almost half the public financing, agreed to support a real budget increase of 3.5% next year. However, the MPG had been hoping for an increase of 5%, as well as an additional $10 million over the next 5 years for scientific equipment.

The Max-Planck-Society did not get its present name (suggested by British scientist Sir Henry Dale) until 1948. It began in Berlin in 1911 as the Kaiser-Wilhelm-Gesellschaft, and originated from a joint proposal by a group of scientists and industrialists who argued that advanced research was sufficiently important to receive public funding but to remain separate from the constraints of the university world.

Despite the many changes that have taken place in the world of science over the past 75 years, the philosophy of the Max-Planck-Society is largely unchanged. As a result, it remains an essentially elitist and conservative (some even use the word "feudal") organization, wedded to the idea that a nation's industry can prosper through the careful nurturing of basic science, but run with the traditional German emphasis on organizational efficiency and discipline.

The scientific activities of its 60 research institutes and project groups cover topics from nuclear physics through molecular genetics and coal research to the study of patent law. In size, they range from the 1000 scientists and technicians employed in the Max Planck Institute for Plasma Physics at Garching near Munich, to others—such as the new mathematics institute in Bonn—with no more than a dozen people on the staff.



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**Max Planck.** *Presided over the Kaiser-Wilhelm-Gesellschaft in the 1930's and immediately after World War II. The organization was named after him in 1948.*

Whatever an institute's size, its scientific autonomy is jealously guarded. The 200 scientific directors who are responsible for the individual research programs are each carefully selected. Once appointed, however, they are free to appoint their own staff and choose their own research topics. But they have to rejustify their support every 7 years.

Accountability is primarily scientific. Each institute is regularly scrutinized by an international team of visiting scientists, who report directly to the Max-Planck-Society president. The reports perform a double function, not merely checking on the quality of the work being performed, but also, says one administrator, "making us trustworthy on the political scene."

According to the current president, chemist Heinz Staab of the Max Planck Institute for Medical Research in Heidelberg, this independence has been made possible because the society's support has always come from two separate sources, each of which has tended to neutralize the influence of the other, leaving the MPG free to determine its own policies.

"There has always been a balance of power," says Staab. Initially it was between government and private sponsorship; now it is between the federal and state governments. "The research has never been dependent on just one of these groups," he adds.

In addition, Max Planck scientists work in an environment that reflects what one official describes as the "higher bourgeois" values of the early years of the century. This means, for example, that there has never been much reluctance to engage in research of explicit value to the private sector (provided individual topics remain set by the scientists themselves).

At the same time, it also means that there has been a conscious effort to isolate the content of research from political debates. During World War II, this led to some murky dealings with the Nazi regime, which later prompted the United States to propose that all the research institutes be disbanded (they were saved after intervention by the British).

In principle, however, the result has been to create a protected system of free enterprise science that is unique in the industrialized world. Scientists with a proven track record are provided considerable flexibility and freedom to innovate. "It is very effi-

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BY COTTON MATHER LINDSAY

# HOW NOT TO CONTROL MEDICAL COSTS

## Trying to keep patients from seeing specialists only pads the bill and undermines quality.

■ For three decades now, thanks to insurance and Medicare, consumers have paid relatively little out of their own pockets for medical services. Lacking compelling reasons to trade off costs against benefits, they naturally have demanded ever-increasing quantities of care. Just as naturally, the suppliers of health care—doctors, hospitals, laboratories, and so forth—have expanded their services, both to compete for business and because payment was a sure thing. Thus our health care system has encouraged "overservicing," a main cause of the upward spiral in health care costs.

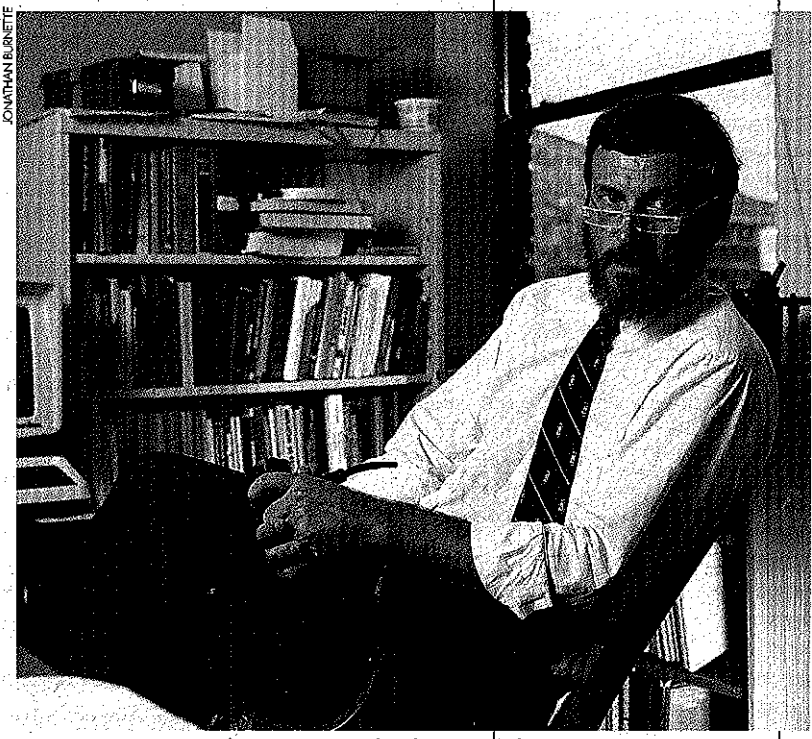
Health maintenance organizations—HMOs—and other prepayment plans were supposed to solve the problem. Since HMOs receive a flat fee in advance, they have an incentive to control costs. But prepayment plans do nothing to constrain demand for care. Once a consumer enrolls in an HMO, he is free, in theory at least, to use as many services as he wants.

To solve that part of the equation, HMOs have turned to "gatekeeping." The idea is deceptively simple: Gatekeepers propose to reduce costs by making sure patients use the least expensive types of services. The gatekeeper, the first person to examine a prospective patient, has a dual function: to keep those who don't need special treatment from wasting the time of specialists, and to guide those who do need such treatment to the appropriate specialist.

Proponents of gatekeeping argue that it controls runaway demand without harming the quality of care. I believe their stand is based on several false assumptions or myths. In fact, gatekeeping may increase the costs of health care, and it poses a serious threat to patients.

Let's examine the myths first, then their consequences.

▶ **Myth 1: Gatekeeping ensures efficient medical care.** Gatekeepers, usually general practitoners or internists, are not efficient when they become middlemen, referring the patient to another physician. Referrals increase costs directly, by requiring another visit to a doctor, and indirectly, by delaying diagnosis of conditions that become more expensive to treat the longer they go untreated.



JONATHAN BURNETTE

Nor are gatekeepers necessarily efficient when they themselves treat patients. The fans of gatekeeping assume that a generalist's fees will be lower than a specialist's, but that's not always true. Cardiologists and neurosurgeons often charge more for an office visit than generalists do; pediatricians, dermatologists, and orthopedic surgeons often charge less.

Fees for office visits aren't the only costs of treatment. Consider a 1983 Emory University study that compared how dermatologists and family practitioners would manage treatment of ten different skin diseases. Compared with the generalists, the specialists ordered tests that cost only half as much, and they would have required patients to return less often for treatment. While the specialists wrote more prescriptions, the total cost of medication wasn't much higher. Taking everything into account, the dermatologists would have provided care for 10% *less* cost than the family practitioners.

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John Preston / Licensing Director at MIT

MIT TESTIMONY



remarks that it was his view that it was a responsibility. Whether something derived by their own interpretation or by specific statutory language, I can't say, but I interpret his remarks to underscore the view within DOE that they should have a significant role in dissemination of technology.

I think that that--which, as I say is already carried in the Federal Acquisition Regs, statement of purpose, is the problem I have. I think that the flow from the Government-university-industry relationship must be clear and channeled through the university to its licensees, and those licensees cannot be subjected to the uncertainties and cross-currents that arise from knowing that the Government may, through some other distribution channel, also be making the technology available in some fashion, particularly if the industrial licensee has invested significant funds to develop it further, and then it looks like the Government might piggy-back its contractors on all of that effort.

Mr. Preston may want to add to that.

Mr. PRESTON. Yes, one of the comments I would like to make about the issue of requesting waivers and giving waivers, is that the timing in licensing technology is so critical that even waiting six months is quite often prohibitive in getting an effective license deal.

I will give you an example. Two months ago in the area

that we have been discussing today, I was approached by a couple of faculty members who had come up with an invention related to superconductors, a technique for making these brittle ceramic into ductile wires. We filed for a patent less than a month after they came into our office, and have now licensed it to a private sector through a major venture capital firm who has a created a company to commercialize this technology. In less than two months, we now have $1 million worth of private money invested into this technology. We have a company created, and we have a license agreement consummated and a patent filed.

If I had to wait six months or a year to get DOE waiver in order to move ahead with this, the venture community would probably be tied up in other deals and this would slow down getting the license done in the first place.

Another comment I wanted to make from the DOE paper that was submitted was that the DOE expressed considerable pride in the fact that there have been 27 start-up companies over the last year from DOE sponsored research, and 200 license agreements to major companies to commercialize DOE research.

MIT is perhaps a drop in the bucket to DOE total--we are less than one-tenth of their budget--our numbers are comparable.* We are creating about the same number of new companies per year, and consummating about the same number of license agreements.

* DOE should have 300-500 businesses instead of 27

# Technology Transfer Isn't Working

*The campaign to pass on the fruits of the federal research labs to industry could be a lost cause.*

*by Fred V. Guterl*

In just a few years, a major new chip-manufacturing technology called X-ray lithography could well become the key to survival in the semiconductor industry. The question is, who will be the first to develop it?

Japan's Ministry of International Trade and Industry plans to spend $700 million on the problem this year. Among other things, it is funding the construction of four specialized synchrotrons for chipmakers to produce the X rays essential for research into the new technology.

In the U.S., the Department of Energy recently finished building the nation's first large-scale synchrotron at its Brookhaven National Laboratory in Upton, New York. But it is a general-purpose synchrotron used by about ninety academic and corporate research groups for a variety of projects. IBM Corp. is the only company using the synchrotron for X-ray lithography, and its researchers often have to wait in line to use it. "The IBM people are pretty unhappy with the schedule," says William Marcuse, director of technology transfer at the lab. "They spend a lot of time twiddling their thumbs."

The DOE plans to build two more synchrotrons for its labs, but neither one will be tailored to X-ray lithography. And to a growing number of industry leaders, government officials and scientists worried about the United State's flagging competitiveness in technology, this state of affairs is a vivid symbol of the inadequacy of the government's program for transferring R&D to industry.

The federal research labs constitute a formidable chunk of the nation's pool of talent and equipment. The 700-plus labs across the country spend more than $18 billion a year and employ one-sixth of the nation's research scientists and engineers.

By tradition, the labs disseminate technology to the public and issue licenses for their published patents to anyone who wants them. But American companies have used few of the thousands of new patents filed every year because they are loath to invest in a technology their competitors can obtain easily. It was a Japanese firm, for example, that developed solar cells for calculators from a National Aeronautics and Space Administration patent.

Since 1980 the Reagan Administration has been spearheading an ambitious campaign to make the fruits of the federal research labs available to private industry. One result is new legislation that now allows companies to license exclusive patents owned by the labs and encourages cooperative R&D programs for industry, government and universities.



These moves have been welcomed. But no significant technological benefits have yet accrued to industry, and the obstacles to implementing the transfer of technology now look so numerous and deeply rooted that it seems doubtful the government labs will ever be able to help industry fulfill its research needs. "The new laws are no panacea for getting technology into private industry," says William Burkman, director of physics at AT&T Bell Laboratories. "There are a lot of stumbling blocks involving the kind of priorities the labs have set up."

The basic problem is that the whole notion of working with private industry runs counter to the long-standing mission of the federal labs to serve the general public. For the better part of four decades, they have pursued their own agendas sheltered from the needs of the marketplace. Federal researchers have deepened the pool of scientific knowledge and enhanced the nation's weapons arsenal. Any benefit derived by industry has been a mere afterthought.

The need to keep classified weapons research under wraps has impeded technology transfer in the DOE and the Defense Department. That becomes a formidable barrier considering that defense will account for 72% of government R&D spending next year, up from 51% in 1980, and that the lion's share of the labs belongs to those two departments.

The DOE is particularly hostile to industry-directed research. It has refused to give its labs authority to license patents to companies—a step that industry considers crucial for making the technology accessible. The department's policy of reviewing every application for a patent license case-by-case, industry complains, is too much trouble and takes too long—anywhere from six months to several years—to pass through the labyrinth of DOE bureaucracy.

This procedure discourages companies from using the labs as a resource. Lee M. Rivers, who recently left the White House Office of Science and Technology Policy to represent the Federal Laboratory Consortium in Washington, says he is "up to my eyeballs" trying to get industry to take the labs seriously. "If a businessman has to take four months to figure out what he needs to do and then has to go through six layers of bureaucracy in Washington, that's going to be tough," he notes.

DOE officials insist they are proceeding with caution only until they learn more about technology transfer and promise to streamline the waiver process down to six months or so. Critics say they are stalling. And Bryan Siebert, DOE director of international security, admits, "I would err on the side of reviewing practically everything, even if it involves delays."

In fact, when Congress passed legislation in 1984 allowing universities and nonprofit organizations that operate DOE labs to license patents, the department tried to nullify the law by claiming that national security and nuclear nonproliferation took precedence. Its position led to an executive order by President Reagan last spring restricting the DOE's discretion to withhold patent licenses.

Regulations also limit the amount of money the DOE labs can spend on research for outside organizations to 20% of their budgets, with most of that going to other government labs. And no company can do research at a DOE lab if comparable facilities can be obtained elsewhere. Emphasizing the DOE's stand, Antoinette G. Joseph, director of field operations management, says, "People argue that there is this technology sitting on the shelf and that if you have a uniform technology transfer policy, the government can make it all available in one fell swoop. Well, it can't. The national defense mission is more important than the technology transfer mission."

The Defense Department has its own bureaucratic problems, but it has been more flexible in issuing licenses. For years, the DOD has allowed the companies it does business with to commercialize at no cost the patented technology they develop. These relationships, however, have existed primarily within the close-knit community of government contractors working on classified projects. "Everything done in the labs is documented and made available to people with the appropriate clearances," says Frank Sobieszczyk, chief of the DOD research program office. "The labs will call in defense contractors and give them a dog-and-pony show." Because of its fear of leaks, the DOD is reluctant to enter into cooperative R&D agreements with other companies.

In addition to the problem of classified R&D, identifying promising new

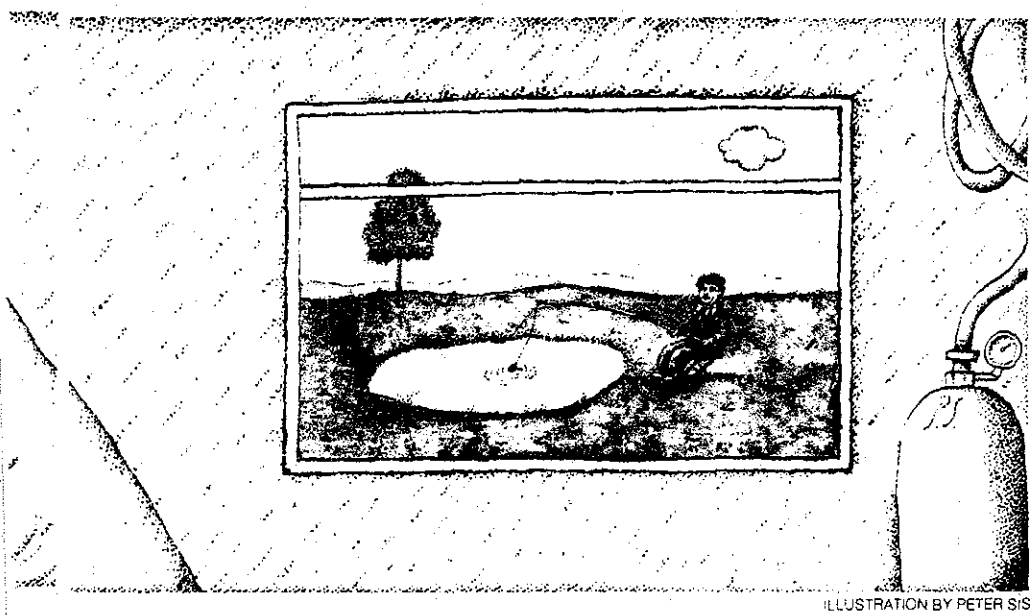

ILLUSTRATION BY PETER SIS

technologies for industry to exploit is a monumental task. Corporate R&D executives have largely ignored what goes on in the labs, viewing them as irrelevant and inaccessible. Reluctant to deal with the bureaucracy, they are unaware of helpful research buried within multimillion-dollar programs.

At the same time, most federal labs lack the staff necessary to sift through the enormous number of projects, ferret out the good ideas and target them for specific industries or companies. "There's a lot of research going on at the labs," says President A. Sidney Alpert of University Patents Inc., which sells university-owned patents to industry. "If they put enough manpower on it, there could be some good inventions. But you won't find them the way the labs are going about it."

It does not help that lab researchers must depend on their technology transfer specialists to explain their innovations to corporate R&D people. These specialists are in short supply—only one DOD lab has one, for instance—and they are a harried lot with responsibility for hundreds of different projects.

As intermediaries, they also are one more roadblock for industry. Hillard Williams, vice president for technology at Monsanto Corp., says that government tech transfer people lack experience in getting technology out to industry. John D. Hale, vice president for research at Kerr-McGee Corp., comments: "We have enough trouble transferring technology out of our own lab. How are we going to keep up with the technology coming from the federal labs?"

Even if industry had free access to the technology at the labs, raw research requires considerable development before it is applicable to new products, and much more input from the labs—information about manufacturing processes, the expertise and judgment of the original researchers, and so forth—is needed by a company planning to adopt a technology. "The basic research at DOE labs is one level less practical than the stuff that is done at universities, which isn't very practical" says University Patents' Alpert.

***"If the government labs move slowly, they will become irrelevant."***

The labs have limited resources to devote to the kinds of coooperative R&D programs that would help industry absorb basic research. And they have had trouble attracting financial support from industry because they lack the authority to issue patents in return for funds. (No longer true)

Companies are also put off by the government's inflexibility in negotiating cooperative research agreements. The agreements are often written like procurement contracts, with specific deadlines scheduled years in advance. Such tight schedules lead to misunderstandings when the research doesn't pan out the way it was originally planned. "Federal people don't speak the same language," says Monsanto's Williams. "Things get complicated, and industry tends to just give up."

Amid this bleak picture, there are a few hopeful signs. Payoff from exclusive patenting, for instance, is evident in Oak Ridge, Tennessee, where a dozen or so companies have sprung up to develop products—heat-resistant diesel engines, high-strength cutting tools and more—based on patent licenses granted by the DOE lab there.

"A kind of magic has set in," says William W. Carpenter, vice president for technology applications at Martin Marietta Energy Systems, which runs the lab for the DOE and aggressively pushed the patents through its licensing process. "In Oak Ridge, houses are selling, school enrollment is up for the first time in twenty years, a new missile plant has gone up. A great deal of that is due to our technology transfer program."

Inside the labs as well, there is some movement afoot to open the door. Eugene E. Stark, an engineer at DOE's Los Alamos National Laboratory, is one of a new generation of government researchers who now sees a unique opportunity to get the labs into the mainstream of technology.

In his spare time, Stark is chairman of the Federal Laboratory Consortium for Technology Transfer, an ad hoc government and industry group that is promoting technology sharing. "We can't wait ten more years to break down the institutional barriers to technology transfer," Stark says. "We're entering a period of restructuring in science and technology institutions. Whatever new relationships develop as a result of international competition will take place in the next three-to-five years. If the labs move slowly, they will become irrelevant."

Groundwork also has been laid for several cooperative agreements between industry and the labs. The Army's Electronics Technology and Devices Laboratory in New Jersey is setting up a consortium with several electronics firms to develop flat-panel display screens. And the DOE's Argonne National Laboratory and the University of Chicago are currently negotiating with companies to do superconductor research.

Meanwhile, the Defense Department is funding a study on building a synchrotron devoted exclusively to semiconductor research. And at the DOE's conference on superconductivity last July, President Reagan proposed a government-sponsored "Superconductivity Initiative," which would include, among other things, increased spending by the labs. In addition, DOD proposes spending $150 million over three years to apply superconductivity research to military ships and weapons.

How all the money is spent—whether industry gets to set at least part of the research agenda—may be the first real test of the technology transfer laws and the nation's resolve.

—with ANNE HOLLYDAY

SCIENCE AND TECHNOLOGY POLICY

## STATE-OWNED PATENTS SPREADING ABROAD

Tokyo KOGYO GIJUTSU in Japanese Mar 86 pp 44-48

[Article by Mitsuo Suzuki, director of the Japan Industrial Technology Association]

[Text] Why International Technology Cooperation Is Now Important

With a turnabout from the first oil crisis, the focus of world technology development trend has been shifting toward lightness, thinness, shortness, and smallness [micro] from heaviest, thickest, longest, and biggest [macro]. Countries in the world are fiercely competing for the development of high technologies, amid the great surge of new technologies from the 1970's toward a peak in the early 2000's.

Emerging as advanced technologies are the technology for utilizing limited sources of energy on earth, electronics technology for fostering an information society, new materials technology for bringing about metamorphic progress in industries, and biotechnology with diverse potential.

The collapsing condition of the Japanese economy after World War II has achieved a marvelous recovery through the support of technical assistance from abroad and the concerted efforts of the people. As a result, Japan has now established a high technology level worldwide.

While Japan has currently achieved economic growth through active industrial activities based on high technologies, other countries have increasingly been seeking Japan's technical cooperation. Public opinion is taking root in that Japan should further promote contributions intellectual to the international society through technologies.

As regards technologies under such international circumstances, the recent activities concerning technology transfer and popularization of the Japan Industrial Technology Association (Inc.) (JITA) engaged in activities of spreading state-owned patents of the Agency of Industrial Science and Technology (AIST) at home and abroad will be outlined (see Figure 1)

Transfer of state-owned patents

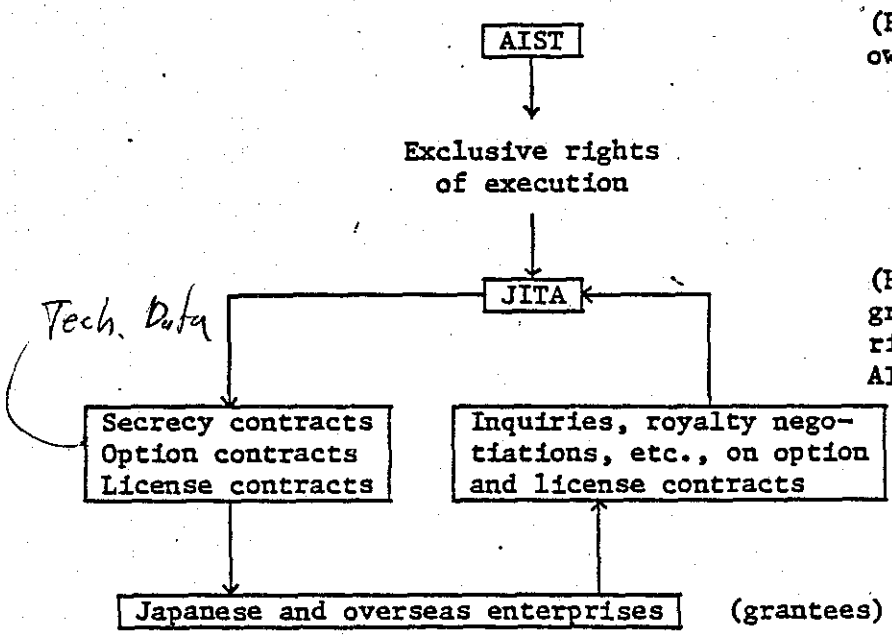


Figure 1. Technical Transfer System of AIST's State-Owned Patents

Activities of High Technology Interchange Missions

JITA has been sending missions to the various European and American countries annually since 1983 to introduce AIST's state-owned technologies in support of AIST and other quarters concerned. The dispatch of the missions is part of the technology interchange between Japan and the various European and American countries, and is also in response to criticism that Japan is not providing technology exports in comparision with the enthusiasm for exports of manufactured products. Among AIST's state-owned patents, 20 to 30 themes, which have been applied for industrial use by Japanese companies or those prospective technologies are selected annually for overseas supply upon approval for technical cooperation by the companies involved.

Missions comprising top technicians or leaders concerned in charge of technical development at such companies visited governmental organizations or research institutes of major enterprises in the various European and American countries to ascertain the needs of such countries (possibilities such as technology transfer and joint development). From this side, technical presentation was provided and at the same time relative discussions pursued.

Institutions visited by year follow:

| | | |
|---|---|---|
| 1983 | Sweden | (state) STU (Swedish Technology Development Agency)<br>(private) ASEA Co., Volvo Co. |
| | West Germany | (private) Dynamite Nobel Co., Siemens Co. |
| | France | (state) CESTA (Advanced Technology System Development Center)<br>(private) Toulouse City Chamber of Commerce and Industry |
| 1984 | United States | (state) Raleigh, North Carolina--Research Triangle Park (research consortium)<br>(private) SWRI, IITRI, SRI (all nonprofit think tanks) |
| | Canada | (provincial) Montreal Urban Community (research consortium) |
| 1985 | Sweden | (private) IDEON (research consortium)<br>(private) SKAPA (creative technology exhibit) |
| | Ireland | (state) IDA (Irish National Research and Development Agency) |
| | Britain | (state) BTG (British Technology Group, formerly NRDC)<br>(private) Berkeley Tech Mart '85 |
| | France | (state) CESTA<br>(private) Rhone Poulenc Co. |
| | West Germany | (private) Bayer Co. |

Fortunately, the dispatch of the missions over the past 3 years has resulted in steadily spreading state-owned technologies abroad due partly to the active cooperation of domestic licensee companies and various foreign governmental organizations and overseas companies. Among the themes presented, some concrete results are beginning to emerge, such as supplying information and samples, to include possibilities for future technology transfer and joint development, and the conclusion of secrecy contracts.

Table 1 shows typical technologies presented by the past three missions. A few examples among overseas responses to the missions were the request from Martin Marietta, a major U.S. enterprise, for a supply of several tens of kilograms of high-performance electromagnetic wave shield materials on a sample basis. Kuraray Co. and two other companies are now conducting experiments for practical application of the materials under the guidance of AIST's Industrial Products Research Institute. General Motors Corp. (GM), a major U.S. automaker, Alcan Canada Co. of Canada, Hinkley and ICI of Great Britain, and many other companies have shown interest in revolutionary fine ceramics processing technologies, and negotiations for a contract are now underway with a certain company. The ceramic technologies involved are the ceramics-metal

Table 1. Technologies Introduced Abroad Through State-Owned Patents

| Category | Title of technology | Institute that made discovery | Year introduced | | |
|---|---|---|---|---|---|
| New materials | High-performance electromagnetic shield material | Industrial Products Research Institute | 1983 | 1984 | |
| | Ceramics-metal bonding | Osaka National Industrial Research Testing Institute (NIRTI) | | 1984 | 1985 |
| | Ceramics-ceramics bonding | | | | |
| | Zirconia sinter | Nagoya NIRTI | 1983 | | 1985 |
| | Easy-to-sinter alumina | " " | | 1984 | |
| | Lubricating agent for die-casting, forging | Osaka NIRTI | 1983 | 1984 | |
| | Lanthanum-chromate for heating | Daikoshi NIRTI | 1983 | | |
| | Carbon-ceramics compound | Kyushu NIRTI | | 1984 | |
| | High-performance pitch carbon fiber | " " | 1983 | 1984 | 1985 |
| | Ultrahigh-molecular polyethylene gel yarn | Research Institute for Polymers and Textiles | | 1984 | |
| | Hydraulic injection plastic molding | " | | 1984 | |
| | High-flux precision filtration membrane and its system | National Chemical Laboratory for Industry, Kyushu NIRTI, Osaka NIRTI | 1983 | 1984 | 1985 |
| | Photocrosslinkage polymer and screen printing | Research Institute of Polymers and Textiles | 1983 | 1984 | |
| | Gas separation using polyimide hollow fiber | National Chemical Laboratory for Industry | | | 1985 |
| | Ion exchange fiber and rare earth metal separation | Research Institute of Polymers and Textiles | 1983 | 1984 | 1985 |
| | High-performance deodorant | National Chemical Laboratory for Industry | 1983 | | |
| Biotechnology | Production of oils and fats by mycosis | National Chemical Laboratory for Industry | 1983 | | |
| | Production of gamma linolenic acid by mycosis | " | | 1984 | 1985 |
| | Production of heat-resisting lipase and dissolution of oils and fats | Fermentation Research Institute | | 1984 | 1985 |
| | High-performance cellulase | " | | 1984 | |
| | Solidification of oxygen by ultrafine fiber carrier | Research Institute of Polymers and Textiles | | | 1985 |
| | Solidification of oxygen by photocrosslinkable polymer | " | | | 1985 |
| | Production of fry feed from alcohol fermentation wastes | Fermentation Research Institute | | | 1985 |
| | Artificial joints | Mechanical Engineering Laboratory | | | 1985 |
| Electronics | High-performance amorphous silicon solar battery | Electrotechnical Laboratory | | 1984 | 1985 |
| | Semiconductor magnetic sensor and its applications | " | | 1984 | 1985 |
| | Assessment of amorphous silicon manufacturing process under CARS system | " | | | 1985 |
| | ICTS system for detecting crystal defects | " | | | 1985 |
| | Nonvolatile semiconductor memory with floating gate | " | | | 1985 |
| | High-output GGG laser | " | | | 1985 |
| | Optical disk pickup (SCOOP) | " | | | 1985 |
| | Magnetic garnet film for optical IC | " | 1983 | | |

bonding and ceramics-ceramics bonding where research for practical applications is being conducted by Sumitomo Cement Co. and Daihen Corp., respectively, under the guidance of AIST's Osaka Industrial Research Institute. Negotiations are also underway with (Reuter) Gas Werke Co., a major West German pitch processing company, concerning technology to manufacture high-performance carbon fiber now being developed for practical application by more than 10 companies, including Nippon Carbon Co. Regarding lubricating agents for forging and die-casting, Hanano Shoji (Inc.) has completed development of manufacturing technology, and is now being made practical with a large amount of samples being supplied abroad for testing, while Great Britain's (Fuoseco) is seeking technology transfer.

In addition not only enterprises, but also Britain's BTG (R&D agency) and France's CESTA (advanced technology center) are requesting long-term, deliberative cooperative relationships with JITA missions, and are showing an active stance toward future technology interchange with Japan.

Progress in R&D of those technologies have been conducted by research institutions under AIST's umbrella with the cooperation of private-sector companies. Behind-the-scene movements concerning technology transfer through various channels have also been observed, and attention focuses on future developments.

Technological Transfer Based on Trusting Relationship

"The more information is assimilated, the more its essence is improved," is a wise statement about data bases by Tokyo University Professor Hiroshi Inose, last year's Cultural Merit awardee. In technology transfer, too, a certain preparatory period is initially required for the exchange of technologies and related information and establishment of a relationship of mutual trust between the provider and the receiver of technologies. The first problem in negotiating transfer of state-owned technologies abroad is that it takes considerable time to establish such relations of trust. Perseverance is required as in an extreme case where the party completely lacking information mutually about the other party begins from scratch. In addition, based on relations of trust, the supplier and receiver of technologies must seek terms on conditions which will mutually benefit both sides from a long-term point of view. Under such circumstances, recent trends for the future technologies or in exploring new areas such as cross-licensing and other forms are increasing.

Next is the establishment of relations of trust regarding protection of patents. The state-owned technologies to be definitely transferred abroad at present are basically on condition that the technologies involved are patented in the recipient countries. Accordingly, it is important that such technologies are fully protected under the recipient countries' patent system and in the operation thereof.

In the various countries visited by JITA's advanced technology exchange missions in the past 3 years, hardly a problem occurred due to the high reliability of the patent protection measures. However, of late, Japan has been strongly urged to expand technology transfer to the newly industrialized countries (NICS) and developing nations. The problem of patent protection in those countries will therefore be an issue to be resolved in the future.

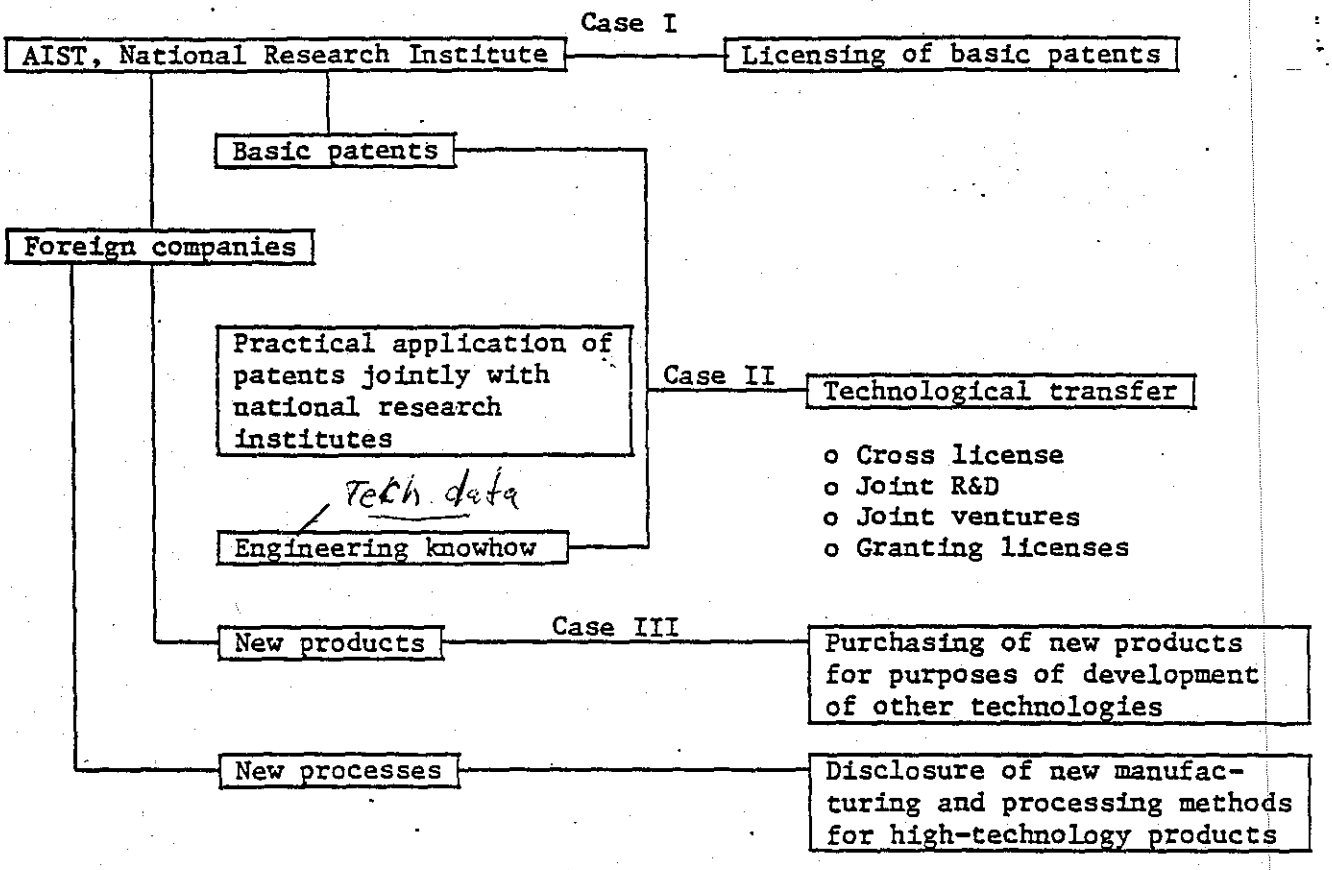


Figure 2. Technology Transfer of State-Owned Patents Abroad

Four Cases of Technological Transfer and Procedures for Transfer

Transfer of state-owned patents has various backgrounds depending on the technologies involved, which is not easy to generalize into one format. However, it can be classified roughly into four cases as shown in Figure 2.

Case I is the licensing of basic patents owned by the Agency of Industrial Science and Technology and of patents jointly owned by the national research institutes and private companies. Case II involves providing all the information necessary for commercialization ranging from basic patents owned by the AIST to related patents, manufacturing know-how and product specifications, etc., possessed by the implementing companies--in other words, the complete transfer of technologies. Depending on circumstances for the suppliers and the receivers of technologies, Case II can be subdivided into four types, i.e., cross-licensing mutually between companies, joint development by both companies for furtherance of technologies involved, establishment of joint ventures between companies based on mutual agreement and conditions for local production and sales, and the unilateral supply of all the technologies to the other country's enterprise in exchange for payment of certain remunerations.

In Case III foreign companies purchase products of technologies involved from the contract-implementing firms of Japan and use such items as a basis to develop new processes or new products. In Case IV foreign companies produce and process products on a contractual production basis, using high technologies developed from basic patents owned by the AIST. For example, one plan now under negotiation is the contractual production of special parts by a foreign enterprise using the "ceramics-metal bonding technology."

Table 2. Procedures for Technology Transfer

| | |
|---|---|
| First stage<br>Secrecy agreement | Providing secret information and samples necessary for assessment of technologies involved |
| Second stage<br>Option agreement | Technical information including know-how, etc., data regarding economical phase, and samples or marketable products necessary for feasibility study |
| Third stage<br>License agreement | All information necessary for practical application of technologies |

Procedures for granting licensing of state-owned patents abroad are basically identical to those in Japan. The first stage, as shown in Table 2, is to cope with clients when they seek more detailed information and samples to be furnished so as to determine the industrial value concerning the nature of the technologies. In such case, if necessary, a secrecy agreement is concluded before providing them.

The second stage is for coping with cases where further concrete information beyond the first stage is sought by the clients such as information about economical feasibility, information concerning marketing and technical information to determine the industrial applicability of the technologies, as well as providing samples on a commercial basis, etc. Usually in this stage, information is furnished under an option agreement on the assumption that technologies involved will be applied for industrial purposes.

The third stage is the execution of technology transfer under a license agreement in which the contract discloses all technical information necessary for the application of technologies and the nature of the patents.

For the Future

Japan is a small country in terms of natural resources, energy, and food, but is substantially rich in intellectual resources. Using these resources, the country has accumulated industrial property and other technology assets since the end of the last war, making itself one of the leading technology-oriented countries in the world. Such intellectual assets will continue to serve as a bargaining power for Japan.

However, today's accumulation of technology assets has resulted from the introduction of technologies from advanced countries in Europe and America, and efforts for creative technology development. Moreover, in the background of facilitating Japan's introduction of technologies from European and American countries is the sense of trust when Japan was furnished technologies, being accustomed to assessing fair value of new, superior technologies which furthered the understanding of patent protection.

Meanwhile, Japan has been strongly criticized by various countries in Europe and America for its huge trade surplus stemming from expanding exports of manufactured products. Of course, free world prosperity lies in orderly exports and imports under the free trading system. However, Japan's export of its abundant intellectual resources, resulting in a surplus in the technology trade balance, would not create trade friction, but would rather contribute to the development and revitalization of the world economy. The conditions to smoothly transfer technologies overseas are as stated above. The three issues of relations of trust, mutual benefit, and patent protection have been proposed. However, these problems in the case of NIC's and developing nations are such that environments are yet to be sufficiently regulated. It is extremely important that Japan mutually cooperate in resolving these problems for future international cooperation.

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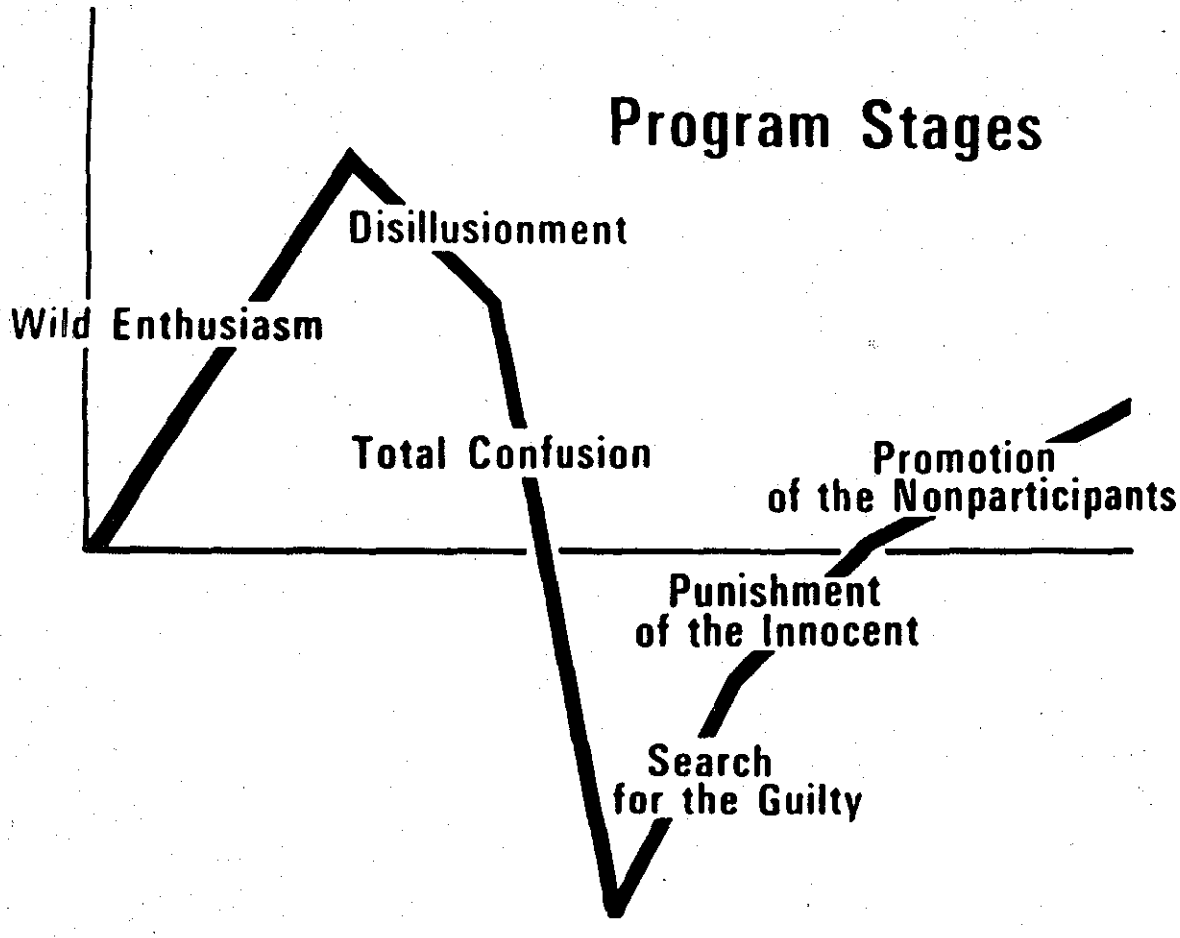
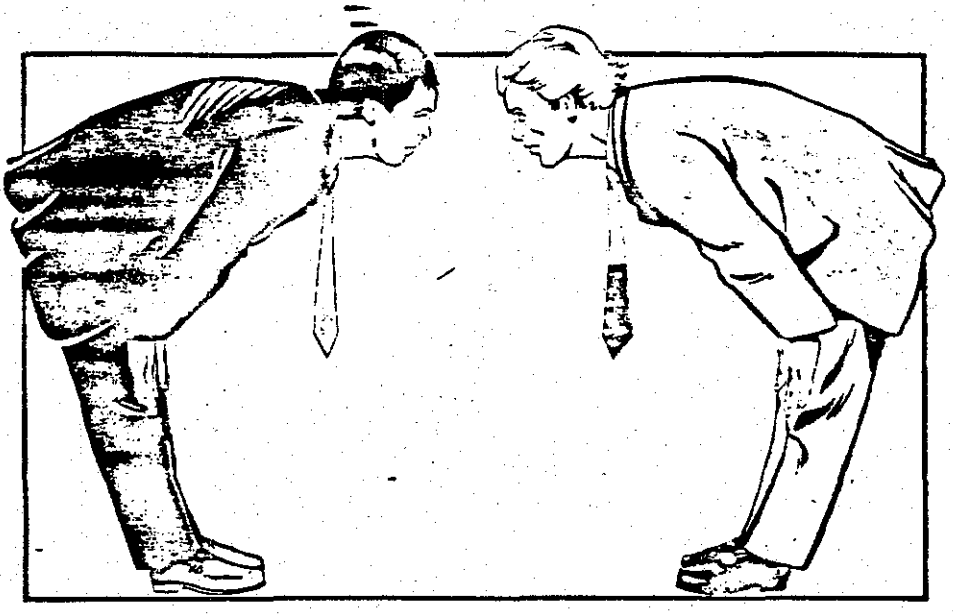

Program Stages
Disillusionment
Wild Enthusiasm
Total Confusion
Promotion
of the Nonparticipants
Punishment
of the Innocent
Search
for the Guilty

# HIGH TECHNOLOGY



## Clash of the titans

**After steel, motor cars, consumer electronics and cheap microchips, Japan has begun to challenge American pre-eminence in the one industrial area the United States has long cherished as its own: high technology. The two are girding up for a trade war in high-tech that threatens to be bloodier than anything yet. Nicholas Valéry reports on the strengths and weaknesses of the two technological superpowers**

The recent movie "Gung Ho" gets a lot of laughs out of the many misunderstandings that ensue when a Japanese car firm moves into a sad little town in Pennsylvania. Stereotypes abound: dedicated Japanese managers putting in double shifts, lazy American loudmouths slowing down the assembly line—with the locals winning a baseball match between the two sides only through brute force and intimidation.

All good clean fun. In real life, however, American workers—despite the popular myth—remain the most productive in the world (see the feature on the next page). In terms of real gross domestic product (GDP) generated per employed person, the United States outstrips all major industrial countries, Japan included (chart 1). The problem for Americans is that the rest of the world has been catching up. In the decade from the first oil shock to 1983, increases in annual productivity in the United States had been roughly a seventh of those of its major trading partners.

In the 1960s, American companies held all the technological high cards and dominated the world's markets for manufactured goods. The United States supplied over three-quarters of the television sets, half the motor cars and a quarter of the steel used around the world. Yet, a mere two decades later, Japan had taken America's place as the dominant supplier of such products.

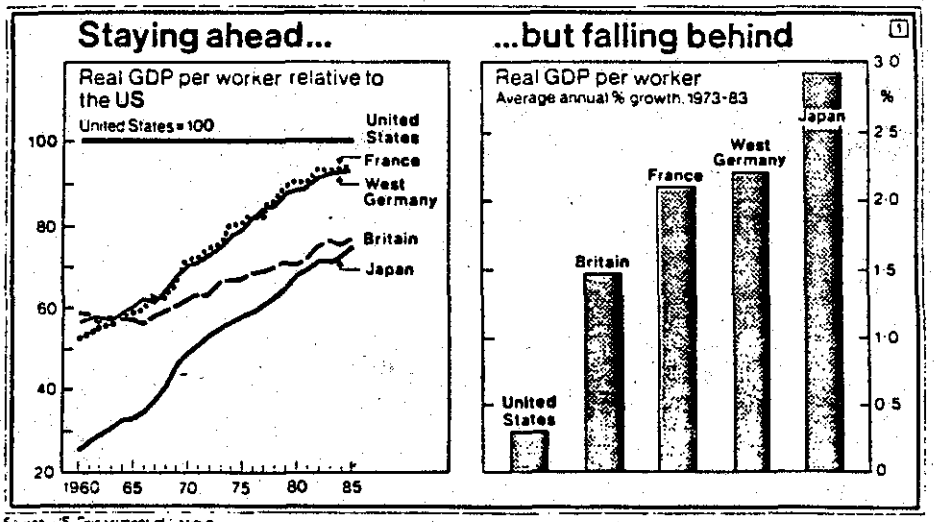
The agony for Americans does not end there. Over the past 25 years they have seen:

- Their share of world trade fall from 21% in 1960 to 14% in 1985.
- The American trade balance go from a surplus of $5 billion in 1960 to a deficit of $150 billion last year.
- More worryingly still, the country's trade balance in manufactured goods slip from a healthy surplus of $11 billion as recently as 1981 to a deficit of $32 billion last year—approaching 1% of America's total output.
- The volume of its manufacturing exports tumble 32% over the past five years—with every $1 billion of exports lost costing an estimated 25,000 American jobs.

Angry and confused, businessmen in the United States have had to stand by and watch as "smokestack" industry all around them has been snuffed out. Then came the unthinkable: if the Japanese could thrash them in mainstream manufacturing, would they give them a mauling in high technology, too?

By the beginning of the 1980s, it began to look as if they would. It became clear that the Ministry of International Trade and Industry (MITI) in Tokyo had "targeted" not just semiconductors and computers but all of America's high technology industries—from aerospace to synthetic materials—for a blitzkrieg attack.

Six years on, Japan has scored some




Source: US Department of Labour

## Power to the elbow

Americans work every bit as hard (and often a lot harder) than the Japanese—and generate proportionately more wealth in the process. The average output of American workers last year was $36,800. The Japanese equivalent was $22,500 (at an average 1985 exchange rate of Y220 to the dollar).

But labour productivity is only half the story. The amount of capital applied to a worker's elbow is crucial, too. The traditional definition of productivity (output per hour of all workers) makes it difficult to measure these inputs separately. True, the definition reflects all the factors that contribute to rising output—from advances in technology, better utilisation of capacity, improvements in the way production is organised and sharper management, to harder efforts by the workers themselves as well as the impact of changes in the amount of capital employed.

In 1983, the American Bureau of Labour Statistics introduced a yardstick called multifactor productivity. This shows the changes in the amount of capital as well as labour used in production. Reworking its data for 1950-83, the bureau found that multifactor productivity in the United States increased at an average annual rate of 1.7% for the period. As output per hour over the same period increased by an annual 2.5%, capital productivity inched up by only a modest 0.8% a year.

Overall, America's multifactor productivity has shown two distinct trends over the past 35 years. Up till the first oil shock of 1973, the country experienced an annual 2% multifactor growth; then an annual average of only 0.1% from 1973 to 1981. The post-OPEC slowdown seems to have resulted from high interest rates keeping the brakes on capital spending, while more people were having to work longer hours to hang on to their jobs.

How did the Japanese fare? The driving force behind the Japanese economy over the past 25 years has been the high growth in capital input. Mr Dale Jorgenson and his colleagues at Harvard University reckon it has been roughly double that in the United States. Growth rates in labour productivity have been much the same for the two countries. All told, the growth in Japanese productivity outstripped that in the United States until 1970, when productivity growth began to slow dramatically in Japan. Thereafter, with Vietnam behind it and two oil shocks ahead, the American economy flexed its muscles and coped more effectively. Then the competitive advantage started to move back in America's favour.

The interesting thing is what has happened since the last recession. Multifactor productivity in the United States has been running at an average of 5% a year, while the growth in labour productivity is now averaging nearly 4% a year. That means that productivity of capital employed is now growing at well over 6% a year.

Could this be the first signs of the productivity pay-off from the $80 billion that Detroit spent on new plant and equipment over the past half dozen years; the combined (additional) $180 billion invested by the airlines since deregulation, telecommunications firms since the AT&T consent decree and the Pentagon since President Reagan's defence build-up began in 1980? It looks remarkably like it.

notable hits. A group of American economists and engineers met for three days at Stanford University, California, last year to assess the damage*. They concluded that Japanese manufacturers were already ahead in consumer electronics, advanced materials and robotics, and were emerging as America's fiercest competitors in such lucrative areas as computers, telecommunications, home and office automation, biotechnology and medical instruments. "In other areas in which Americans still hold the lead, such as semiconductors and optoelectronics, American companies are hearing the footsteps of the Japanese", commented the Stanford economist Mr Daniel Okimoto.

How loud will those footsteps become? American industry may have been deaf in the past, but it certainly isn't any more. And never forget that Americans are a proud and energetic people. More to the point, they are prone to periodic bouts of honest self-reflection—as if, throughout their two centuries of nationhood, they have been impelled forward by a "kick up the backside" theory of history.

Once every couple of decades, America has received a short and painful blow to its self-esteem; Pearl Harbour, Sputnik, Vietnam are recent examples. What follows then is usually a brief and heart-searching debate along with a detailed analysis of the problem, then an awesome display of industrial muscle coupled with unexpected consensus between old adversaries—most notably between Congress, business and labour.

With its ceaseless shipments of cameras, cars, television sets, video recorders, photocopiers, computers and microchips, Japan unwittingly supplied the latest kick up the broad American buttocks. After witnessing Japanese exporters almost single-handedly reduce Pittsburgh's steel industry to a smouldering heap, drive Detroit into a ditch, butcher some of the weaker commodity microchip makers of Silicon Valley, and threaten America's remaining bastions of technological clout—aircraft and computers—then, and finally then, American lethargy ceased.

This survey tries to assess the strengths and weaknesses of the world's two technological superpowers. For if the past decade has seen some of the ugliest recrimination between Washington and Tokyo over trade issues generally, imagine what the coming decade must have in store. Henceforth, industrial competition between America and Japan is going to range fiercely along the high-tech frontier—where both countries take a special pride in their industrial skills and cherish sacred beliefs about their innate abilities.

The question that ultimately has to be answered is whether America is going to allow the Japanese to carry on nibbling away at its industrial base without let, hindrance or concession? Or are the Americans (as some bystanders have begun to suspect) "about to take the Japanese apart"?

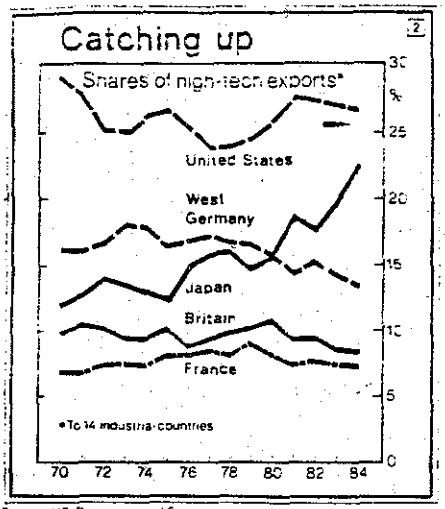
With the gloves now off, which of the two technological heavyweights should one put some money on? In the blue corner, Yankee ingenuity? In the red, Japanese production savvy?

*Symposium on Economics and Technology held at Stanford University, March 17-19 1985. Now published as "The Positive Sum Strategy: Harnessing Technology for Economic Growth" by National Academy Press, Washington, DC.

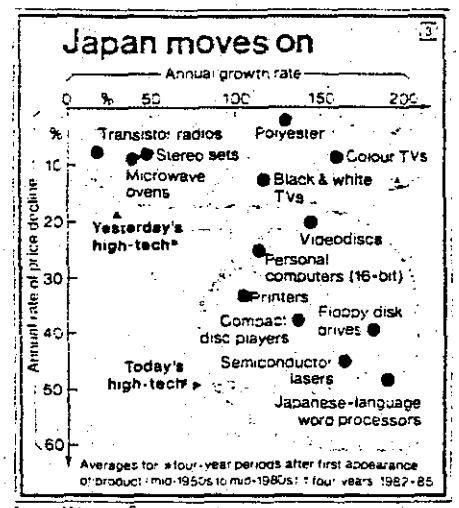
# Copycat turns leader?

**Is Japan still a technological free-loader—or has it become a pacesetter in high-tech?**

America may still have the largest share of high technology exports, but Japan is catching up fast. It skipped smartly past West Germany to become the second largest supplier of high-tech goods in 1980 (chart 2 on next page). Only in three high-tech industries—communications and electronics, office automation, and ordnance—have American companies increased their market share.




Source: US Department of Commerce




Source: Mitsubishi Bank

The Japanese know they do not have a chance in fields that are either defence-related (for example, weapons, aircraft, satellites and avionics) or too dependent on imported energy or raw materials (like petrochemicals). But they see everything else as up for grabs. Even in lasers, software and computer-integrated engineering—where American pre-eminence was long thought unassailable—the Japanese have begun to make inroads.

Who would have thought it possible a decade ago? Of the 500 breakthroughs in technology considered seminal during the two decades between 1953 and 1973, only 5% (some 34 inventions) were made in Japan compared with 63% (315 inventions) in the United States. Despite its large, well-educated population, Japan has won only four Nobel prizes in science: American researchers have won 158. It is not hard to see why Japan has been considered more an imitator than innovator.

Stanford University's Mr Daniel Okimoto lists half a dozen reasons for Japan's lack of technological originality in the past:

- As an industrial latecomer, it has always been trying to catch up.
- The Japanese tendency towards group conformity has made it difficult to win a hearing at home for radical ideas.
- Research in Japanese universities is bureaucratic, starved of cash and dominated by old men.
- The venture-capital market is almost non-existent.
- Lifetime employment, along with a rigid seniority system, stifles innovation inside industry.
- And the traditional heavy gearing (high debt-to-equity ratio) of much of Japanese industry has made firms think twice about taking risks.

All these things—and more—have been true to some extent in the past; but all are also changing. The deregulation of Tokyo's financial markets, for instance, is forcing Japanese companies to reduce their levels of debt (see accompanying feature on next page). This, in turn, is making them more adventurous, while at the same time helping ferment a number of venture-capital funds.

Japan's "invisible" balance of technological trade (its receipts compared with payments for patent royalties, licences, etc) which had a ratio of 1:47 a couple of decades ago came within a whisker of being in balance last year. That said, Japan still buys its high-tech goods and knowhow predominantly in the West and sells them mainly to the developing world.

In certain industries, however, Japanese manufacturers have already started bumping their heads against the ceiling of current knowhow. There are no more high-tech secrets to be garnered from abroad in fibre optics for telecommunications, gallium arsenide memory chips for superfast computers, numerically-controlled machine tools and robots, and computer disk-drives, printers and magnetic storage media. In all these, Japan now leads the world. Today, Japanese-language word processors represent the cutting edge of high-tech in Japan—taking over the technological (but hardly export-leading) role that colour television played earlier (chart 3).

Although it is no longer quite the technological free-loader it was in the past, is Japan's new reputation as a pacesetter in high-tech justified? A new image has certainly emerged over the past few years of Japan as an invincible Goliath, capable of vanquishing any rival, whatever the field. Yesterday, the smokestack sectors. Today, high technology. Tomorrow, services. . . "Which is the 'real' Japan?" asks Mr Okimoto:

> Is it a technological imitator and industrial over-achiever? Or is Japan an astute learner and unbeatable colossus? Will Japan dislodge the United States from its current position of dominance in high technology as convincingly as it did in the smokestack sectors? Or has it reached the limits of its phenomenal postwar growth?

Japan is all these things and more. And to understand what the future holds, and whether America is up against a David or a Goliath, means looking closely at the frontiers of modern electronics. For the country that commands the three most crucial technologies of all—semiconductors, computing and communications—will most assuredly command the mightiest industrial bandwagon of the twenty-first century.

# Made in the USA

Just as Japan has begun to muscle into high-tech, America has raised the technological stakes. The name of the game now is ultra-tech

High technology is an American invention. Despite the near meltdown at Three Mile Island, broken helicopters in the Iranian desert and recent disasters on the launch pad, Americans remain the supreme practitioners of this demanding and arcane art. And while the United States has racked up large deficits on its international trading account, it has enjoyed growing surpluses in its worldwide sales of high-tech goods. Or, rather, it did so until recently. Once again, blame the Japanese.

Five years ago, America sold the world $23.6 billion more technological widgets than it bought. That handy surplus had dwindled, says America's Department of Commerce, to a token $5 billion by 1984 (chart 7 on later page). Meanwhile, foreigners had grabbed three-quarters of the world's current $300 billion in high-tech trade. In the process, Japan has gone from being a small-time tinkerer in the 1960s to becoming (as in everything else) the Avis of high technology to America's Hertz.

Even so, trade in high-technology goods remains a crucial breadwinner for the United States. Since the mid-1960s, high-tech's share of American manufactured goods sold around the world has gone from a little over a quarter to close to a half.

Office automation is now America's most competitive high-tech industry as well as its biggest revenue-earner abroad. Selling its trading partners computers, copiers and word processors brought in

# Crying all the way to the bank

One thing Americans have learned is that having the world's most productive labour force does not guarantee industrial competitiveness. At least three other things are needed. The first is to keep a lid on wages. The second concerns exchange rates. The third involves the return on capital employed. All three have been seen lately as spanners in the American works.

Take wages. During the ten years before 1973, real wages for American workers had increased steadily at an average rate of 2.6% a year. But ever since the first oil shock, real wages in the United States have stagnated. So American labour is becoming more competitive, yes?

Unfortunately no. When fringe benefits are included, hourly compensation for blue-collar workers in the United States has continued to rise. American labour has sensibly been taking raises less in cash than kind. Total compensation for American industrial workers—a modest $6.30 an hour in 1975—had climbed to $9.80 an hour by 1980 and to $12.40 by 1983.

Compared with Japan, hourly labour costs in America went from being on average a little over $3 more expensive in 1975 to becoming nearly $6 more so by 1983 (chart 4). So much for narrowing the $1,900 gap between making a motor car in Nagoya compared with Detroit.

Ah, yes, but hasn't the dollar tumbled dramatically? It has indeed—from a 1985 high of over Y260 to the dollar to a low this year of Y150 or so. In trade-weighted terms, that represents a drop for the dollar of 28% in 15 months. Meanwhile, the trade-weighted value of the yen has appreciated by over 40%.

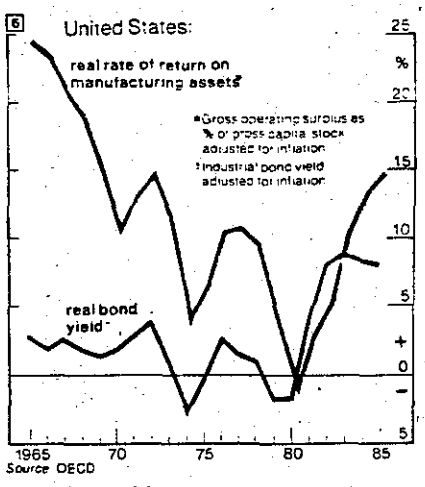
What about differences between America and Japan in terms of return on capital? Here things are actually better than most American businessmen imagine. True, real rates of return earned by American manufacturing assets in the 1960s were substantially higher than investments in financial instruments, while things were briefly the other way round during the early 1980s (chart 6). On the face of it, capital for buying equipment or building factories seems twice as expensive in America as in Japan.

Today's most cited account comes from Mr George Hatsopoulos of Thermo Electron Corporation in Massachusetts. Comparing the cost of (non-financial) capital in the two countries between 1961 and 1983, Mr Hatsopoulos found real pre-tax rates ranged between 6% and 10% for Japanese firms and anything from 13% to 20% for their American counterparts.

The conventional explanation for this difference is that Japanese firms are more highly geared (leveraged) and thus benefit because debt generally costs less than equity—interest payments being deducted from pre-tax profits, while dividends come out of taxed earnings.

Then there is Japan's two-tier interest rate structure, which is carefully regulated to favour business debt at the expense of consumer credit. Throw in a banking system that is bursting at the seams with yen being squirrelled away by housewives worried about school fees, rainy days and the ever-present threat of their husband's early (and often unpensioned) retirement. All of which, say American trade officials, adds up to a financial advantage that makes it tough for American firms to compete.

What is studiously ignored in the financial folklore about Japan Inc is the fact that, over the past decade, Japanese manufacturers have been getting out of debt as fast as decently possible (see the survey on corporate finance in *The Economist*, June 7 1986). The most compelling reason right now is because Tokyo's financial markets have joined the fashionable trend towards liberalisation. With old controls over the movement of capital going out of the window, Japanese interest rates are destined to become more volatile. So who wants to be highly geared when interest rates are rising or (worse) becoming less predictable?

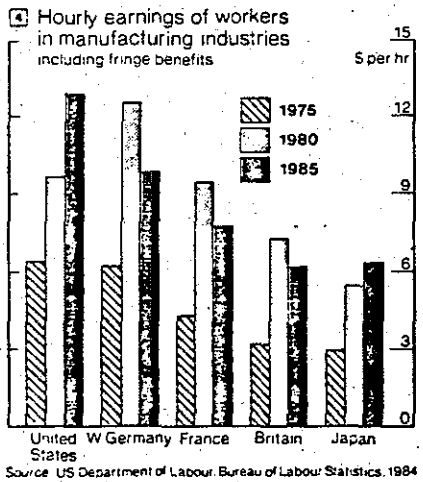


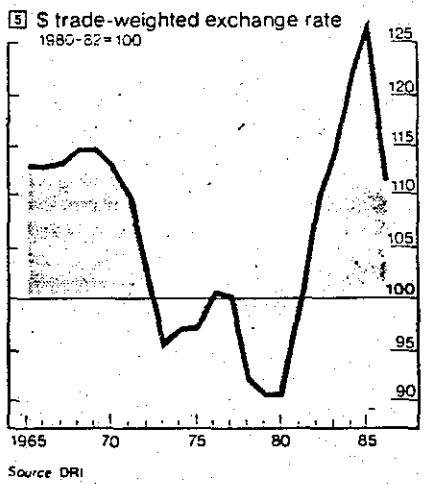

Another thing Japanese manufacturers resent about some of these allegedly cheap industrial loans are the strings and hidden costs involved. The most punishing are the so-called "compensating balances" which a borrower has to deposit (at a considerably lower interest rate) with the bank offering the industrial loan. And so he has to borrow more money—at higher cost and with greater restrictions—than he actually needs.

Yet another thing that muddies the water is the way debt in Japanese balance sheets is grossly overstated by western standards. For one thing, the compensating balances, though they are actually deposits, are recorded as borrowings. Then there is the habit Japanese companies have of doing much of their business on credit, especially with suppliers and subsidiaries. This makes their accounts payable and receivable look huge—in fact, twice as large as in America.

Other factors inflating debt among at least the bigger Japanese companies are things like non-taxable reserves for special contingencies and (if they pay them) pensions. The last time figures were collected in Japan (in 1981), employees in large corporations with established retirement plans were divvying up 15-20% of their companies' capital through their pension contributions. All of which showed up in their corporate accounts as debt.

All that said, Japanese companies are on balance more highly geared than American corporations; and, overall, the cost of financing industry has been lower in Japan than in the United States. But at most only 20% lower, and nothing like the 50% lower claimed by lobbyists in America.



# Technology's top ten

How high is the high in high-tech? Difficult to say. Most economists at least agree that high technology products embody an "above average" concentration of scientific and engineering skills. As far as the National Science Foundation in Washington is concerned, this means anything produced by organisations employing 25 or more scientists and engineers per 1,000 employees and spending over 3.5% of net sales on R&D.

The American Department of Commerce is a bit more scientific. Its definition of high-tech is derived from input-output analyses of the total R&D spent on a spectrum of individual products. Thus an aircraft gets credit for not only the R&D done in developing the airframe, but also the relevant contribution of the avionics supplier and even the tyre maker. Using this definition, high-tech industry is a ranking of the ten most "research-intensive" sectors, where the tenth has at least double the R&D intensity of manufacturing generally (table 1).

A laudable effort, but not without criticism. First, such a definition focuses entirely on products, ignoring the booming business in high-tech processes—and, increasingly, high-tech services as well. Second, it favours systems (that is, collections of interdependent components) over individual widgets, as well as products manufactured by large companies rather than small firms.

Third, because the data come of necessity from broad industrial categories, anomalies crop up—like cuckoo clocks being labelled high-tech because they fall within the eighth-ranking group, professional instruments.

Fourth, and perhaps most damning, the Commerce Department's definition is based on Standard Industrial Classification (SIC) codes—many of which have been rendered irrelevant by technological changes that have occurred since the SIC codes were last overhauled in 1972.

## Table 1: Product range

| | HIGH-TECH SECTOR | EXAMPLES OF PRODUCTS |
|---|---|---|
| 1 | Missiles and spacecraft | Rocket engines; satellites and parts |
| 2 | Electronics and telecoms | Telephone and telegraph apparatus, radio and TV receiving and broadcast equipment, telecoms equipment, sonar and other instruments, semiconductors, tape recorders |
| 3 | Aircraft and parts | Commercial aircraft, fighters, bombers, helicopters, aircraft engines, parts |
| 4 | Office automation | Computers, input-output devices, storage devices, desk calculators, duplicating machines, parts |
| 5 | Ordnance and accessories | Non-military arms, hunting and sporting ammunition, blasting and percussion caps |
| 6 | Drugs and medicines | Vitamins, antibiotics, hormones, vaccines |
| 7 | Inorganic chemicals | Nitrogen, sodium hydroxide, rare gases, inorganic pigments, radioactive isotopes and compounds, special nuclear materials |
| 8 | Professional and scientific instruments | Industrial process controls, optical instruments and lenses, navigational instruments, medical instruments, photographic equipment |
| 9 | Engines, turbines and parts | Generator sets, diesel engines, non-automotive petrol engines, gas turbines, water turbines |
| 10 | Plastics, rubber and synthetic fibres | Various chemicals derived from condensation, polycondensation, polyaddition, polymerisation and copolymerisation; synthetic resins and fibres |

$20 billion in 1984. Along with aircraft, electronics and professional instruments, these "big four" account for more than three-quarters of the United States' exports of high technology (table 2). Despite the popular myth, America exports only modest amounts of missiles and aerospace products. But fears that foreigners may eventually storm even the high frontier of aerospace keep Washington officials awake at night.

Of the ten industrial sectors designated high-tech (see feature above), America has managed to increase its share of the global market in only two: office automation and electronics. For which, it should thank the likes of IBM, Hewlett-Packard, Digital Equipment, Xerox, ITT, RCA, General Electric, Texas Instruments and a host of brainy technological-based businesses scattered around the West Coast, Rockies, Sunbelt, Mid-Atlantic and New England.

A common cry in Washington is that this "narrowing" of America's high-tech base is one of the most disturbing problems facing the United States today. Others see this trend as more or less inevitable—and perhaps even to be encouraged. Trade ministers in Western Europe, for instance, only wish they had such "problems"; Japanese bureaucrats are doing all they can to create similar "problems" back home.

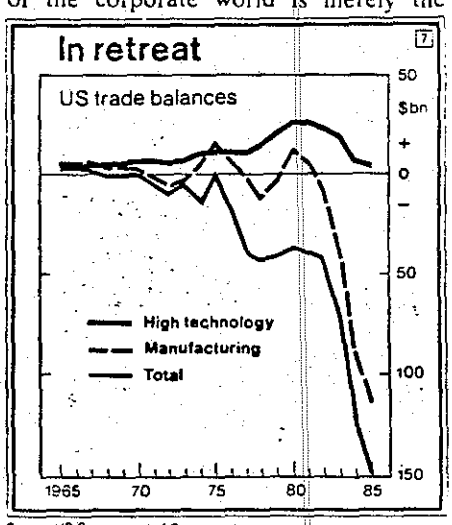
The reason is simple. These so-called "problems" concern a focusing of all the underlying technologies that have come to drive the computing, office automation and communications industries. All three provide the tools for handling information; and information—its collation, storage, processing, transmission and use elsewhere—will, quite literally, be the oil of the twenty-first century (see the survey on information technology in *The Economist*, July 12 1986).

All that noisy jostling going on right now between the IBMs, Xeroxs and AT&Ts of the corporate world is merely the

## Table 2: High-tech exports in 1984

| High-tech sector | American exports | | Others' exports* | |
|---|---|---|---|---|
| | Value | % of total | Value | % of total |
| Office automation | $19.7bn | 22.4 | $6.5bn | 14.5 |
| Electronics & telecoms | $14.4bn | 22.0 | $53.8bn | 29.4 |
| Aircraft and parts | $13.5bn | 20.7 | $15.4bn | 8.4 |
| Profess'l instruments | $7.2bn | 11.0 | $27.0bn | 14.7 |
| Plastics, rubber, etc | $4.4bn | 6.7 | $26.5bn | 14.5 |
| Inorganic chemicals | $3.5bn | 5.4 | $10.9bn | 6.0 |
| Engines and turbines | $3.2bn | 4.9 | $10.7bn | 5.9 |
| Drugs and medicines | $2.7bn | 4.1 | $10.7bn | 5.9 |
| Missiles and spacecraft | $1.0bn | 1.5 | $0.6bn | 0.3 |
| Ordnance | $0.8bn | 1.3 | $0.7bn | 0.4 |

*Of the 14 other countries (apart from America) exporting high-tech goods, France, West Germany, Japan and Britain accounted for three-quarters of total trade.
Source: US Department of Commerce.



Source: US Department of Commerce

clatter of these three industrial sectors (each with its own distinctive style of manufacturing, procurement and customer support) being forged together by their underlying technologies into a single ultra-tech activity called information services.

Yes, beyond high-tech in the industrial spectrum lies ultra-tech—today a mere multi-billion-dollar stripling of a business, but by the year 2000 potentially a trillion-dollar leviathan. As such, ultra-tech alone will come to dwarf all manufacturing sectors before the century is out. America is well on the way to making that happen. A lap or two behind, Japan at least is getting up speed. Europe is barely in the race.

# Chips with everything

Gone are the days when American semiconductor firms short-sightedly sold their licences and knowhow to Japanese microchip makers

America's electronics firms have maintained their global leadership in all branches of their business save one. They kissed goodbye to consumer electronics (television, hi-fi, video recorders, etc) as customers across the country voted with their pockets for shiny boxes with flashing lights and labels like Panasonic, Technics, JVC and Sony.

The American electronics industry came close to allowing much the same to happen in microchips. In 1982, Silicon Valley took a caning when the Japanese started flooding the market with cheap 64k RAMs (random-access memory chips capable of storing over 64,000 bits of computer data). Most beat a hasty retreat up or out of the market.

From having a dozen mass producers of dynamic-RAMs in 1980, only five American chip makers were still in the high-volume memory business by 1983. Today, there are effectively only two or three with the capacity to produce the latest generation of memory chips (1 megabit RAMs) in anything like economic volumes. Meanwhile, the six Japanese firms that plunged into the memory-chip business back in the early 1970s are still around—and now have a 70% share of the dynamic-RAM market in America.

Microchips have been the engine powering Japan's drive into high-tech generally. But before it could join the microchip generation, Japan had to find a way of disseminating this vital American technology throughout its fledgling semiconductor industry. The trick adopted was, first, to protect the home market, and then to bully abler firms into joining government-sponsored research schemes—one run by the Japanese telephone authority NTT and the other by the Ministry of International Trade and Industry—to develop the knowhow for making their own very large-scale integrated (VLSI) circuits.

Next, by "blessing" VLSI as the wave of the future and crucial to Japan's survival, the government triggered a scramble among the country's electronics firms (encouraged by their long-term investment banks) to build VLSI plants. The net result was massive over-capacity (first in 64k RAMs and then in 256k versions), abundant local supply for the domestic consumer electronics makers and an impelling urgency to export (or dump) surplus microchips abroad.

This targeting ploy had been tried before. Japanese manufacturers found it worked moderately well with steel, much better with motorcycles, better still with consumer electronics and best of all with semiconductors. The only requirement was a steeply falling "learning curve" (that is, rapidly reducing unit costs as production volume builds up and manufacturers learn how to squeeze waste out of the process).

The trick was simply to devise a forward-pricing strategy that allowed Japanese manufacturers to capture all the new growth that their below-cost pricing created in export markets, while underwriting the negative cashflow by cross-subsidies and higher prices back home.

The Americans finally lost their patience when the Japanese tried to do a repeat performance with pricier memory chips called EPROMs. The price fell from $17 each when the Japanese first entered the American market with their EPROM chips early in 1985 to less than $4 six months later. Intel, National Semiconductor and Advanced Micro Devices promptly filed a joint petition, accusing the Japanese of dumping EPROMs on the American market at below their manufacturing costs in Japan (then estimated to be $6.30 apiece). The issue is currently being used by Washington as a battering ram to breach the wall Japan has erected around its own $8 billion semiconductor market back home.

For America, this get-tough policy has come only just in time. Japan now enjoys a 27% share (to America's 64%) of the world's $42 billion semiconductor market. And while cut-throat competition may make memory chips a loss-leader, acquiring the technology for producing RAMs has given Japan's microcircuit makers a leg-up in getting to grips with more complex semiconductors used in computer graphics, communications and video equipment.

So far, however, it has not helped Japanese chip makers to loosen the stranglehold that American semiconductor firms have on the lucrative microprocessor business. Where 256k RAMs have become commodity products that sell wholesale for $1 or so each, 32-bit microprocessors from the likes of Motorola, Intel, National Semiconductor, Texas Instruments, AT&T and Zilog cost hundreds of dollars apiece. Between them, these six American chip makers control 90% of the world market for the latest generation of microprocessors, leaving just 10% for the rest of the American semiconductor industry, Europe and Japan.

Fortunately for the Americans, micro-



Street map for a microchip circuit

processors are not like memory chips. Being literally a "computer-on-a-chip", they are vastly more complex and cannot be designed in any routine manner. Sweat, insight and inspiration are needed every step of the way. And they have to be designed with their software applications in mind. Americans have been doing this longer, and are better at it, than anyone else.

More to the point, American firms are not parting with their patents as readily as they did in the past. Hitachi has been trying (with little luck) to persuade Motorola to sell it a licence for making its advanced 68020 microprocessor. Meanwhile, Japan's leading electronics firm, NEC, is having to defend itself in the American courts for infringing one of Intel's microprocessor patents.

With America's new, stricter copyright laws making it difficult to imitate American designs, Japanese chip makers are being shut out of all the major markets for microprocessors. Fujitsu, Matsushita, Mitsubishi and Toshiba are all gambling on a microprocessor design called TRON developed at the University of Tokyo. But nobody, least of all NEC or Hitachi, holds out much hope for the TRON design winning a big enough share of the market in its own right to be economic—at least, not until the mid-1990s. And, by then, Silicon Valley will have upped the technological stakes again.

When, late at night, the conversation gets down to *honne* (brass tacks), even Japan's ablest microchip wizards despair at ever matching Silicon Valley's mix of entrepreneurial and innovative flair. "Japan is powerful in only one sub-field of a single application of semiconductors tied to a specific line of products", bemoans Mr Atsushi Asada of Sharp Corporation.

# Calculus of competition

## Aping IBM has given Japan's computer makers a toe-hold in the market—but largely on Big Blue's terms

America's response to Japan's challenge in microchips is being repeated in computers. Here, Japan's specialty has been making workalike copies of IBM's big office machines (mainframes). The most one can say about these "plug-compatible" computers is that they have managed to prevent IBM from swamping the Japanese home market completely. Big Blue has to put up with being number two in Japan. Overall, however, Japanese compatibles have had only a marginal impact on the $150 billion computer business worldwide.

American manufacturers have established an almost impregnable position in mainframes and minicomputers—the stuff of corporate sales and accounting departments. And in the push to put a microcomputer on every desk, a handful of American firms (IBM, Compaq, Apple, Atari and Commodore) have been feeding the market a feast of cleverer, faster and (in many cases) cheaper machines that have left Japan's "IBMulators" nibbling on the leftovers of yesterday's lunch. In the personal-computer market, the IBM clone makers having the most impact come mainly from low-cost South Korea and Taiwan rather than Japan.

Meanwhile, in developing the programs that make computers tick, American software engineers have been every bit as clever as their chip-designing colleagues in Silicon Valley. In the process, they have increased their share of the world's software market (worth $40 billion a year) from under 65% a decade ago to over 75% today.

All this does not mean Japan's computer industry is a write-off. Its component suppliers have quietly established a significant position for themselves in the United States and elsewhere. In personal computers, for instance, Japanese machines account for less than 2% of the $14 billion annual sales of PCs in America. But Japanese components and peripherals (chips, disk-drives, keyboards, monitors, printers, etc) account for nearly 30% of the market's wholesale value.

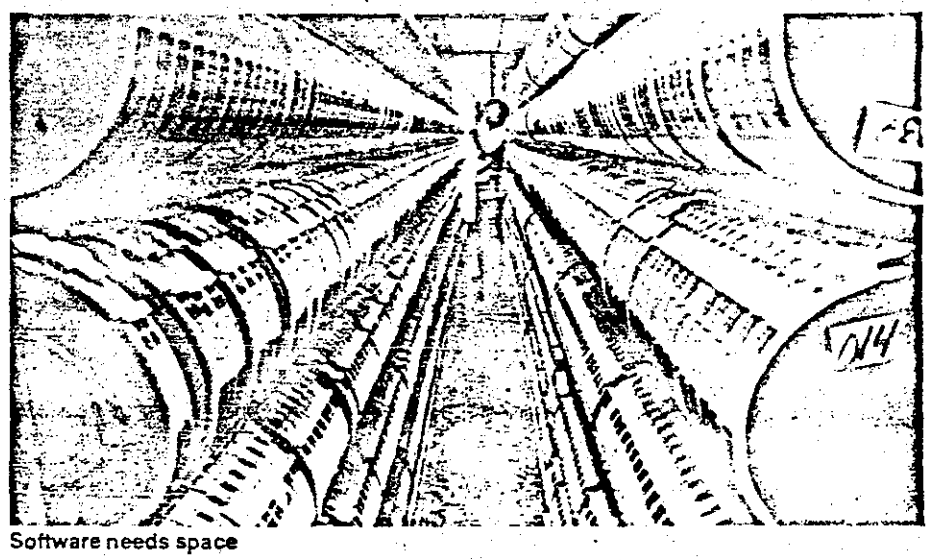
Most of Japan's computer makers came a cropper by riding a bit too blindly on IBM's coat-tails. Lacking the home-grown programming skills, Fujitsu, Hitachi and Mitsubishi made their computers imitate IBM's so they could sell cheaper versions to customers who were already using IBM machines equipped with the necessary software. That worked well until the slumbering giant woke up.

Then, in 1979, IBM introduced its 4300 series computers at a price that shook not just rival Japanese makers, but other American suppliers too. Since then, IBM's aggressive price-cutting and frequent model changes have made life tough for the plug-compatible trade.

Not only is IBM automating vigorously (the company is spending $15 billion over the next four years to achieve lower production costs than anyone in Asia), but it has also begun flexing its technological muscles. Its R&D expenditure is now running at $3.5 billion a year—more than all other computer manufacturers combined. Though for antitrust reasons it will never say so publicly, IBM is nevertheless determined to trample the plug-compatible makers down—both in the personal-computer end of the business as well as among its mainframe competitors.

One of the dodges being adopted is to incorporate more "microcode" in its computers' operating systems (the basic programs that manage a machine's internal housekeeping and support the customers' applications software). Used as an offensive weapon, microcode replaces parts of the computer's electrical circuitry, making it possible to change the whole character of a machine long after it has been installed at a customer's premises. The implication is that IBM can then sell products that can be continuously enhanced—something customers appreciate and will pay a premium for.

Starting with its 3081 series in 1981, IBM caught the competition off guard with a new internal structure called XA ("extended architecture") which allows customers to update their machines with packets of microcode whenever IBM decrees the market needs a shake-up. This



Software needs space

has thrown the plug-compatible makers on the defensive, forcing them to devote more of their development resources than they can afford to trying to anticipate IBM's next round of operating-system changes and to try to match them with hurriedly engineered modifications to their hardware. That involves digging ever deeper into their profit margins.

America's other computer firms are also pushing this trend towards replacing hardware with software wherever possible. Writing and "debugging" the programs now accounts for 50-80% of their budgets for developing new computers. Two reasons, then, why American computer executives are smiling:

- At a stroke, the trend towards greater use of software helps neutralise the one great advantage their Japanese competitors have long possessed—namely, the ability to manufacture well-made mechanical components at a modest price.
- And it changes the business of manufacturing computers from being heavily capital-intensive to becoming more brain-intensive. The large pool of experienced programmers and diverse software firms in the United States puts the advantage firmly in American hands.

The Japanese response has been to launch another government-sponsored scheme, this time to help the country's computer makers invent "intelligent" machines for tomorrow. The ten-year fifth-generation project, based largely on "dataflow" concepts pioneered at Massachusetts Institute of Technology, will have cost $450m by the time it is completed in 1992. The aim is to create computers able to infer answers from rough information presented to them visually or orally. Even Japanese scientists working on the project are not sure whether such goals are realistic.

The Americans are not leaving anything to chance. Congress has been persuaded to relax the antitrust rules so that rival manufacturers can collaborate on advanced research without running foul of the law. Two of the first collaborative research institutions to spring up aim to match any challenge the Japanese might offer in computing, software and components for the 1990s. In one, the Semiconductor Research Corporation, 13 microchip companies have clubbed together to form a non-profit consortium for supporting research on advanced integrated circuits at American universities. The consortium is now doling out $35m a year to designers of tomorrow's microchips.

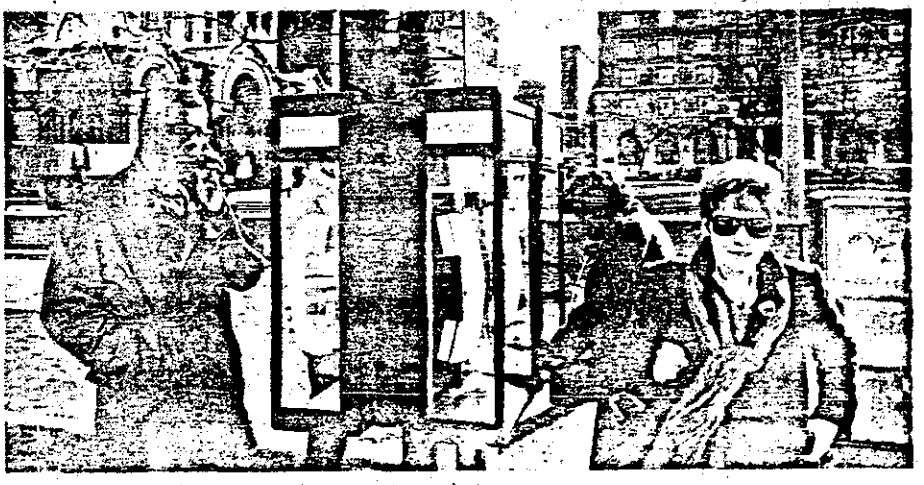
The other institution, the Microelectronics and Computer Technology Corporation (MCC), is an interesting experiment in its own right. Set up as a joint venture in 1983 by initially ten (now 21) rival American computer and semiconductor companies, MCC has 250 scientists carrying out research at its headquarters in Austin, Texas, to the tune of $75m a year. What is for sure, says Mr Bobby Inman, MCC's chief executive and former deputy director of the CIA, "MCC wouldn't have occurred except for MITI."

But the most orchestrated response of all to the Japanese challenge in computing comes not from IBM, Silicon Valley or collaborative consortia of American chip makers and computer firms. Though it is rarely in the public headlines, the Pentagon has been pouring barrels of cash into computing. Its Defence Advanced Research Projects Agency (DARPA) in Washington has been playing busy midwife to some of the most exotic technology of all for computers, communications and electronic equipment generally.

Its VHSIC (very high-speed integrated circuit) project alone has pumped $300m over the past five years into advanced methods for making the superchips needed for radar, missiles, code-breaking and futuristic computers. Also earmarked for DARPA is a reported $1 billion for sponsoring a range of supercomputers which, say insiders, "will outperform anything the Japanese can develop under their super-speed computing project or their fifth-generation programme."

At least a dozen "fifth-generation bashers" have surfaced as research projects around the United States, mainly in university laboratories, but also in small start-up companies founded by academics, entrepreneurs and engineering emigrés from the mainframe computer industry. The latest supercomputer to go public (the prototype was shipped last year to the American navy) is a cluster of boxes a yard square capable of calculating over a billion instructions per second (the Japanese government hopes to have a similar greyhound of a computer by 1992). The group that built it spun off mainly from nearby Massachusetts Institute of Technology to form their own company, Thinking Machines. The firm is now taking orders for a bigger brother with four times the processing power.

If only a handful of the score or so of American groups building advanced computers survives, the United States is going to enlarge its existing technology base in computing over the next decade by as much new engineering talent as its rivals have in totality. And that, not least for the Japanese, is a sobering thought.



# Reach out and crush someone

Even more than breakthroughs in telecommunications technology, America's new deregulated freedom to plug in, switch on and sell an information service is breeding a whole new generation of infopreneurs

Americans complain about it, but if truth be told they still have the best and cheapest telephone system in the world. Japan's is a good one too—about as good as the Bell System was in the late 1960s. Which means it is reliable and cheap when making calls within the country, but not particularly good at performing electronic tricks like automatic call-forwarding, call-waiting, short-code dialling, credit-card billing, conference calling—all things Bell users take for granted today.

Americans also take for granted the choice of being able to dial long-distance numbers using alternative carriers who offer cheaper rates. Liberating the phone system from the state monopoly's clutches (so customers may choose what they want instead of what they are given) has barely begun in Japan.

The United States is the world's dominant supplier as well as its most prolific user of telephone equipment. The global market, worth $57 billion in 1982, is

expected to grow to $83 billion by 1987. American manufacturers have 42% of it; Japanese firms 8-9%. But that has not prevented Japan from becoming a major exporter of telecoms products. It now sells well over $1 billion worth of telephone equipment abroad, a quarter of it even to the United States. How did that happen?

The main reason is the size of the American market itself. Though the American share of the global telecoms business is five times bigger than Japan's, practically all of it is at home. Some 90% of the domestic market is controlled by the mighty American Telephone and Telegraph ("Ma Bell"). GTE has 10% of the American market, while ITT has traditionally sold its telephone equipment almost exclusively abroad.

Until the deregulation of the American phone system in the wake of AT&T's 1982 consent decree, Ma Bell's manufacturing arm (Western Electric) directed its entire production effort at meeting just the needs of the various Bell phone companies around the country. It got all its inventions and designs from the legendary Bell Laboratories in New Jersey, and neither imported nor exported a single transistor.

Bell Labs has been responsible for a blizzard of innovations (transistor, laser, stored-program control, optical fibres, etc) that have driven down the real cost of communications and raised the quality and availability of telephone service throughout the United States. But because of AT&T's preoccupation in the past with just the domestic market, the best of its technology has had little direct impact on the rest of the world. The door to export sales was thus left ajar for telecoms suppliers elsewhere—from Europe (Siemens, Ericsson, Thomson, GEC and Philips), Canada (Northern Telecom and Mitel) and Japan (NEC, Oki, Fujitsu and Hitachi).

American firms retain their dominant position in supplying switching and transmission equipment. But the Japanese have mounted a serious challenge based on their growing expertise in transmitting messages on the backs of light beams. Made out of cheap silica instead of costly copper, optical fibres can carry three times the telephone traffic of conventional cables, need few repeater stations to boost the signals and send them on their way, are immune to electrical interference and do not corrode like metal wires.

The early American lead in fibre optics, built up by Western Electric and Corning Glass, has been chipped away by scientists at NEC, Sumitomo and Japan's telephone authority (NTT). Apart from learning how to manufacture low-loss fibres, Japanese companies have become superb at making the minute lasers, light-emitting diodes and minuscule receivers used for projecting and catching the messages.

Hand in glove with fibre optics is the growing trend towards digital transmission—sending spoken or picture messages coded as the ones and zeros of computerspeak. The transmission part is easy, but optical switching has presented horrendous headaches and the competition here is fierce.

But American makers have used their knowhow to better commercial ends. In particular, digital transmission has been used to speed the growth in data traffic between big computer systems, especially those owned by airlines, banks, insurance companies and financial institutions. Here, the Federal Communications Commission has taken the initiative, by freeing America's telecommunications networks so anyone can plug in, switch on and sell an information service. Other countries—Britain and West Germany particularly—have been inexplicably making life as difficult as possible for their own infopreneurs.

The lesson has not been wasted on telecommunications mandarins in Japan. They have seen how getting the government off the back of the telephone companies in America has spurred a vibrant free-for-all in "value-added networking", creating numerous jobs in information services and giving local manufacturers a headstart in carving out a piece of a brand new high-tech business for themselves.

This new communications freedom—even more than the changes in digital switching and new transmission technologies—is one of the key driving forces behind the merger between computing, office automation and telecommunications that is beginning to take place within the United States. Last year, computer maker IBM absorbed Rolm, a leading manufacturer of digital private-branch exchanges. At the same time the telephone giant, AT&T, broadened its growing base in computing and office equipment by buying 25% of Olivetti in Italy. The leader of the office-automation pack, Xerox, is still suffering from a surfeit of exotic technology dreamed up by engineering wizards at its PARC laboratories in California.

Japan has no intention of being left behind. The government in Tokyo is pressing on with its plan to privatise as much of its telecommunications services as possible. And while the big names of the Japanese telecoms business (Fujitsu, Hitachi, NEC and Oki) may have deficiencies of their own, each is nevertheless a big name in computing too. And though smaller, all are more horizontally integrated than AT&T, IBM or Xerox.

Will Japan close the technological gap in telecoms with America? Quite possibly. But only through setting up shop in the United States. The reason concerns one missing ingredient, now as essential in telecoms as in computing: ingenious software. Just as Motorola and Texas Instruments have built semiconductor factories in Japan to learn the secrets of quality and cost control, Japanese firms will have to establish telecoms plants in the United States if they are to acquire the necessary software skills. NEC has now done so—for precisely that reason.

# Getting smart

**Manufacturing is also going high-tech, threatening to turn today's dedicated factories full of automation into relics of the past**

Microchips, computers and telecoms equipment will be to the next quarter century what oil, steel and shipbuilding were to the years between Hiroshima and the Yom Kippur war. More than anything else, these three technologies will fuel the engine of economic growth in countries that learn to manage their "smart" machinery properly. This will hasten not so much the trend towards service jobs, but more the revitalisation of manufacturing itself.

Manufacturing? That grimy old metal-bashing business which the more prosperous have been quietly jettisoning for better-paid office jobs in the service sector? It is true that manufacturing jobs in all industrial countries (save Italy and Japan) have been shed continuously since 1973. In the United States, employment in manufacturing industry fell 2.5% last year to less than 20% of the civilian workforce.

But looking at jobs alone is misleading. In terms of manufacturing's contribution to GNP, for instance, little has changed. In fact, manufacturing's share of value added (at current prices) in America was 22% of GNP in both 1947 and 1984, and has wavered narrowly within the 20-25% band for close on 50 years. So much for de-industrialisation.

Manufacturing still means big business in anybody's book. It currently contributes $300 billion and 20m jobs to the American economy; about $350 billion (at today's exchange rate) and 15m jobs in Japan. But manufacturing is really a matter of how you define it. Traditional measures based on Standard Industrial

Classification codes continue to give the impression that making anything in a factory is going the same way as smokestack industry generally—up in smoke. Yet software engineering alone is an explosive new "manufacturing" industry that barely enters the American Treasury Department's calculations of growth, let alone its vision of what constitutes industry.

What is for sure is that the new battle in manufacturing competitiveness and productivity is going to be fought in the fields of process and design technology. Here is what Mr Daniel Roos of Massachusetts Institute of Technology has to say:

> Over the next 25 years, all over the world, semi-skilled labour—whether cheap or expensive—will rapidly give way to smart machinery as the key element in competitiveness. Neither cheap Korean labour nor expensive American labour is our real problem. Rather the challenge lies in rapidly introducing and perfecting the new generations of design and process equipment—and the complex social systems that must accompany them.

It does not require an MIT professor to explain why conventional manufacturing is limping out and new computerised forms of design and fabrication are muscling in. Using the favoured yardstick of productivity (return on investment after discounting for the current cost of money) even back-of-the-envelope calculations show only two factors really count. Energy costs are irrelevant, being typically 3-4% of factory costs. Much the same is true for labour, which now accounts for only 5-15% of total costs.

"The only significant, and controllable, factors are material costs and production volume", preaches Dr Bruce Merrifield of the American Department of Commerce. Thus, with roughly 30% of material costs being in inventory, a "just-in-time" delivery system (like the Japanese *kanban* method for supplying components to motor manufacturers) could improve the real return on investment by as much as 15%.



. . . to robots . . .



From smokestack . . .

Getting manufacturing volumes right is trickier. Here high technology is making the whole notion of the special-purpose factory—with its automated equipment purring smoothly along as it churns out millions of identical parts all made to the same high standard of precision—a relic of the smokestack past. The marketplace is much more competitive today, no longer accepting the 10-12 year product life cycles needed to justify the investment of such dedicated plants. The pace of technological change is demanding that manufactured goods be replaced every four or five years; in consumer electronics, every two or three years.

The Japanese factory devoted solely to turning out 10,000 video recorders a day with a handful of operators is the end of the line—not quite yet, but destined shortly to become, a magnificent anachronism and epitaph to the age of mass production. It was a brief and grimy era, spanning just the single lifetime from Henry Ford to Soichiro Toyoda. To take its place, a whole new concept of manufacturing is being hustled out of the laboratory and on to the factory floor. This is the final melding of microchips, computers, software, sensors and telecoms to become in themselves the cutting tools of manufacturing industry.

# The retooling of America

## Flexible make-anything factories are beginning to sprout across America, bringing back jobs that had slipped offshore

American engineers call it CIM. Computer-integrated manufacturing—hurried into the workplace by a kind of Caesarian section—has arrived before managers have had a chance to find out what they really want or are able to handle. The trouble—and there have been plenty of teething troubles—is that CIM has a grown-up job to do right now. To corporate America, it is the one remaining way of using the country's still considerable clout in high technology to claw back some of the manufacturing advantage Japan has gained through heavy investment, hard work and scrupulous attention to detail.

American companies began pouring big money into high-tech manufacturing around 1980. All told, firms in the United States spent less than $7 billion that year on computerised automation. Today they are spending annually $16 billion, mostly on more sophisticated CIM equipment. By 1990, investment in computer-integrated manufacturing will have doubled to $30 billion or more, forecasts Dataquest of San Jose, California.

General Motors has spent no less than $40 billion over the past five years on factories of the future. Even its suppliers are being hooked into GM's vast computerised information net, allowing them to swap data with the giant motor maker as a first step towards integrating them wholly within its CIM environment. IBM has been spending $3 billion a year on computerising its manufacturing processes. In so doing, it has been able to bring numerous jobs, previously done offshore, back into the United States. Pleased with the results so far, IBM has raised its investment in CIM to an annual $4 billion.

The heart of a CIM plant is a flexible manufacturing shop which can run 24

hours a day, but which is capable of being retooled in minutes rather than days, and able to turn out hundreds of different products instead of being dedicated to just one line. The difference between the best of traditional automation (for example, Toyota's Corolla line in Nagoya) and the best of new style CIM plants (for example, General Electric's household-appliance centre in Kentucky) is that the former automates just the flow of material through the factory, while the latter automates the total flow of information needed for managing the enterprise—from ordering the materials to paying the wages and shipping the finished goods out of the front door.

The aim of CIM is not simply to reduce the amount of direct labour involved in manufacturing a product (only 5-15% of the cost). The real savings come instead from applying strict computer and communications controls to slash the amount of waste (typically 30% of the cost) through having up-to-the-minute information on tool wear, while minimising the handling, management and overhead charges (rarely less than 40%) by knowing precisely where items are at any instant during the manufacturing process. The net result is that a CIM factory has a much lower breakeven point than a highly automated conventional plant. The majority of the CIM plants now onstream in the United States break even at half the level of a conventional plant (typically 65-70% of full capacity). And because it does not have to operate flat out from the start to be efficient, a CIM plant makes it easier and cheaper to launch new products. That spells shorter life cycles—and hence more frequent (and more attractive) model updates.

That would be reason enough for enterprising high-tech companies to invest in CIM. But a number of American corporations are being encouraged for other, more strategic, reasons to integrate their computerised manufacturing processes. The Pentagon sees CIM as a nifty way of allowing manufacturing capacity to be sprinkled lightly across the land, instead of being concentrated heavily in targeted areas along the Ohio Valley, parts of Illinois and up through Michigan.

The generals also see CIM plants—with their rapid response and flexible, make-anything nature—as handy standby capacity ready to be instantly reprogrammed to meet the military surge of a national emergency. Apart from its costly military stockpiles, the Pentagon has to underwrite a good deal of redundant and idle capacity among America's defence contractors. That is a political luxury it can no longer afford.

Pressure from other parts of Washington is also helping to usher high-tech



**. . . to CIM**

manufacturing into American factories. To government gurus like Dr Bruce Merrifield, the attraction of these flexible manufacturing plants is that they are ideal not just for industrial giants like General Electric, Westinghouse or IBM, but even more so for the tens of thousands of tiny workshops across the country. While Japan has two-thirds of its industrial output within the grasp of broad-based *keiretsu* manufacturing groups, American industry by contrast has always relied heavily on its 100,000 or so independent subcontracting firms. In metal working, for instance, 75% of the parts made in the United States are manufactured by small independent workshops in batches of 50 or less.

The American Commerce Department sees no antitrust reasons why smaller firms should not band together to share a flexible manufacturing centre, making spindles for washing machines one minute, wheel bearings the next, then switching to precision mounts for a microscope maker, crankshafts for diesel engines, microwave cavities for radar equipment, nose-cones for missiles and so on. This would reduce the investment risk for the individual firms, while providing a higher return for the CIM plant as a whole. It could also help rebuild much of the industrial base of rustbowl America.

# Let the daisies grow

**Bureaucratic guidance is still no match for a fertile economy where anything can take root and flower**

Who, then, is better suited to life on the high road of technology—America or Japan? The answer is complicated by the way the two industrial superpowers have honed their separate skills in wholly separate ways (table 3). American technology is overwhelming in big systems, software, computing and aerospace. But nobody can touch Japan in the process technologies that underlie conventional manufacturing. American technology reaches out for the unknown: Japan's bends down to tend the commonplace.

The differences in style mirror the differences in ideals that the two peoples hold dear. The Japanese have a saying: "The nail that stands up will be hammered flat." The Americans say: "Let the daisies grow." So it is hardly surprising that American technology is individualistic, often erratic and always iconoclastic. Japan's, if anything, is pragmatic, geared primarily to problem-solving and hustled along by a herd-instinct.

To date, Japan's high-tech success has been almost exclusively with developments that were predictable—like packing more and more circuits into dynamic RAM chips, or making video recorders smarter and smaller. This is a result of having total mastery of the process technologies. While all the basic breakthroughs for making semiconductors—electron beam lithography, ion implantation, plasma etching, etc—came from the United States, Japanese firms improved the ideas step by step until their equipment was a match for anything made abroad.

By carrying out development continu-

**Table 3: Balance of forces**

| Japanese strengths | American strengths |
|---|---|
| Applied research and development | Basic research |
| Incremental improvements | Breakthroughs and inventions |
| Commercial applications | Military applications |
| Process and production technology | New product design |
| Components | Systems integration |
| Hardware | Software |
| Predictable technologies | Less predictable technologies |
| Quality control | New functionalities |
| Miniaturisation | New architectural designs |
| Standardised, mass volume | Customisation |

Source: "The Positive Sum Strategy", National Academy Press, Washington DC, 1986

ously in small incremental steps (instead of the American way of great quantum leaps every decade or so). Japanese firms have been able to bombard customers with a barrage of new models offering yet better value, quality and reliability. American firms, by contrast, have traditionally made cosmetic improvements every few years, and then brought out complete model overhauls once a decade or so. That has made their products look long in the tooth, then suddenly change dramatically—often for the worse while design bugs and production wrinkles are sorted out.

American technology has also tended to be geared for use mainly at home (for example, telephone systems, motor cars). With its smaller domestic market, Japanese technology has been forced to look farther afield. The Stanford economist, Mr Daniel Okimoto, makes the point that though Japanese firms have excelled at technologies tied closely to commodities with huge export markets (for example, continuous casting in steel, emission-control for motor cars, optical coatings for camera lenses), lately they have begun to do well in technologies for domestic use too. Some examples include gamma interferon and Interleukin II in pharmaceuticals, digital switching and transmission in telecommunications. And with their breakthroughs in gallium arsenide semiconductors, optoelectronics, superceramics and composite materials, the Japanese have shown themselves selectively capable of innovating at the frontier of knowledge as well as anyone.

On the whole, however, Japanese firms have been less successful with technologies that are inherently complex, not particularly predictable and dependent upon ideas springing from basic research. Making jet engines is one such technology. Designing air-traffic-control radars is another. Developing computer-aided design and manufacturing systems is a third. And despite MITI's "targeting" of lasers as a technology to be conquered, little progress has been made here to date—because not enough basic research has been done in the necessary branch of physics.

Such incidents point to serious problems in Japan's educational system. While Japanese youngsters out-perform western school children in all meaningful tests of mathematics and science, their training stresses rote learning rather than critical analysis and creative synthesis. At university, their skills in problem-solving are enhanced at the expense of their abilities to conceptualise.

As faculty members, Japanese academics are civil servants unable to fraternise as paid consultants in industry during the summer vacation. So Japan has none of the cross-fertilisation between basic research and commercial development that characterises MIT and Route 128, Stanford and Silicon Valley and a hundred other campuses across America. Also, because all the leading universities in Japan are state-owned and run rigidly by a conservative central bureaucracy, it is difficult to allocate grants (by peer-review) to the most deserving researchers rather than the most senior.

In the days when Japan could storm the

## Lift-off for the airborne economy

Forget about America's underground economy of do-it-yourselfers pushing hamburger carts, paint brushes and illicit drugs. Above the conventional economy, a star-spangled wealth launcher lifted off three or four years ago—to take advantage of the soaring power and plummeting cost of microchips, the breakup of the geriatric telephone monopoly, the chimera of President Reagan's space shield and, above all, the technological collision of computing, communications and office automation. Meet America's exciting new airborne economy.

The first thing to understand is that nobody is quite sure how well even America's conventional economy is performing, let alone its underground or overground components. The only items reported properly seem to be imports and unemployment. The trouble is that the economy is changing so fast—from old-fangled businesses based on metal bashing and carting things around to new-fangled ones that massage, transmit and memorise scraps of information. What is for sure, the leading economic indicators—those monthly headlines that send shockwaves around the world's financial markets—seriously underestimate some of the most important growth sectors within the United States.

Because the statistics have not kept pace with the way American business is becoming internationalised, computerised and more service-oriented, the picture the statisticians paint depicts an economic landscape of a decade or two ago. Here are some examples of lagging statistical response:

- Companies are classified by industrial sectors using definitions last updated in 1972.
- Twenty years after computers swept manual accounting into the dustbin, the first price index for computers has just been introduced—and is still incomplete. Where America's computing costs have been assumed to be fixed, henceforth they will be deemed to fall (as they have actually been doing) by at least 14% a year—adding nearly 1% to GNP.
- An archaic processing system for logging foreign trade, confronted with a 90% increase in imports over the past decade, is ignoring America's growth in foreign sales. A significant proportion (some say 15-20%) of American exports now goes unreported.
- Measures of family income, designed in an age when welfare was a dirty word, omit non-cash components such as company fringe benefits for professionals (pension rights, deferred income plans, health and life insurance, etc) and in-kind government assistance for the poor (food stamps, rent subsidies, etc).
- Poverty is still defined by consumption patterns of the mid-1950s, when a family of three spent a third of its income on food. The same food basket today costs a fifth the equivalent family's income.

Don't snigger. Despite budgetary cuts, the American statistical system is still one of the best in the world. Its only real weakness is that—employment figures aside—the statistics used for determining, say, GNP or growth tend to be by-products of non-statistical agencies (such as the Internal Revenue Service, the Customs Service, Medicare and the Department of Agriculture). As such, they are far from being as clean, complete or timely as the experts would like.

Consider some recent anomalies caused by the quickening pace of technological change. With 70% of Americans being employed in the service sector, you might be tempted to categorise the United States as essentially a service-based economy. It is. But you would not think so from the Standard Industrial Classification (SIC) used in generating the input-output tables for measuring GNP. This has 140 three-digit codes for manufacturing firms, only 66 for services. Moreover, since the SIC system was last revised in 1972, whole new business activities (for example, video rental, computer retailing, software retailing, discount broking, factory-owned retail outlets) have sprung up, while others have withered away.

Nuts and bolts, for instance, are in an SIC category all of their own, employing a grand total of just 46,000 people. Envelope makers, again with their own SIC category, provide fewer than 25,000 jobs. Yet one SIC code in the service sector alone, general medical and surgical hospitals, now covers some 2.3m people. Lots of high-tech service businesses—including computer stores and software publishers and manufacturers—do not even qualify for their own SIC codes yet.

There is no reason why all SIC categories should be the same size. But the imbalance exaggerates the importance of traditional manufacturing at the expense of services in the American economy. Above all, it allows whole sections of America's booming high-tech economy to go unreported.

## Back to the future

A glimpse or two at the future will dispel any doubts about Yankee ingenuity as it probes the limits of tomorrow's technology. First, to Silicon Valley where Mr Alan Kay, refugee from such technological hotbeds as DARPA, Stanford, Xerox PARC and Atari, is nowadays visionary-at-large at Apple Computer. Building on the learning theories of John Dewey and Jean Piaget, Mr Kay is trying to create a "fantasy amplifier"—a computer with enough power to outrace the user's senses, enough memory to store library loads of reference material, and enough clever software to couple man's natural desire for exploring fantasies with his innate ability to learn from experiment.

The concept, called "Dynabook", combines the seductive power of both a video game and a graffiti artist's spray-can with the cultural resources of a library, museum, art gallery and concert hall combined. Difficult to make? You bet, especially if the whole gizmo has to fit in a package no bigger than a notepad and be cheap enough for every schoolkid to own.

Smalltalk is the computer language Mr Kay has developed to allow kids to converse with the fantasy amplifier. The rest of the ingredients are all technologically imaginable, just prohibitively expensive and unwieldy for the time being. But a decade ago the first personal computer was just being built at considerable expense. Its functional equivalent today costs less than $50. Still only in his mid-40s, Mr Kay has ample time to put a Dynabook in the hands of millions of youngsters with open minds and a sense of wonder still intact.

Next, meet Mr Ted Nelson, gadfly, prophet and self-confessed computer crackpot, with a lifetime's obsession wrapped up in an enormous program called (after Coleridge's unfinished poem) Xanadu. Boon or boondoggle, nobody is quite sure. But the giant piece of software for steering one's own thought processes (including alternative paths, mental backtracks and intellectual leaps) is hardly lacking in ambition or vision.

Conceived originally by Mr Nelson while a student at Harvard as simply a note-keeping program for preserving his every thought, Xanadu has evolved into a total literary process: creating ideas; organising the thoughts, with traces showing backtracks, alternative versions and jumps to cross-referenced documents; manipulating the text; publishing the results; and logging a share of the royalties to every other author cited.

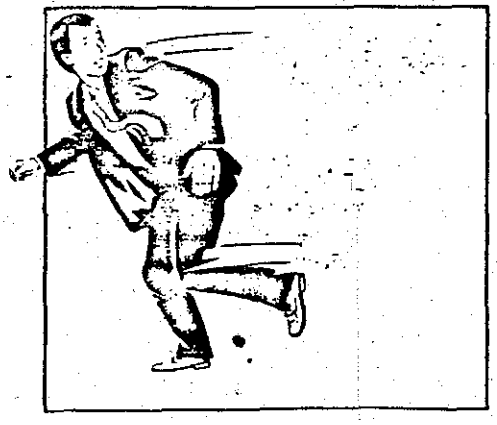
Every document in Xanadu's database has links to its intellectual antecedents and to others covering related topics. The linked references work like footnotes, except that Xanadu offers an electronic "window" through which they can be accessed there and then. Because the whole process works in a non-sequential way, the inventor calls the output "hypertext".

Mr Nelson looks forward to the day when anybody can create what he or she wants—from recipes to research papers, sonnets to songs—and put it into Xanadu's database and quote or cite anybody else. Royalties and sub-royalties, monitored automatically by the host computer, would be paid according to the amount of time a user was on-line and reading a specific document. It sounds pretty wild at the moment, but hypertext could be commonplace before the century is out.

industrial heights with foreign licences, homegrown development and production excellence, the inadequacies of its educational system and academic research hardly mattered. But such shortcomings are becoming increasingly a problem as high-tech competition intensifies.

Nor can Japan call on its little firms to provide the invigorating fillip of innovation such enterprises provide in the United States. And with their lifetime employment practices, Japan's big technology-based corporations rarely get a chance to attract high-flying talent from outside. Technological diffusion between small firms and large corporations, and between companies generally as engineers swap jobs, is one of the more invigorating forces for innovation in the United States.

Nor, also, is there an adequate way in Japan for financing risky innovation outside the big corporations. Since 1978, American equity markets have raised $8 billion for start-ups in electronics alone and a further $3.3 billion for new biotech companies. Over the same period, Japan's venture-capital investments in high-tech have totalled just $100m.



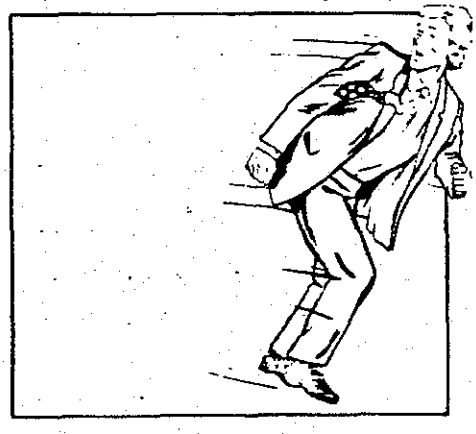
Lacking all these things, the Japanese have sought a substitute. This is one of the main reasons for MITI's special emphasis on collaborative research projects—as in VLSI or fifth-generation computers. To Mr Gary Saxonhouse of the University of Michigan, Japan's lauded industrial policies are little more than a substitute for the ingredients that American companies enjoy from their vibrant capital and labour markets.

As for MITI's infamous industrial targeting, many Japanese (as well as foreigners) have long doubted its effectiveness and believe it is now wholly inappropriate anyway. All technologies have started moving simply too fast to wait upon the whim of bickering bureaucrats. It is not as though Japanese civil servants have shown themselves any better at picking industrial winners than officials elsewhere; and none has bettered the invisible hand of the marketplace.

Apart from possessing vastly greater resources of well-trained brains, more diverse and flexible forms of finance, and a bigger and more acquisitive domestic market, America has one final, decisive factor moving in its favour—the pace of innovation itself.

High-tech products tend to have two things in common: they fall in price rapidly as production builds up (they possess steep learning curves) and they get replaced fairly frequently (they have short life cycles). The trend in high-tech is towards things becoming steeper and shorter. So the competitive advantage of being first to market is going increasingly to outweigh almost everything else.

This spells an end to the traditional low-risk, low-cost approach that Japanese companies have used so successfully to date—coming in second with massive volume and forward prices after others have primed the market. Henceforth, Japanese firms are going to have to take the same technological risks—and pay the same financial penalties—as everyone else. And that puts the advantage decidedly on the side of Yankee ingenuity.



*Robert H. Goldberg*

# False Economy On Drugs

WASH. POST

The debate in Congress over prescription drugs has focused largely on cost-saving issues: coverage, copays and competition. But more important questions have been overlooked: Will the new drug coverage pay for the best medicines available to seniors, and what will happen to the overall Medicare budget if it does?

The perceived wisdom underlying congressional debate has been that giving physicians freedom to choose the best medicines for their patients (including the newest medicines) is in conflict with the imperative to rein in Medicare spending. Everyone seems to assume that any coverage plan that pays for the newest medicines will break the bank. This assumption is badly flawed. Years of research indicate that using newer drugs and allowing doctors to choose and mix the medicines that are right for their patients is generally better for patients and costs less in the long run than the kind of bureaucratic cost containment strategies Congress is contemplating. Both seniors and Medicare's ultimate financial solvency would be better served if Congress stopped trying to reduce the Medicare drug budget through the use of restrictive formularies and generic substitution and instead adopted a policy of reimbursing for the drugs a physician believes are medically necessary.

Standard cost containment practice these days is to substitute old medicines for new, or to allow patients to "fail" on cheap drugs before trying a higher-priced one. Private insurers and state governments are rushing to adopt formularies—a list of preferred drugs that forces patients to pay more out of pocket for the newer, more expensive drugs. Notably, both the House and Senate prescription drug bills would strongly encourage the use of generic medications.

with that of patient health often have the unintended consequence of making people feel worse, not better. And sick patients who can't get the drugs they need are forced to use other parts of the health care system, driving up total costs in the end.

Take, for example, the approach used by the Department of Veterans Affairs to contain drug costs. The VA implemented a policy that requires schizophrenics to "fail first" on the cheaper drug before being allowed to use the one that works. This policy was developed not in response to published guidelines or best practices or to the needs of individual veterans but in an effort to cut drug costs. But "fail-first" was found to drive up the total treatment costs of people who needed not the cheapest medicine but the one that was right for them.

Similarly, a small study of the VA's efforts to switch patients to the cheapest ulcer drugs found that patients who "failed" were sicker and cost more to treat than those who were able to stay on their more expensive medicine.

These findings have been replicated in studies focusing on seniors. A 1996 study of 13,000 patients from six HMOs conducted by Dr. Susan Horn found that the more restrictive the limits on drugs, the more patients used other, more expensive services such as emergency rooms, hospitals and doctor visits. Horn's research also shows that limiting access to new drugs simply because they are new drives up total costs and increases sickness, while increasing access to new drugs does exactly the opposite. When she looked at the relationship between use of new drugs and total spending on specific illnesses, she found that a 10 percent increase in use of the newest asthma medications was associated with a $72.31 decrease in overall annual drug costs per patient and a 1 percent decrease in doctor visits per patient. Meanwhile, greater use of older asthma technology was associated with a $41.59 *increase* in total drug costs and about a 1 percent increase in office visits.

prescription drugs than we do. But at the same time they are substituting cheaper medicines and restricting access to newer ones at an accelerating pace. The impact has been twofold: increasing rates of suboptimal care for chronic illnesses, which translate into more hospitalization and doctor visits for these diseases, and a decline in discovery of new drugs as the "market" for new medicines evaporates. Americans can avoid this fate by giving seniors and doctors in Medicare more freedom and more dollars to spend on the best medicines for them now and the next generation of medicines in the future.

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*The writer is director of the Manhattan Institute's Center for Medical Progress.*

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**TELEFAX CONTROL SHEET**

**SENT TO:** HOWARD BREMER

**DATE SENT:** 9/16/03

**SUBJECT:** Hearings + News Art.

**No. of pages (including this cover sheet):** 5

**FROM:** Norm Latker

**Remarks:** Howard
Stuff we discussed

N.

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## Washington Merry-go-Round

# U.S. has tariffs beef with Japan

By JACK ANDERSON

WASHINGTON — Two influential Texas Democrats, silver-haired Sen. Lloyd Bentson and silver-tongued trade troubleshooter Bob Strauss, were arguing recently about the multibillion-dollar licking American businessmen are taking from their Japanese counterparts.

The senator, concerned for his cattle-raising constituents, complained to Strauss that the Carter administration was letting the Japanese get away with murderous tariffs on American beef. This has pushed the price of sirloin steak as high as $45 a pound in Japan. The current trade negotiations, said Strauss a bit defensively, "are a step in the right direction and I'm not going to say any more than that."

The normally mild-mannered Bentson was moved to sarcasm by Strauss' claim. The slight increase in the shipments of American beef to Japan, Benston said, merely means that the Japanese have increased their per-capita beef consumption from "a thin patty to a quarter-pounder."

The Texas senator's disgust reflects a growing concern in Congress that the Japanese are winning their biggest victory over the United States since Pearl Harbor.

While the Japanese government's protectionist policies put the cost of imported oranges at a dollar each and push American beef toward the price range of caviar, Japanese manufacturers have no trouble undercutting American automobile and television makers in this country.

We now import $11.6 billion more in goods from Japan than we export in a year, a situation that costs thousands of American jobs, adds fuel to inflation and drives the dollar's value down. A confidential memo prepared by the staff of the congressional Joint Economic Committee pin-



ANDERSON

points the cause as far as trade with Japan is concerned.

"Japanese barriers to U.S. exports is one case where there is more fire than smoke," the memo states. The committee staff suggests that an upcoming congressional investigation may prove to be so "inflammatory" that it may "fuel the growing mood of protectionism in the country and the Congress."

For example, the eyes-only study shows that the Japanese government's grain-buying agency charges buyers of imported grain twice the actual import price, while American cigarettes receive a 500 percent markup.

And while Datsun and Toyota are treated just like any other auto makers in the United States, American manufacturers run into all sorts of difficulties trying to sell their cars in Japan.

Two years ago, the secret report notes, American firms scored a major production breakthrough of phosphate fertilizers, widely used in Japan. But the Japanese Ministry of International Trade and Investment began, "informally asking major Japanese customers to buy Japanese," the report states. The U.S. firms subsequently lost about 30 percent of their business in Japan.

The Japanese set tariffs on high-technology products at triple the rates charged by other free-trading nations, while encouraging their own manufacturers to organize monopolistic cartels for research and production of this badly needed equipment.

Already worried about bad publicity in this country, the Japanese have hired dozens of high-powered agents, including former CIA Director William Colby, to help influence public opinion in hopes that nothing will be done to bring the one-sided profiteering to an end.

The Japanese aren't overlooking the American media, either. Costly junkets and other freebies are arranged for American reporters; newsmen who might be expected to write favorable stories are given red-carpet treatment, while those who might be critical find it hard to get interviews with top officials.

One veteran correspondent told our associates Jack Mitchell and Les Whitten that some American reporters in Japan are actually getting payoffs from the Japanese government in return for sympathetic stories.

## Mailbag

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# The fading guidelines

The Carter Administration may maintain a brave face in public, but in its strategy sessions it should recognize the fact that its wage-price guidelines program is coming to pieces. It would be better for the Administration to write off the whole unfortunate experiment as a failure than to try to keep up the pretense of effectiveness.

The guidelines, of course, have never been more than window dressing. The real hope of stopping inflation lies in fiscal and monetary discipline—in a shrinking federal deficit and strict limits on the growth of money supply. But even as window dressing, the wage-price control program has lost conviction. The breathtaking rise of 1.3% in wholesale prices in January inevitably will work through the chain and emerge as double-digit inflation at the consumer level. The big unions that will negotiate major agreements this year—the Rubber Workers and the Teamsters, for instance—will want to make up for what inflation has cost them before they begin talking about the 7% raises the guidelines prescribe (page 22).

At this point, the Administration will be under mounting pressure to do one of two things: Either make the controls compulsory or relax the wage guideline to permit increases that match the rate of inflation. The President should firmly reject both choices.

Mandatory controls do not work for more than a short time. They can check the wage-price spiral briefly, but in doing so they create distortions in the market and continuing misallocations of resources. The result is shortages, black markets, and, eventually, an inflationary explosion.

Bending the guidelines to accommodate higher wage increases would make the control apparatus part of the inflation process. It would give the Administration's blessing to wage increases that are bound to keep the wage-price spiral spinning.

Before taking either step, the Administration should acknowledge that the control program is one more failure in the long history of attempts to stop inflation by dealing with symptoms rather than causes.

# Japan's money machine

Japan has been an eager participant in the five years of negotiations among the world's major trading nations that finally have produced a package of liberalizing agreements. But now that the negotiators are nearly ready to bring their codes home for ratification, the Japanese are still trying to exclude key government agencies from the new rules.

Perhaps the most crucial test of Japan's good faith in these negotiations will be whether or not it agrees to allow free international bidding on purchases by Nippon Telegraph & Telephone Public Corp. and by roughly 140 other Japanese government-controlled corporations. The combined budget of these operations comes to about half the size of the Japanese government's total national budget of $170 billion. NTT alone controls directly and indirectly about $2 billion worth of procurement.

The agreement calls for open international bidding procedures in government procurement. But, says Japan, it has not yet been determined that NTT's buying falls in that category.

This is just one more example of the way Japan has used interrelated companies and nontariff barriers to shut its markets to imports. U. S. producers who have tried to sell in Japan have encountered taxes, testing requirements, licensing, and a wide variety of other regulations that shut the door to U. S. goods. Meanwhile, Japan runs enormous trade surpluses that have been one of the reasons for the decline of the dollar.

NTT has always followed a rigid "buy Japanese" policy. Recently, a subcommittee of the House Ways & Means Committee singled out the company as a flagrant example. NTT, the subcommittee remarked, "does not appear to have any awareness of the incredibly serious trade problems between our two nations or that NTT procurement policies are one of the sorest points in our bilateral trade. . . ." This is an issue on which the U. S. should make no concessions.

# Chicken Little says

The Energy Dept. that Secretary James Schlesinger has built seems to believe that the way to solve a problem is to dramatize it. Predictably, its reaction to the relatively small shortfall in oil supplies, caused by the Iranian revolution, was to talk of an "oil crisis" and forecast gasless Sundays.

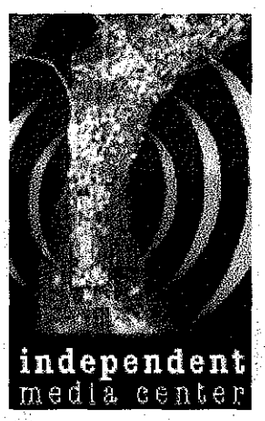
Doomsday forecasting is a good way to get attention, as Chicken Little demonstrated when he declared that the sky was falling. But a Cabinet officer who demands attention should be prepared to make constructive use of it, and Schlesinger's thinking apparently did not extend that far.

And so the net effect of the dramatics was to start a modest wave of hoarding. So far, it has not had serious effects on supplies because not many consumers seem to take Schlesinger seriously. But with enough encouragement from the Energy Dept., it could become a panic.

Actually, the loss of Iran's production is not comparable to the 1973 embargo, although Schlesinger does not seem to see a difference. The 1973 cutoff was abrupt and deep. It was accompanied by a quadrupling in prices, a violently disruptive move.

The Iranian shortage is troublesome mainly because the U. S. did not let domestic prices adjust to the new world price. The easiest response to Iran's shutdown would be to let the open market determine the price, but the U. S. cannot do this now, because the switch from a controlled price to a free price would be too inflationary for the economy to take at this time.

There are things the Energy Dept. could be doing—such as shifting consumers from oil to natural gas and encouraging the development of small increments of new supply. It should be doing them instead of crying havoc.

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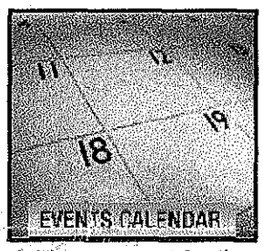


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## UW-Madison Doles Out Dubious Degrees

by Charlie Van Hise *8:00am Thu May 16 '02* (Modified on 9:34pm Wed Aug 21 '02)
phone: 262-9036

UW-Madison's 2002 graduation ceremony includes two rather dubious honorary degree awards to apologists for university privatization and corporate globalization.

While many students, friends, and relatives should be justifiably proud of the diplomas they will be lining up to receive this coming graduation weekend, there are a few more dubious degrees being doled out by UW-Madison, as well.

Many may recall that last year's ceremony was marred by the keynote speech of Charlene Barshefsky, former U.S. Trade Representative under Pres. Clinton and chief apologist for such undemocratic free trade regimes as the World Trade Organization (WTO). Even as she gave another tired university-sanctioned plea for everyone to just jump on the corporate globalization bandwagon, UW graduates were facing a harsh economic future with unprecedented downsizing, slashed benefit packages and blatant union busting statewide. Thanks to NAFTA alone, Wisconsin has lost over 19,000 jobs since 1994 as companies shut down and relocated elsewhere in this race to the bottom.

This year UW-Madison has once again found it fit to honor not one – but two - technocratic architects of university privatization and corporate globalization. Among those receiving special honorary degrees on Fri. May 17th at 5:30 pm in the Kohl Center are Norman J. Latker and David S. Ruder.

Mr. Latker is probably most infamous for his role in crafting the Bayh-Dohl Act. Passed in 1980, this federal legislation allows universities to patent and then sell-off the results of public research to private interests. UW-Madison now ranks among the top ten in terms of royalty income, exceeding $20+ million per year. UW has also become rather fond of boasting about its numerous spin-off corporations – such as Middleton-based Gala Designs where genetically engineered dairy cows are being forced to crank out pharmaceutical products in their milk. A recent survey of U.S. industrial patents found that over 73% were largely

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**Prolefeed Studios**
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**PR Watch**
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**Forest Conservation Portal**
Nexus of information dedicated to the "age of ecological restoration"

**Rainbow Bookstore Cooperative**
A source for left-leaning literature

**The Whitebreads**
A locally produced comic strip lampooning the affluent American lifestyle

**System P**
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**John Nichols on Indymedia**

derived from work done at taxpayer expense at institutions like UW-Madison. Corporations get their own federal tax breaks – to the tune of $2+ billion per year - for giving kick-backs in the form of research "donations" to the same universities from which they later leverage lucrative results. One sure hopes Mr.Latker has gotten his fair share of the cream off the top of all this public largesse over the years.

As for Mr. Ruder, he's working diligently to tweak the legal standards in favor of U.S. corporations in the era of cutthroat global competition. He was chair of the Security and Exchange Commission under Reagan/Bush from 1987-1989 when the SEC ran interference on behalf of U.S. corporations facing domestic pressure for propping up the South African apartheid regime and other heinous dictatorships. Ruder has since moved on to become a law prof. at Northwestern and president of the Corporate Counsel Center. In case any budding profiteers want to capture pearls of wisdom straight from his lips, they should ante up $850 each to attend the 40th Annual Corporate Counsel Institute. The two day session includes several workshops addressing such vexing corporate issues as: "Mergers and Acquisitions," "Intellectual Property," and "What to do when the Press Calls." When not greasing the skids for private interests in the global capital markets, Mr. Ruder is greasing palms for the UW Law School, having raised $6.6 million for the newly remodeled "aircraft hanger" on Bascom Hall.

Mr. Latker and Mr. Ruder definitely deserve some sort of recognition for enabling such amazingly irresponsible mercenary behavior - maybe a delicious pie in the face?

add your own comments

**Can Van Hise bake pies as well as facts?**
by Richard Latker *9:34pm Wed Aug 21 '02*
address: Lot 1, DD228, Fei Ngo Shan, Hong Kong pristine@asia.com

Dear Indymedia:

I've only now come across your May 16, 2002 article "UW-Madison Doles Out Dubious Degrees." I know it's rather late for a reply. Still, the writer did have it wrong, and I'd appreciate the chance to set the record straight.

Thanks & regards,
Richard Latker

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I share Charlie Van Hise's suspicion of the 1980 Bayh-Dole Act, of which my father, Norman Latker, was a key architect (UW-Madison Doles Out Dubious Degrees, May 16, 2002). It was a

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fundamental rightward shift in intellectual property policy that, while perhaps bringing new drugs to market more quickly, has ultimately served to bolster corporate control over academia and erode research independence at state universities. The issue has prompted spirited disagreements between my father and I for many years.

Accusing my father of "amazingly irresponsible mercenary behavior" is quite ridiculous, however. And assuming that he has "gotten his fair share of the cream off the top", would be just plain wrong. What he did get was *fired*. His boss at the time--Secretary of Health, Education and Welfare (HEW) Joseph Califano—was a bitter opponent of the bill. Mr. Califano wasted no time in terminating my father's employment once it became clear that the latter was the intellectual force behind the legislation. While he became something of a Republican cause celebre, it was quite some time before my father was once again gainfully employed. Our family lived on government severance pay and, when that ran out, my mother's modest salary as government biological scientist.

Just before the bill came to a vote in 1980, Califano himself was fired by President Jimmy Carter, and my father reinstated for a time. But he was never employed or compensated by the giant agro-chem and pharmaceutical corporations that so vastly benefited from his efforts. While my father has received a handsome collection of awards and certificates over the years for his efforts on Bayh-Dole, he has never shared in the corporate spoils. No kickbacks, no stock options and no briefcases full of cash.

What had motivated my father, then a civil-servant patent attorney in HEW, to assist Senators Birch Bayh (D) and Robert Dole (R) in redrafting the country's patent legislation was not a desire to empower Monsanto or Genentech. It was a libertarian-inspired frustration that medical advances developed in universities were not finding their way to market, due to federal government lethargy in disseminating the intellectual property it controlled. HEW was sitting on a mound of unutilised advances in drugs and medical technology that it "owned" by virtue of the fact that federal funds had supported a portion of the initial research. Senator Bayh, one of the country's more liberal legislators at the time, had personal reasons to move the bill through congress: his wife was dying of cancer. He stated publicly that the sluggish pharmaceutical development pipeline had reduced treatment options for her.

Both Senator Bayh and my father believed that they were empowering universities—not corporations—by giving them

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vermont

commercial control over the innovations they developed. An obvious majority of research scholars at the time supported the bill, too. Few envisioned how corporations would use the new legislation to leverage control over academic research in public institutions. Nor did they really appreciate the deleterious effect the bill would have on American agriculture.

My father, who voted for Nader in 2000, nowadays spends his time picking hopeless fights with nasty suburban property developers. He might even enjoy the pie in the face you prescribe for him, if it tasted good and was delivered in a spirit of democratic debate. He takes attacks on his political legacy in good cheer. But to demonize him as a greed-driven "mercenary" when you are not acquainted with the facts is mean-spirited, and undermines the credibility of your argument.

Richard Latker
(former state secretary of the Wisconsin Labor-Farm Party, a convenor of the UW-Greens in 1987, and occassional all-night production editor at the Madison Insurgent)

ps: an aside --- (One of the few politicians at the time who did understand the ramifications of the Bayh-Dole legislation was Wisconsin congressional representative Robert Kastenmeier, who alienated core academic supporters at UW-Madison with his opposition to the bill. His arguments were spot on. Unfortunately, rather than speak out against the very corporate influence he had predicted would emerge, Kastenmeier began pandering to university corporate donors in the mid-1980s at the expense of his Dane family farm/Madison Left constituency. His muddled stance contributed to his defeat in 1990.)

pss: note spelling of Robert Dole (not "Dohl").

**Norman Latker**

**From:** Latker, Carole (NIH/NIGMS) [LATKERC@nigms.nih.gov]
**Sent:** Wednesday, December 08, 2004 10:08 AM
**To:** Norman Latker
**Subject:** FYI

*The Washington Fax*

December 8, 2004

# Academic research produced more patents, yet fewer startups, AUTM survey reports

Universities and research institutions produced more commercially viable innovations and signed more licensing agreements with business in FY 2003 than in previous years, a survey shows.

The Association of University Technology Managers released its 2003 licensing survey Nov. 30. AUTM began asking its members about their tech transfer activities in 1991. One-hundred ninety-eight U.S. universities, research institutions, teaching hospitals and tech investment firms responded to the current survey.

Tech transfer has been growing since the passage of the Bayh-Dole Act in 1980, allowing academic institutions to license their discoveries to business. For 2003, 195 institutions reported creating 4,516 new licenses, adding to the 25,979 licenses already in effect. This activity yielded $1.310 billion in income, up 6.1% from FY 2002.

One-hundred thirty institutions reported introducing 472 new commercial products to the marketplace in fiscal year 2003 under license agreements with commercial partners. While the number of new products is down 13.1% from 2002, the $1.125 billion earned in royalties from product sales tops the 2002 figure by 14.5%. These products run the gamut from neonatal care drugs to a technology that improves accuracy in weather forecasting.

However, these figures continue to be dwarfed by research expenditures. Survey participants reported spending $38.525 billion on research in 2003, up 10.1% from the previous year. Of these funds, $25.501 billion came from federal grants and $2.857 billion was provided by industry. The rest was contributed by the institutions themselves.

Accordingly, the institutions that reap the most rewards from tech transfer are the ones that spend the most on research. The University of California system was the top earner in FY 2003, with about $61 million gross income. The UC system also spent more on research than any other institution, about $2.6 billion. Johns Hopkins University, the Massachusetts Institute of Technology, the University of Illinois system, and the University of Washington round out the top five in terms of income and research funding.

The investment in research has paid off in terms of new patents. The FY 2003 survey reports that 7,921 patent applications were filed by 194 institutions, up 8.2% from the previous year. One-hundred ninety-five institutions reported receiving 3,933 patents, an increase of 12.3% over 2002 that reverses two years of declining numbers of patents issued.

The majority of licenses executed in 2003 were in accordance with the Bay-Dole Act's provision that most discoveries should be licensed with small companies. Startup companies received 12.9% of the licenses, 52.5% were with existing small companies and 34.5% were with large companies (those that employ more than 500 people).

Fewer exclusive licenses were executed in 2003 than in the previous year; 44.9% were exclusive licenses, down from 45.9% in 2002. The balance, 55.1%, comprises nonexclusive licenses. Small companies garnered 8% more exclusive licenses than large companies. The number of exclusive licenses with large companies has declined over recent years, but rebounded in 2003.

The vast majority of licenses with startup companies are exclusive. This share has remained at around 94% throughout the 13 years in which AUTM has conducted the survey, because startup companies have historically been the first to embrace new technologies and assume the risk of developing them.

Licenses produced in 2003 earned more in total; the revenue earned from the 2003 licenses totaled $1.419 billion compared to the $1.304 billion earned in 2002. However, the rate of income from active licenses is slightly down from 2002. These agreements yielded income 41.3% of the time in 2003, 0.3 percentage points down from the previous year.

While royalty income continued to climb, very few individual licenses bring in large amounts of income. Only 59 of responding institutions reported that any one license earned more than $1 million. This is only 1.4% of total licenses that yield income, or 151 licenses. Accordingly, royalties account for less than 3% of funds for research.

Additionally there has been slower growth in university spin-off startup companies in the past few years. The number of new startup companies is down 6.7% since 2002, with 374 new companies created this year. Venture capital investments have been in decline since 2000 and have experienced only an uptick since early 2004; this was not included in this year's survey.

-- Molly Laas

The AUTM Licensing Survey: 2003 is available at

Carole

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## TELEFAX CONTROL SHEET

**SENT TO:** Beth Berman

**DATE SENT:** 1/13/05

**SUBJECT:** Consent forms

**No. of pages (including this cover sheet):** 3

**FROM:** Norm Latker

**Remarks:** As Requested

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This confidential facsimile message is intended only for the individual entity named above, and may contain information that is privileged and exempt from disclosure under applicable law. If you, the reader of this message, are not the intended recipient, or the employee or agent responsible for delivering this message to the intended recipient, you are hereby notified that you should not copy this facsimile or distribute it to anyone other than the intended recipient. In addition, if you have received this telecopy in error, please immediately notify us by telephone or telefax and return the original message to us at the address above via the United States Postal Service. Finally, if it would not inconvenience you, we would appreciate it if you would first refax this message to the intended recipient. Thank you.

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DEPARTMENT OF SOCIOLOGY
410 BARROWS HALL, MC: #1980
BERKELEY, CA 94720-1980

(510) 642-4766 FAX: (510) 642-0659

Web Site: http://sociology.berkeley.edu

My name is Elizabeth Popp Berman and I am a PhD candidate in the Department of Sociology at the University of California, Berkeley. I would like to invite you to take part in my study of the changing economic role of the research university over the past forty years.

If you agree to take part in my research, you will be asked to participate in an interview, lasting about sixty to ninety minutes, at a time and place of your choosing. I want to learn more about your experiences participating in, administering, and/or observing research activity within universities and your general understanding of how the university's economic role has changed over time. In particular, I want to learn more about how federal funding agencies, technology transfer activity, and the biotechnology industry have affected how research universities work. With your permission, the interview will be audiotaped. I may ask to contact you by email, telephone, or mail if I have any follow-up questions.

All of the information that I obtain from you during the interview will be kept confidential. Your name and other identifying information about you will not be used in any reports of the research without your additional consent on this form. I will store the tape recording and related notes in a locked file, and any related electronic data will be password-protected. Each person interviewed will have his or her own code number so that there will be no name associated with the interview. The key to the code of names will be kept in a separate location.

After this research is completed, I may save the tape recordings and my notes for use in future research by myself. I may want to use some of the information in public presentations of the research. There is a Records Release Form attached that outlines several possible uses for the tapes and asks for specific consent to use these items in each way. If you agree to allow these items to be used after this research study is over, please read and initial and sign that form as well. I will not use the tapes or other identifiable information about you in any future presentation without your consent.

There are no known risks to you from taking part in this research, and no foreseeable direct benefit to you either. However, it is hoped that this study will deepen our understanding of universities so that they can be managed as well as possible.

Your participation in this research is voluntary. You are free to refuse to take part. You may refuse to answer any questions and may stop taking part at any time. If you have any questions about the research, you may telephone me, Elizabeth Popp Berman, at (510) 549-1154, or contact me by email at epopp@berkeley.edu. If you agree to take part in this research, please sign the form below. Please keep the other copy of this agreement for your future reference.

If you have any questions regarding your treatment or rights as a participant in this research project, please contact the Committee for the Protection of Human Subjects at the University of California, Berkeley: (510) 642-7461 or subjects@berkeley.edu.

---

I have read this consent form and I agree to take part in this research.

N—12—t
Signature

1/13/2005
Date

I also agree to allow my name or other identifying information to be included in all final reports and publication resulting from my participation in this research.

N—12—t

1/13/05

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Web Site: http://sociology.berkeley.edu

As part of this project I have made an audio recording of you while you participated in the research. I would like you to indicate below what uses of these records you are willing to consent to. This is completely up to you. I will only use the records in ways that you agree to. In any use of these records, your name will not be identified unless you have separately consented to allow such identification.

1. The records can be studied by researchers for use in this research project. Initials NJ

2. The records can be used for scientific publications. Initials NJ

3. The records can be used for other, non-academic publications. Initials Case-by case Review

4. The records can be used at meetings of scientists interested in this research. Initials NJ

I have read the above description and give my consent for the use of the records as indicated above.

NORMAN J. LATKER Date 11/13/05
Name (print)

N—J— Date 11/13/05
Signature

**Subject:** Fw: Avery
**From:** "Latker, Carole (NIH/NIGMS)" <LATKERC@nigms.nih.gov>
**Date:** Tue, 8 Feb 2005 16:22:40 -0500
**To:** "'latkerc@bellatlantic.net'" <latkerc@bellatlantic.net>

---
Sent from my Wireless Handheld

-----Original Message-----
From: Richard Latker <pristine@netvigator.com>
To: Harold Krauthamer <harold@krauthamerstahl.com>
CC: Latker, Carole (NIH/NIGMS) <LATKERC@nigms.nih.gov>
Sent: Tue Feb 08 12:30:53 2005
Subject: Re: Avery

Dear Mr Krauthamer:

Thank you for your letter.

I am familiar with the concept of a "special needs trust" or, as it is called in many states, a "supplementary needs trust." However, I'm not sure we're entirely on the same wavelength about its construction and purpose.

Below are a few thoughts on the matter. Please offer any comments you might have:

* The trust should be set up immediately, not upon the death of my parents.

* My parents should be encouraged to earmark a significant portion of their estate directly for the trust, whether or not I am alive at the time of their deaths.

* The trust should be set up to accept contributions from all parties, and be an eligible beneficiary for life insurance policies.

* "Discretion" for the trustee must be explicity limited to supplemental care of Avery Edward Latker. There must be clear distribution limitations for both the beneficiary and the trustee. The trust should be used as collateral, or incur debt. The trust should be protected from Avery's creditors, even in the event of bankruptcy.

* The trust should be,as far as possible, in complaince with the emerging Uniform Trust Code. As supplementary needs definitions differ from state to state, the trust would need to be drafted using common acceptable language for Maryland, Pennsylvania and Wisconsin, which are the most likely states of residence for us should we choose to return to the US.

* Some provision should be made for the possibility that Avery proves capable of managing his own affairs, including this trust. Perhaps the "supplementary needs" restrictions could expire at some point, at which time

Avery could seek control of the assets, the trust can be renewed as is, or some form of limited guardianship created if he is moderately impaired.

* The trustee cascade should be as follows: My father, who is best placed at

present to nurture and manage US investments, should be the trustee at present. Upon his incapacitation, my mother should be next in line. Next should be myself and my wife (although it should be noted that my wife is not a US citizen). Should both my wife and I be incapacitated, the

trusteeship should pass to another individual we have in mind who is wealthy, trustworthy and committed to the well-being of my family.

* Miriam is not an appropriate candidate for trusteeeship as our relationship is not particulary close and she already has three children to be concerned with. In the unlikely event that she were to accept custodial guardianship for Avery (ie, Avery were to live with her), the trust could provide allowances for this by making her a representative payee. However, the supplementary needs limitations on disbursements must still apply.

* The trust language should include restrictions on the type of investments that can be undertaken by the trustee. For example, a specified proportion of the trust, perhaps 50 per cent, should be reserved for low-risk investments, such as fixed guaranteed annuities not linked to equity or debt

markets.

* The trust should allow for expenses associated with managing the trust,.ie, it should aside set modest sums aside every year for fees charged

by professional money managers, attornies, etc.

Thanks and regards,
Richard Latker

----- Original Message -----
From: "Harold Krauthamer" <harold@krauthamerstahl.com>
To: <pristine@netvigator.com>
Cc: <latkerc@nigms.nih.gov>
Sent: Tuesday, February 08, 2005 4:28 AM
Subject: Avery

Dear Richard:

I am e-mailing you at the request of your parents. As you may know, I am working with your parents on their estate planning.

Their estate plan provides that in the event of their deaths, you will inherit one-half of their estate outright. However, if you were to predecease your parents, your share would be held in a trust for Avery and his siblings, if any. Miriam would be the Trustee of the trust. With regard to Avery's share, we would create a special needs trust so that the assets in the trust would not preclude Avery from receiving any government benefits that he would otherwise be able to receive. This trust would be totally discretionary. That is Miriam would distribute income and/or principal in her discretion to or for the benefit of Avery.

While your parents are alive, they can assist you with the cost of Avery's education and medical care without incurring a gift tax. In order for this
to happen, they must make payments directly to the educational institution,
health insurance company or provider of the health care rather than to you. So, if you needed assistance paying a medical provider, health insurance premium or educational institution, they could assist you by

paying it directly.

In addition, your parents can make annual gifts to you, your spouse and Avery of $22,000 each annually (a total of $66,000). If the gifts exceed this amount, your parents would either owe gift tax or use a portion of the amount that they can gift during their lives. Gifts made to Avery should be made to a trust. Using a trust for the annual gifts makes most sense if at least $11,000 will be gifted to the trust annually. As described above, a trust created for Avery during your parents' lives would also be drafted as a special needs trust.

If you have any questions or would like to discuss some of your ideas, please feel free to contact me or my associate, Gilda Zimmet.

Harold

**Subject:** Fw: Avery
**From:** "Latker, Carole (NIH/NIGMS)" <LATKERC@nigms.nih.gov>
**Date:** Tue, 8 Feb 2005 16:21:41 -0500
**To:** "'latkerc@bellatlantic.net'" <latkerc@bellatlantic.net>

---
Sent from my Wireless Handheld

-----Original Message-----
From: Richard Latker <pristine@netvigator.com>
To: Latker, Carole (NIH/NIGMS) <LATKERC@nigms.nih.gov>
Sent: Tue Feb 08 12:34:12 2005
Subject: Re: Avery

Hi:

Krauthamer's letter asked no questions and contained nothing I did not already know.

It didn't inspire confidence that you've chosen the right attorney to draft the trust.

Perhaps you should consider one who specialises in trusts.

We'll see how he responds to my note.

R---

**To: Norm Latker**
**From: Beth Popp Berman**
**Date: 28 January 2005**
**Re: Areas to discuss further**

MJ NDA x
301-951-0375

I learned so much from our conversation that it was challenging to decide exactly what areas to pursue in more detail. Ultimately, I settled on three themes. One area, not surprisingly, is the role played by universities in this process, since that is most relevant to my dissertation. But there are two other themes that I would like to follow up on because I think they might make good journal articles on their own—they have interesting sociological implications in addition to being part of the history of an important piece of legislation.

I don't know exactly what kinds of material you've saved in your files that might be relevant and that you'd be willing to share, but I have tried to list some types of material that I imagine you might have. If there is other information that you think is important or that is relevant to these themes, I would be interested in that too.

These are the three topics:

KB 7 TECH #1986

**1) The role of universities in the evolution of federal patent policy**

As you know, my dissertation focuses on how universities took on an "economic engine" role. Developing the capacity to patent and license inventions was an important part of this. Some topics we might go back to in this area include: more about how institutional patent agreements were reintroduced and spread, your interactions with university patent administrators and university scientists, changing attitudes in universities towards patenting and licensing over time, how a community of university technology transfer administrators arose (before and after the Case Western conference), your efforts to educate/make your argument to university audiences at conferences, the roles played by SUPA and professional education associations like ACE, COGR, etc. in passing Bayh-Dole.

Relevant records might include: Any other talks you gave to university audiences (besides the ones I listed as having), lists of early IPA holders, any records from the Case Western conference (besides the proceedings) or other conferences, correspondence with groups like the Society of University Patent Administrators or ACE.

**2) Your role in building support for and negotiating opposition to patent policy reform.**

Sociologists often focus on the effects broad social forces have on historical events—for example, how the economic recession of the 1970s helped create an environment which made a bill like Bayh-Dole look more appealing to Congress. But increasingly sociologists are trying to remedy their neglect of the role individuals play in creating social change.

Bayh-Dole and its successor bills were passed in large part because of two decades of behind-the-scenes work by you and a few other key individuals. Against all odds, you managed to eventually secure the legislation even though your role is not widely known. I think *especially*

because your story is not widely known it has something to say to our understanding of how this kind of process happens. The question is how individuals can gradually build enough leverage/momentum to create such an important change even without being in a position of great direct power.

Topics to discuss might include your efforts to build support for regulatory reform and later for legislation, interagency work (like with the FCST committee and the Government Procurement committee), how the university and small business communities came on board, relationships with those opposed to patent policy liberalization (both those who you were eventually able to convince and those who remained opposed), how you managed conflicts, efforts to educate a wider audience about the need for reform (I think I remember reading in one of your talks that at one point you were traveling to conferences on your own dime to talk about this issue), the benefits and disadvantages of being a public servant working on this issue rather than a political appointee, how the opposition of industry was managed after it was decided that Bayh-Dole could not be passed if it included big business.

Relevant material might include any reports or memos from the FCST committee/subcommittees, the unpublished report you mentioned writing for the Government Procurement committee, any other records of interagency work, conference talks, or correspondence.

**3) How Congressional interest in technology transfer became tied to patent policy.**

This is something we only began to touch on last week, and it may be a little further from your own experience—or maybe not; I'm not sure—but I would be interested in hearing your perspective on the question.

In the early-mid 1960s Congress started asking a lot more questions about how federal research dollars were being spent, what kinds of results could be shown with the money, and whether those results were being applied usefully. A number of relevant hearings were held. Among these were 1967 and 1970 hearings on technology transfer, which was a fairly new term at the time. At these hearings, little connection was made between the idea of technology transfer and patenting/licensing activity. Instead, the focus was on promoting technology transfer through things like the Office of State Technical Services and information clearinghouses.

By the time of the Case Western conference (1974), universities were labeling their patenting activities "technology transfer", and patenting and licensing eventually became central to the process of technology transfer. I'm very interested in how this shift occurred—how patent policy became an important means through which government pursued its technology transfer goals. Was this a natural evolution? Was there a process through which the two became connected? Did this Congressional interest in encouraging technology transfer and in showing what kinds of value the nation was getting for its research dollars make it easier for you to make a case for patent policy reform? Did the economic slump of the 1970s affect this process?

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More than one-quarter of all the start-ups came from seven institutions that each created 10 or more companies, the University of California system, the Universities of Florida and Pennsylvania, Cornell and Stanford Universities, and the Georgia and Massachusetts Institutes of Technology.

Participation in the annual survey has increased in recent years, from 142 institutions in 2001. Even so, this year's respondents formed 16 fewer spinoff companies than in the 2002 fiscal year, and 54 fewer than in 2001, a record year for academic spinoffs. Because different institutions participate from year to year, the value of the data for identifying trends is limited.

New York University was one of three universities with licensing income of $65-million or more in 2003, according to the report. The other two were among seven institutions that responded to the survey on the condition that the association not report their data individually. Those responders included Columbia, Georgetown, Rockefeller, and Yale Universities, which are known to be among the most successful and active in patenting and licensing.

In the 2002 survey, Columbia was No. 1 in licensing income, with revenues in excess of $155-million, thanks to a set of lucrative biotechnology patents that have since expired. The other anonymous responders were the Universities of South Dakota and Wyoming and Loyola University Medical Center, in Illinois.

Of those willing to be identified, NYU ranked first in income, with revenues of just under $86-million, a 37-percent increase over the previous year. The University of California, which reports collective totals from its nine campuses, was second, with $61-million, a reduction of more than 25 percent from its 2002 total.

For NYU, royalties from the sale of a drug called Remicade, which is used to treat rheumatoid arthritis and Crohn's disease, were again the biggest source of income. But Avram M. Goldfinger, executive director of the office of technology transfer, said the drug was just one of 20 medical products now on the market that use NYU technology. They include diagnostic tools and a number of devices used in neurosurgery, orthopedics, and magnetic-resonance imaging. Sales of Remicade and of many of the other products increased in 2003, he said, which gave a boost to the university's income totals.

The future also looks bright for NYU. Its technology played a role in 13 other drugs that are now being tested in clinical trials, Mr. Goldfinger said, "so there is the potential that some of them might come to market over the next several years."

**Payoffs From Big Hits**

True to historical patterns, institutions that had substantial increases in royalty income in 2003 often prospered because of one or two key deals.

For Washington University in St. Louis, the big hit involved a treatment for Crohn's disease. Professors found that an existing drug could alleviate the symptoms of that gastrointestinal ailment. The

institution licensed the invention to Berlex Laboratories Inc., the American affiliate of Schering AG, a German pharmaceutical company, which in return made a large, upfront payment to the university in 2003. The university reported $12.5-million in royalties in that year, up from $6.5-million in the previous year. Without that license, the increase in royalties would have been more in the range of 15 percent, said Michael Douglas, associate vice chancellor and director of the Office of Technology Management. "It all depends on bringing in a big deal," he said.

Wayne State University said its big jump in revenues -- from about $2.2-million to nearly $13.7-million -- came primarily from cashing out its stake in a 17-year-old spinoff company called Lumigen. It makes chemical compounds that decompose and emit light when triggered by enzymes. The compounds are used to test for infectious diseases or hormonal imbalances.

The company, which was Wayne State's first spinoff, became the source of a controversy in the mid-1990s, when a chemist from a rival company who had consulted with Lumigen's founder sued him and the university for patent infringement. The two companies settled, but the case cost Wayne State about $6-million in legal fees, and some professors contended that the university had acted improperly.

Fred H. Reinhart, director of the technology-transfer office, said Lumigen's subsequent success had been good for the Michigan university. Not only has the company hired many graduates, but it also was prosperous enough to buy out the university's stake. Because Wayne State shares licensing income with its inventors, the founder of the company, A. Paul Schaap, a professor of chemistry, will share in the windfall. He has pledged to use the money to endow a chair in chemistry at Wayne State.

Case Western Reserve University tripled its revenues from 2002 to 2003 largely as a result of one new deal and one older deal that finally "hit its stride," said Catherine Porto, associate vice president for technology transfer. The old deal involves a compound developed at Case Western that is used in the chemotherapy drug Rituxin, a treatment for non-Hodgkin's lymphoma. The new deal, too, involves a medical product, but Ms. Porto would say only that it was for a "female health-care product."

**One-Time Payments**

Flukes of licensing were a factor for several of the institutions that reported a one-year decrease in royalties. Several said the reported declines were not as severe as they appeared because the 2002 revenues had been inflated by one-time events.

The University of California, for example, said its 2002 figure included a one-time payment of $8.8-million for a license on an electronics invention and a $5-million settlement in a separate royalty dispute.

The University of Rochester said the $42-million it received in 2002 included several settlements of patent-infringement cases related to its Blue Noise Mask computer-imaging technology. It had fewer settlements in 2003, when it nonetheless received more than

$26.7-million in licensing revenue.

Rochester saw an uptick in royalties in 2004, thanks to a new license on a treatment for menopausal hot flashes. It expects even more income from that invention, which is now in clinical trials, once the product comes on the market in three or four years.

Rochester's deal shows that politics isn't the only activity that can make strange bedfellows. The company that licensed the hot-flash invention is the pharmaceutical giant Pfizer, the same company that Rochester is suing in a bitter patent-infringement dispute involving the company's anti-inflammatory drugs Celebrex and Bextra.

The dispute "didn't even come up" in the talks, said Marjorie D. Hunter, director of technology transfer at Rochester's medical center.

Information on obtaining copies of "AUTM Licensing Survey: FY 2003" can be found at the Web site of the technology managers' group (http://www.autm.net).

**EARNINGS FROM TECHNOLOGY**

While many universities engage in technology transfer, most still do not earn much money from licenses on their inventions.

| | | |
|---|---|---|
| Institutions earning $1-million or less | **84** | (52%) |
| Institutions earning $1-million to $5-million | **40** | (25%) |
| Institutions earning $5-million to $20-million | **22** | (14%) |
| Institutions earning more than $20-million | **15** | (9%) |

Note: 161 institutions responded

**SOURCE:** Association of University Technology Managers

http://chronicle.com
Section: Money & Management
Volume 51, Issue 15, Page A27

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# SCIENCE & GOVERNMENT REPORT

The Independent Bulletin of Science Policy

Vol. IV, No. 8 | P.O. Box 6226A, Washington, D.C. 20015 | April 15, 1974


# Spinoff from DoD R&D? Not Much, Study Finds

A committee working under the auspices of the National Academy of Engineering, the nation's most prestigious organization for engineers, has come close to labeling as a sham the oft-made claim that the massive amount of money which has been poured into space and defense research has resulted in widespread spinoff benefits to society.

"With a few exceptions, the vast technology developed by federally-funded programs since World War II has not resulted in widespread 'spinoffs' of secondary or additional applications of practical products, processes, and services that have made an impact on the nation's economic growth, industrial productivity, employment gains, and foreign trade," the committee states.

It goes on to note that there is a huge amount of technology developed in federal laboratories which could be exploited for the public good, but "a plethora of structural and institutional barriers exist in the federal government and the private economy to prevent the efficient and effective use of this technology."

In 1972, when the now-defunct Office of Science and Technology put together Nixon's historic message on science and technology, the talk then was of finding ways of putting R&D to work in solving "critical national problems." Nixon's message promised that the federal government would seek to find ways to stimulate private investment in R&D and to get technology which had been developed in

(Continued on page 2.

## IRS Querying Travel Writeoffs

One of the more charming perquisites of the scientific life, the tax-deductible conference trip with playtime thrown in, is drawing dirty looks from the Internal Revenue Service as part of a general crackdown on questionable "business" deductions.

With conferencing an historic ingredient of the research profession, and the provision of conference services and facilities a booming and increasingly competitive business, recreational aspects have come to be loudly touted in pitches for the patronage of scientific groups.

However, according to IRS Commissioner Donald C. Alexander, who discussed the subject in a speech last month in Washington, abuses have reached the point where IRS is disallowing what amount to no more than "vacations in disguise."

Citing the case of a physician who went to a convention and then took a post-convention cruise with "professional talks" on the ship, Alexander notes that a tax court decision allowed all the costs of the convention to be deducted, but accepted only 20 percent of the cruise costs.

Deductions claimed for cruises and other holiday-type activities, an IRS press release states, will henceforth be subjected to additional scrutiny, and where doubt exists, the taxpayer will be required to provide data to substantiate the claim that the holiday setting was actually devoted to professional activity.

## In Brief

**With gasoline supplies nearly back to normal, Washington is beginning to show a perceptible lessening of urgency about energy-related measures. A House-passed bill to give NASA $50 million for solar demonstration projects is bogged down in jurisdictional squabbles in the Senate, and the problem is compounded by the Administration's contention—as voiced by NSF Director Stever—that the present research base is inadequate for moving on to large-scale demonstration efforts.**

*Fulfilling the prophecy of space-shuttle opponents who described the multi-billion venture as a gold-plated solution that will search for problems, the manager of GE's Advanced Programs Space Division, David W. Keller, has proposed that the shuttle be used for orbital manufacture of vaccines. Processing in space, he said, "may help us find a solution to the common cold. . ." Gesundheit!*

**To help you keep track of Washington's shifting tables of energy organizations: By Executive Order, dated March 28, the President has abolished the Energy Policy Office, which he established last June, and has assigned its remnants to the Oil Policy Committee, which is chaired by the head of the Federal Energy Office.**

*Meanwhile, NSF announces the creation of an Office of Energy-Related General Research as part of its Research Directorate, and also announces the establishment of "a separate program on the Environmental Effects of Energy, in RANN's (Research Applied to National Needs) Division of Environmental Systems and Resources, to determine the effects of energy resource extraction, conversion, and use on the natural environment."*

# OTA Gets Moving with Drug Study for Kennedy

The Congressional Office of Technology Assessment (OTA), which has drawn some sniping for its leisurely startup pace (SGR Vol. IV, No. 5), has decided to move along swiftly on at least one assessment and report to Congress by July 1.

The subject selected for fast treatment is "bioequivalency" of pharmaceutical drugs, which became a hot item last December when HEW Secretary Caspar W. Weinberger recommended that in purchasing drugs, the government opt for the least expensive version "in (the) absence of demonstrated differences in uniform quality and therapeutic equivalence. . ." Weinberger's recommendation was included in testimony presented to the Senate Labor and Public Welfare subcommitttee on health, whose chairman, Edward M. Kennedy, shares the Secretary's concern about high profit margins in the pharmaceutical industry.

Weinberger said that the system of buying at lowest cost, with specified exceptions, could safely be adopted because "all the evidence to date indicates that clinically significant differences in bioavailability are not frequent."

His position, however, was challenged by representatives of the pharmaceutical industry who contended that the absence of demonstrable differences could not be taken as evidence that they did not exist. Kennedy, who is chairman of OTA's board, subsequently recommended that OTA carry out a study on the subject and report back to his subcommittee.

Since this is the first OTA study to get underway, the organizational arrangements are of some interest. OTA's first step was to start putting together an advisory panel to supervise the study. Selected to chair the panel was Robert W. Berliner, newly appointed dean of Yale Medical School, and former director for science of the National Institutes of Health. While other members are being selected, a contract for $149,000 was awarded to a Washington-based organization, Family Health Care, Inc., headed by Stanley C. Scheyer, former medical director of the Peace Corps, to carry out the study.

As stated in an OTA announcement, "The key issue to be assessed is whether present day technology can determine that two drugs with the same chemical composition but produced under different manufacturing processes will produce the same therapeutic results."

Since the value of OTA in the hurly-burly of Congressional affairs is yet to be proven, there is a good deal more riding on this study than mere determination of the particular issue at hand. If the OTA study decisively settles the matter one way or the other for Kennedy's subcommittee, due note of this will pass along the Congressional grapevine and members confronted by scientific and technical problems will be more inclined to turn to OTA for assistance.

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**SPINOFF** *(Continued from page 1.)*

federal laboratories out into the marketplace.

But about the only federal project to emerge from the gusher of talk was the Experimental Technology Incentives Program (ETIP), jointly funded and administered by the National Science Foundation and the National Bureau of Standards. NBS is only now getting round to announcing its first contracts, and NSF's part of the operation has been reduced from an $11 million a year enterprise to a miniscule $1 million. According to NSF Director Guyford Stever, the program is now in an "evaluation mode."

The accomplishments have therefore so far failed to live up to the rhetoric of Nixon's message, and the NAE committee—which was in fact convened through a grant from the NSF ETIP program—has suggested that so far the Administration has been taking too timid an approach.

For a start, the committee believes that the federal government has been spending a paltry sum of money encouraging technology utilization—in 1973, it spent $43 million, or 0.25 per cent of the total research budget on such activities. The NAE committee reckons that the figure should be pumped up to $1 billion.

The money would be used to fund a search of projects supported by federal agencies, to determine which have developed products likely to be useful to society, and then to fund a variety of incentives to industry to exploit them. Such incentives as exclusive licenses, and "imaginatively bold financing to users in the private and public sectors in order to accelerate the direct implementation or to stimulate financial institutions to provide greater investment in new technology enterprises" should be tried, the committee suggested.

Most of the committee's suggestions and recommendations are familiar stuff, and reflect the industrial bent of the majority of its members. Like similar recommendations made last year by representatives from state and local governments for harnessing federal R&D for the common good, they will probably be quietly forgotten.

The committee was chaired by Joseph H. Newman, senior vice president, Tishman Research Corp., New York City. The report, titled, *Technology Transfer and Utilization*, is available without charge from the Printing and Publishing Office, National Academy of Sciences, 2101 Constitution Ave. Nw., Washington, D.C. 20418.

# *AEC Very Quiet about Failure of Rio Blanco Test*

In keeping with the tradition that government agencies trumpet their successes but keep quiet about their failures, the Atomic Energy Commission hasn't been saying much recently about Project Rio Blanco, the 90-kiloton underground nuclear explosion which was set off last year in Colorado amid a gusher of protests. However, a check with AEC officials confirms that the experiment has turned out to be less than a resounding success.

Since a technical failure could well prove fatal to the AEC's already tottering plan to set off thousands of Rio Blanco-type explosions to blast natural gas out of a layer of sandstone deep under the Rocky Mountains, the AEC's silence on the matter is not altogether surprising, particularly in view of the fact that the plan has picked up a raft of opponents to whom news of problems is akin to manna from heaven.

A hint that something went wrong with Rio Blanco is buried in the sixth paragraph of a nine-paragraph announcement put out by the AEC's Denver office, but the blandness of the announcement belies the fact that the experiment failed to meet what AEC officials had previously described as its "major objective."

Rio Blanco was the third underground nuclear explosion in a series designed to see whether nuclear weapons technology can be used to get natural gas out of "tight" rock formations where it is trapped in small isolated pockets. The idea is to blast out a cavern about a mile underground, let it fill with gas released by fractures in the surrounding rock, wait until the radioactivity has declined to an "acceptable" level, and bring it to the surface.

If the technique is ever going to be used commercially, some method must be found for fracturing a thick layer of gas-bearing rock to produce a high

*(Continued on page 4.)*

## Head of NAS Herbicide Study Assails Kistiakowsky

The venerable National Academy of Sciences continues to reverberate with angry exchanges following successful efforts by dissident members to get a jump on the Defense Department in making public a Vietnam defoliation study that the NAS carried out under a Defense contract.

The study, which was ordered by Congress, presented a horrendous picture of the effects of defoliation and was leaked to the press (SGR Vol. IV, Nos. 5 and 6) because of fears that if initial release came from DoD, the public impact would be blunted by obfuscatory statements from the military.

Among those taking the lead in getting the report to the press before official release and in criticizing it for not being even harsher, was George B. Kistiakowsky, retired vice president of the Academy, who has long been at loggerheads with Academy President Philip Handler. While serving as vice president of the Academy—he reached the mandatory retirement age last year and was required to step down while the report was in the mill—Kistiakowsky was responsible for appointing the panel that was required to pass on the quality of the report. The panel is widely credited with forcing the study committee to bear down hard on the subject and produce a report that demolished DoD's contention that defoliation had a relatively limited ecological effect.

Following widespread press coverage of leaked versions of the report, things quieted down for a while at the Academy, but just last week, the chairman of the committee that conducted the study, Anton Lang, of Michigan State University, took out after Kistiakowsky in the letters column of the *Washington Post*.

The committee, he wrote, "operated with the understanding that the report would not be released, nor commented upon, before it was in the hands of Congress and had been released by the latter. Other members of the Academy who were given the report for review purposes were under the same obligation.

"I do not know," he continued, "how Dr. Kistiakowsky was authorized to comment on and criticize a report before it was made public. This is not the normal procedure in science; and in this case represents a clear and blatant breach of confidence. . . .

"I find it particularly regrettable that while you gave great prominence to criticism of the committee and disagreements within the latter (although they were limited to one major problem among many), you did not say one word on the constructive aspects of its report. . . .

"Reading your account of the Committee's efforts one cannot help feeling that you and Dr. Kistiakowsky were much less concerned with the meaning of the military herbicide program to Vietnam and the Vietnamese — the country and the people directly concerned and let us not forget, our allies — and with a constructive approach to the problem than with having another horror story."

With the Academy's annual meeting scheduled for the end of this month, it may be assumed that we have not heard the last of this matter.

## Gifts to Education Hit Record

The widely held notion that the public is turning its back on the financial needs of higher education finds no support in figures recently released by the Council for Financial Aid to Education.

For the year ended last June 30, according to the CFAE, contributions from individuals, corporations, and foundations reached a record high — $2.24 billion, an increase of 11 percent over the previous year.

The top recipients were: Harvard, $57.1 million; Stanford, $46.5 million; University of California System, $44.3 million; Yale, $32.1 million; Cornell, $30.6 million; Northwestern, $30.3 million; University of Pennsylvania, $28.9 million; University of Chicago, $28.7 million; Emory University, $27.4 million, and Columbia, $27.1 million.

Details are contained in *Voluntary Support of Education*, 1972-73, $6, to be published at the end of May, (CFAE, 680 Fifth Ave., New York, N.Y. 10019.)

# Medical School Rejects Flocking Abroad

Faced with diminishing prospects for enrolling in medical schools in the United States, prospective physicians are turning in droves to schools and colleges abroad. According to a survey carried out by the Department of Health, Education and Welfare, 2,045 US citizens were studying medicine in Latin America and Canada in the 1971-72 academic year, and there are indications that the number has grown since then.

By far the largest home for expatriate US medical students is Mexico, where 1,744 are enrolled in the Autonomous University of Guadalajara alone, each of them paying $4,000 a year for tuition. A new medical school has also recently opened at the University of Monterrey, and the HEW survey reckons that it could soon attract as many US medical students as Guadalajara.

The chief incentive for foreign study is the fact that in 1972, US medical schools rejected 16,800 applicants, and the less restrictive admission policies in some foreign countries help create "a haven for would-be physicians who are not able to compete with other applicants meeting medical school admissions criteria more exactly."

Copies of the report, *Foreign Medical Students in the Americas*, can be obtained from the US government Printing Office, Washington, D.C. 20402. Price, 55 cents. Number 1741-00069.

**BLAST** *(Continued from page 3.)*

yield, and Rio Blanco was designed to do just that. In short, the test involved stringing three 30-kiloton explosives together in a vertical line, about 450 feet apart, in the hope that the caverns blasted out by each one would join together to form a huge underground chimney.

But when the AEC drilled into the cavern, it found that it was getting gas only from the area around the topmost explosive—the caverns either failed to join together, or they had become blocked off from each other.

### IMPACT STATEMENT

This rather embarrassing discovery is going to present a huge obstacle to the nuclear gas stimulation plans because the AEC itself pointed out in an environmental impact statement two years ago that "the use of multiple explosives is required to improve both the economics and the total recoverable fraction of the gas."

But the whole notion of exploding thousands of nuclear devices under the Rockies had already run into some pretty devastating opposition long before Rio Blanco shattered the peace last year, and the handwriting was probably already on the wall.

For a start, people living in the area are not very happy about the prospect of having their homes shaken by shockwaves. But more important, the gas fields happen to lie directly beneath the highly prized oil shale fields which have been proclaimed as offering a potentially huge source of domestic petroleum. The oil companies which have been bidding for a piece of the shale lands are unlikely to sit back and allow the AEC's nuclear fantasies to jeopardize their operations. They will be only too happy to use Rio Blanco's technical problems as a club with which to beat the program into an early grave.

### "NO KNOWN ALTERNATIVE"

In view of the fact that about 300 trillion cubic feet of natural gas are reckoned to be recoverable from the Rocky Mountain oil shale area, enough to satisfy the entire US demand for 10 years, neither the federal government nor the energy industry is likely to give up trying to get it out. Unfortunately, though, the AEC said in its environmental impact statement on Rio Blanco that "there is no known alternative to nuclear gas stimulation for recovering the gas from tight formations."

Be that as it may, the AEC announced last month that it is putting up $1 million to test a technique known as massive hydraulic fracturing—essentially pumping high pressure fluids down a borehole to fracture the gas bearing rock—at a site a mile away from Rio Blanco.

# Law Suit Challenges Academy Committee Secrecy

The National Academy of Sciences' tradition of performing most of its government advisory work in mole-like secrecy is under challenge in a lawsuit filed by an independent, Nader-style organization known as the Public Interest Campaign.

The suit, filed March 15 in the US District Court of the District of Columbia, is specifically aimed at acquiring the records and opening up the proceedings of the Academy's Committee on Motor Vehicle Emissions, which is under contract to advise the Environmental Protection Agency on enforcement of the Clean Air Act. However, if successful, the suit could have a devastating effect on the Academy's operating style, which is predicated on the assumption that candor thrives in secrecy and that, therefore, specialists who are summoned to help the Academy fulfill its congressionally chartered role of adviser to the federal government should meet in private.

The challenge to the Academy is based on the Freedom of Information Act and the closely linked Federal Advisory Committee Act, which together were intended to let the public in on the operations of the Executive Branch by severely limiting the grounds for both holding back federal documents and closing advisory meetings to the public. The two measures are a long way from converting government to a fishbowl operation, but they have provided levers for prying loose a good deal of information that previously was arbitrarily withheld. The Academy has not yet formally replied to the suit, but on the basis of past attempts to open it up, it can be expected to contend that, though Congressionally chartered and deep in government work, it is a private organization and as a consequence is outside the scope of both acts.

The legalities are actually a bit fuzzy. Though the boundries between public and private have been greatly eroded in many American institutions, the Academy has most of the traditional attributes of a private organization, even though it is so tightly linked to the federal government that it is included in the *Congressional Directory's* list of federal agencies and until recently was entered in the Washington, D.C., telephone directory under US Government. Nevertheless, it is privately chartered, elects its own officers, and receives no direct appropriation from the Congress; rather, its government funds are received under contract from federal agencies. Furthermore, though the Federal Advisory Committee Act does not explicitly exclude the Academy from its provisions, it was stated during House floor debate that it was not intended that the measure apply to the Academy or organizations working for the government on contract.

Nevertheless, the Advisory Committee Act provides some support for the contention that advisory operations such as those conducted by the Academy are within its scope. Thus, the Act states that "The term 'advisory committee' means any committee, board, commission, council, conference, panel, task force, or other similar group. . . .established or utilized by one or more agencies, in the interest of obtaining advice or recommendations for the President or one or more agencies or officers of the Federal Government. . . ."

Before taking legal action, the president of Public Interest Campaign, Louis V. Lombardo, asked Academy President Philip Handler for a formal opinion on the applicability of the Advisory Committee Act to the proceedings of the Committee on Motor Vehicle Emissions.

A reply was furnished by the Academy's executive officer, John S. Coleman, who piously asserted, "That the Academy is able to obtain (privileged) information depends on large measure upon its unquestioned integrity, independence and objectivity. In itself, this ability is a valuable resource to the federal government. The application of the regulatory provisions of the Federal Advisory Committee Act to the deliberations of the Academy Committees could seriously compromise this independence and objectivity."

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# NIMH Puts Restrictions On Psychosurgery Support

The federal government's long-awaited guidelines governing the use of psychosurgery to control "abnormal" behavior are now undergoing final review in the top echelons of HEW, having been drawn up by staff members of the National Institute of Mental Health.

As set out in a memorandum signed by NIMH director Bert Brown and sent to Assistant Secretary for Health Charles C. Edwards, the proposed guidelines would prevent federal aid from being used to support the most controversial applications of psychosurgery—those operations performed on children, prisoners and mental patients detained in institutions against their will—but they would stop well short of calling for a flat ban on the irreversible behavior modification technique.

Since psychosurgery has generally been performed with hopelessly inadequate experimental controls, there's a great division of opinion whether or not it even works as its proponents claim, and until such basic disagreements can be resolved, NIMH is proposing that the technique should be re-

*(Continued on page 6.)*

Letter to the Editor

# Forest Service Denies Lag on DDT Replacement

Dear Sir:

In discussing the recent decision by the Environmental Protection Agency (EPA) to allow emergency use of DDT, if needed, to control the tussock moth in forests of the Pacific Northwest, SGR (Vol. IV, No. 6) concludes that alternative means of control had been ignored until last year.

Both the writer of the article and EPA Administrator Russell Train are wrong in this conclusion. A major effort to find alternatives to DDT for controlling the tussock moth has been underway since 1964—8 years before the ban on DDT by the Environmental Protection Agency.

Research goals in finding these alternate controls have not yet succeeded, partly because of the long time period between outbreaks (when it was difficult to find even low-level populations for study and testing) and partly because research funding has been limited.

But significant progress has been made and I cite the following facts to rebut the article's contention that it wasn't until last summer "that the Forest Service did any serious research and testing of alternatives to DDT to control the pest."

1. In 1964 we began to investigate the use of natural biological agents to control the moth. Through this investigation, many of the natural parasites, predators and diseases which attack the moth have been identified. One of these—a nucleopolyhedrosis virus—shows exceptional promise. The virus achieved population reductions as high as 99 percent when sprayed on small plots last year. A commercially available bacterium (Bacillus thuringiensis) was also tested in 1973. It achieved population reductions as high as 98 percent. But some research problems still remain. . .

2. In 1966, the Forest Service began initial screening of insecticides against the tussock moth at its Insecticide Evaluation Laboratory in Berkeley, Calif. Of the 80 compounds tested so far, half show significant toxicity to the moth larvae. But until the 1972 outbreak in eastern Oregon and Washington in 1972, there had not been a significant outbreak on which these insecticides could be tested. In 1972, Zectran was tested against the tussock moth in Washington and Oregon. In 1973, it and three others of the most promising insecticides—carbaryl, Dylox and bioethanomethrin (a synthetic pyrethrin) were tested in the Wallowa and Blue mountains in Oregon. The field test for Zectran covered more than 70,000 acres, but it proved only moderately encouraging. Consequently, this year more extensive tests will be conducted with carbaryl and Dylox. As you know, it is impossible to complete a field testing program in one or two years.

3. Because of the need to know about the biology of the moth, we have been devoting much of our research effort over the years to studies of insect population trends and ecology, population genetics and behavior, relationship of weather to outbreaks, and tree physiology.

4. These tangible research activities, plus the fact the Forest Service spent $370,000 last year and is spending over $600,000 this year on research for safer controls, I think, belies Mr. Train's statement that efforts to date have been "almost totally inadequate—to the point of dereliction."

It is disappointing that a scientific publication such as yours failed to obtain the facts relating to Forest Service research for alternatives to DDT before erroneously reporting that no serious efforts were undertaken until last summer.

JOHN R. McGUIRE
Chief, Forest Service,
US Department of Agriculture

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**PSYCHOSURGERY** *(Continued from page 5.)*

garded as strictly experimental, to be used only in rare circumstances, when all else has failed.

The effect of such a classification would be to slap a number of restrictions on when and how psychosurgery should be performed. For a start, the proposed guidelines suggest that such operations should be carried out only in hospitals which have "strong and intimate affiliation with, and attachment to, academic sciences," and comprehensive research protocols would have to be drawn up for each operation. Strict controls would have to be applied to make sure that informed consent is freely given, and "every effort must be made to ensure that all reasonable alternative therapies are attempted before resorting to psychosurgery."

When they finally emerge, the new regulations will legally apply only to the use of federal funds for psychosurgery, but they are likely to have an impact on non-federal programs as well because they are expected to be copied at the state level, which means that they will apply to a wide range of medical and research institutions.

# Joint Atomic Committee Fights for Energy Role

There's probably no institution more prone to turf fighting and jurisdictional blood feuds than the US Congress, and a good example of bloodletting is about to emerge over the Bolling Committee's proposals for revamping the committee structure of the House of Representatives (SGR Vol. III, No. 22).

Although Wilbur Mills, the powerful Arkansas Democrat, is likely to be in the front line, protecting the authority of his Ways and Means Committee, which would be decimated by the Bolling proposals, the Joint Committee on Atomic Energy (JCAE) is the first off the mark with a counter proposal to extend, rather than diminish, its jurisdictional patch.

The Bolling proposals would designate the House Committee on Science and Astronautics as the preeminent committee on energy research and development, which means that it would handle some bills that are now the exclusive prerogative of the JCAE. Although the Bolling proposals say nothing about the JCAE as such—being partly a committee of the Senate, the Joint Committee is outside the purview of proposals for revamping committees of the House—the effect of the changes, if they are implemented, would clearly be to clip its wings.

Believing that the best means of defense is attack, the two senior Senate members of the JCAE, John Pastore (D-R.I.) and George Aiken (R-Vt), and House member Rep. Orval Hansen (D-Idaho) have introduced bills into their respective legislative chambers which would extend the committee's jurisdiction to cover not just atomic energy, but all aspects of energy research and development. The committee would be renamed the Joint Committee on Energy, and its membership would be increased from 18 to 28.

The Joint Committee is already about to be weakened because its two most senior House members, Chet Holifield (D-Calif) and Craig Hosmer (R-Calif), are leaving Congress after long stints at the helm of the federal government's nuclear energy policies, and there is considerable sentiment in Congress for setting up a new legislative structure to handle the slew of legislation that all Congressmen are now duty bound to purpose.

But, in the dim past, when environmental protection was all the rage, there were plenty of calls for new Congressional arrangements for dealing with that topic, so why should the energy crisis be more effective in bringing about changes in the Congressional committee structure?

One reason is that Congress is moving along with a proposal to set up an Energy Research and Development Administration (ERDA) by bringing together most of the energy research programs of the federal government into a single agency organized around the laboratories of the Atomic Energy Commission. Although the Administration, which strongly supports the ERDA proposal, has made great play of the fact that it wouldn't require any change in the Congressional committee structure, ERDA would come under the purview of about eight committees.

So the Joint Committee has seized its chance and proposed that ERDA should come under the jurisdiction of only one committee—the Joint Committee on Energy.

But the proposal has already fallen afoul of Senator Henry M. Jackson (D-Wash), the chairman of the Senate Interior Committee, who has carved out a place for himself as Capitol Hill's most prominent spokesman on energy matters—mostly by riding roughshod over other committee jurisdictions. Jackson said in a Senate speech that energy policy is too complex a matter to be left to a single committee. The proposal would also rob him of a major advantage in his quest for the Democratic presidential nomination in 1976.

In any case, nothing is likely to happen to the proposal until Congress has disposed of the ERDA legislation. Although the prospects are now bright for Senate passage of the bill, which passed the House in December, it's going to take some time to tie up the loose ends.

In the meantime, if the House of Representatives agrees on the Bolling proposals—or even just on those of them that deal with energy matters—the Joint Committee's pitch for more power would be preempted. The House is the sole master of its own internal structure, and so if it agreed that energy research and development bills should be sent to the Science and Astronautics Committee that's where they will go, no matter what happens to the Joint Committee on Atomic Energy.

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## CEQ Chief Hits Industry For Energy Scare Ads

Russell Peterson, the new chairman of the Council on Environmental Quality, has got himself into a public scrap with executives of the American Electric Power Company, the largest investor-owned utility in the country, with Peterson accusing AEP of irresponsible and nonsensical advertising, and AEP's chairman firing off a letter to President Nixon suggesting that he should investigate Peterson's "conduct of his office."

The conflict started when Peterson, incensed by a series of full-page ads taken out by AEP in national news publications which suggested that energy conservation will "generate galloping unemployment," wrote to AEP president George Patterson, calling such a suggestion "the least comprehending of our energy problem and the most subversive of the public interest." Peterson also made his letter public.

Donald C. Cook, AEP's chairman, replied to Peterson with a vituperative attack in which he failed to defend the advertising campaign but suggested that Peterson was trying to take away AEP's "right of free speech and thereby preventing the dissemination of the truth about the inevitable consequences of your extremism." Peterson's crime is that he has publicly advocated that the United States should cut its growth in energy consumption by half.

Cook was particularly concerned that Peterson had made his original letter public, but CEQ officials point out that it was the only way to make their case known. Since AEP's advertising campaign probably cost more than CEQ's entire budget, CEQ could hardly respond in kind to the advertisements' self-interested rubbish.

## Technology Transfer Hearings

The well-worn theme of the transfer of technology from the United States to developing countries is about to get another airing on Capitol Hill through a bill introduced in the House by Richard T. Hanna, a lame-duck (through voluntary retirement) Congressman from California.

Since Congress is likely to be hung up on impeachment in the next few months, the bill isn't going to get anywhere, but Hanna, who happens to be chairman of a subcommittee on international scientific affairs, is planning some hearings on the matter next month.

The nub of his proposal is the establishment of an International Institute for Technology Transfer, a kind of international data bank staffed by scientists, which will supply information to underdeveloped countries on request. Hanna has the novel idea that the Institute would use leased satellite telecommunication lines, though he is not too specific about why such speed would be required to get information across.

Hanna claims that he's getting a favorable reception for the idea from the Administration, but since Nixon and his associates are not currently disposed to avoidable squabbles with Congress, the good reception, such as it may be, can probably be written off as a tactical courtesy.

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# NCI seeks a 'magic bullet' for cancer

## Agency has screened 300,000 chemicals for biological activity in search for anticancer drugs, but less than one in 5,000 gets to the multimillion-dollar clinical test stage

Although some oxidation catalysts, antioxidants and vulcanization accelerators formulated by Goodyear Tire & Rubber Co.'s research division were found by the National Cancer Institute early this summer to retard tumors in mice, Goodyear's vice-president for research, Richard C. Waller, cautioned against "drawing any premature conclusions."

These chemicals have many years and millions of dollars worth of testing to go through if they are to reach the stage of clinical use in combatting cancer in humans. In fact, the chances of these rubber chemicals actually being used against cancer are slight—somewhere between 0.02 and 0.1%, according to NCI officials.

Nevertheless, NCI's drug synthesis and chemistry branch has been supplied with more than 300,000 chemicals since it began the widespread search for cancer fighters in 1956.

Many companies, including Dow, Du Pont and Union Carbide, have participated in the program.

Rewards can be large for developers of successful compounds, such as the nitrosoureas used to combat brain tumors and Hodgkins disease. But the odds have been so slim that NCI, rather than chemical and pharmaceutical companies, has supplied the leadership in anticancer drug research.

That could soon be changing, says Saul Schepartz, deputy director of NCI's division of cancer treatment and former director of the development program. He sees the return on investment improving and that could make research attractive to companies.

NCI's testing program has shown the way, and when industry is ready to take over, "we'll be prepared to pass it on to them," Schepartz says.

**In the Beginning:** NCI began by supplementing an anticancer development program that was already under way at the Sloan-Kettering Institute for Cancer Research (New York). The test program, which grew steadily, was given a resounding boost in 1972 by federal funding in the "war on cancer."

By 1974 NCI was screening up to 50,000 chemicals a year for anticancer activity. "That was probably a mistake to test so many chemicals," Schepartz concedes. But he says that at the time "we didn't know enough to predict the kinds of chemicals that would be effective, so we had to explore a variety of structures."

The number tested per year has been cut to about 15,000, according to Robert Ing, assistant to the chief of NCI's drug synthesis and chemistry branch.

NCI now restricts its search to new kinds of chemical structures. "We're now trying to preselect based on prior biological activity. If the chemical is a new structure we will test it, if it's a class of structure already tested then we reject it," says Schepartz.

Goodyear's Waller explains that his company's proprietary chemicals "interest NCI scientists because they might lead to some different mechanisms for fighting cancer than those used in the past."

NCI's Ing agrees: "We're looking for new classes of chemicals with unique features. Hopefully, we can use intellectual insight to determine possible activity."

**Some Serendipity:** Despite the "intellectual insights" less than one in 5,000 chemicals tested make it to clinical trials, according to Schepartz. Most of those that get there are based on rational chemical designs for specific biological activity. Although, he adds that there is "some serendipity" in the search for the right chemicals.

Methyl nitrosourea is an off-the-shelf chemical that has good biological activity, which NCI tried to capitalize on by having outside laboratories develop specific chemicals based on it. Result: two of the major anticancer drugs, BCNU—1,3-(2-bis chloro ethyl)1-nitrosourea, tradenamed carmustine—and CCNU—1(2,chloro ethyl)3-(4 methyl cyclohexyl)1-nitrosourea, tradenamed lomustine.



NCI's SCHEPARTZ see day when test program will be passed on to industry.

Similarly, DTIC—5(3,3 dimethyl. 1 triazeno) imidazold 4-carboxamide—is a major drug used to combat malignant melanoma that was designed by the Stanford Research Institute, based on the activity of imidazold carboxamide.

**Maintaining Rights:** Companies, such as Goodyear, that submit chemicals to NCI for testing, maintain proprietary rights to their compounds. Schepartz says they can have "all sorts of relationships set up, depending on how much they want to participate in the testing." And if the chemical goes to clinical trial, the company may want to license it. On the other hand, if an analog of the chemical is synthesized for testing, the company's proprietary rights may not be upheld, says Schepartz.

**Long Pull:** The kinds of tests the Goodyear compounds have passed (passed by about one in 1,000 of the chemicals submitted) is only the first step.

This step, which takes up to 60 days, involves implanting a tumor in a mouse sensitive to leukemia. The mouse will die within 15 days if untreated. If its life is extended a "meaningful" period of time through treatment, the chemical is considered to have good activity.

Successful passage of this preliminary test, which is repeated three times at a total cost of some $3,000, leads to a broader series of tests. These involve a variety of animals as well as a variety of tumors. Success at this stage is followed by production of the compound in kilogram quatities for pharmacological and toxicological testing and review by the NCI board to decide if it is a candidate for clinical testing. By this time up to $300,000 has been spent on the compound.

Clinical trials, which can take up to four years, can add several million dollars to the cost of the compound's development. Only six to 10 chemicals per year make it to clinical trial, says Schepartz.

# Jack W. Germond & Jules Witcover: 1978's different drummer

File w/ Editorials 9-1/6

A month ago Gov. Michael Dukakis of Massachusetts received some political intelligence he should have taken more seriously. Although he was still 15 percentage points ahead of his competition in the Democratic primary campaign, he had lost nine points in about 10 days.

The apparent reason: The impact of the charge being leveled against him by Frank Hatch, one of the candidates in the Republican primary, that he had been derelict in trying to recover $100 million in tax delinquencies. But Dukakis was his usual ineffably assured self. When a visiting reporter suggested the tax delinquency issue might make Hatch a formidable opponent in the general election, he sniffed: "No, I've taken care of that."

As it has turned out, however, Michael Dukakis is the one who has been taken care of — defeated in the Democratic primary by Edward J. King, a hard-line conservative who used the high tax issue, capital punishment and abortion to score one of the year's many political upsets. King now will be facing that same Frank Hatch in the November election.

The simple answer everyone seems to be seeking is that the taxpayers' revolt is what brought Dukakis down. The explanation, however, is far more complicated than that — and far more threatening to other officeholders at all levels. It is neither a secret nor a surprise that the voters are hot about taxes; what is significant is what the results say about their attitude toward politicians in general and incumbents in particular. Color it hostile.

Patrick Caddell, an astute analyst of public opinion, sees the key element as what he calls "the level of frustration" in an electorate. Generally, he argues, that level is higher in the northern and northeastern states where taxes generally are higher than in those areas of the South and Far West that are economically most healthy. What the chance to vote for an anti-tax, anti-government candidate represents, in Caddell's formulation, is "a safety valve" that allows them to express those frustrations.

What is apparent from the results in the primaries so far this year, however, is that it is by no means only taxes — or only the north and northeast that are affected.

There are returns, for example, that suggest a combination of volatile issues is required. Edward King relied on abortion and capital punishment, as well as high taxes and Dukakis's reputation for being an abrasive personality. Similarly, in Minnesota a week earlier, Bob Short defeated Rep. Donald Fraser in a Democratic Senate primary on taxes, abortion and an apparently widespread distrust of the political establishment.

The latter, the search for new faces less identified with the power structure, has shown up in other states in which taxes have not been the only concern. That was an issue, for example, in South Carolina, where Richard Riley defeated Lt. Gov. Brantley Harvey for the Democratic gubernatorial nomination; in North Carolina, where John Ingram beat Luther Hodges Jr. for a Senate nomination; in Maryland, where Harry Hughes defeated acting Gov. Blair Lee; in Mississippi, where Maurice Dantin whipped Gov. Cliff Finch for a Senate nomination; in New Jersey, where political novice Jeffrey Bell upset Republican Sen. Clifford Case.

A Republican pollster has found the average job approval rating of 20 incumbent governors to be

Thursday, September 21, 1978 The Washington Star A-1

only 32 per cent. And Peter Hart, another insightful Democratic pollster, says the rule he is following is: "Don't count anything as free and safe this year." Says Caddell: "This (the Dukakis defeat) will scare the living daylights out of every incumbent up."

Some of those incumbents already are running scared. Gov. Hugh Carey of New York, for example, is no better than even money despite having won his primary. The same is true for Govs. Ella Grasso in Connecticut and James Rhodes in Ohio. Some of those who were looking forward to boat rides in November — Govs. Jerry Brown in California and James Thompson in Illinois, for example — no longer can be viewed as totally secure.

Indeed, if there was an incumbent who seemed safe this year, it had to be Dukakis. Although the other politicians derided his determinedly modest personal style — "The guy grows vegetables in his front yard," one of them growled in horror — they had considered him invulnerable to anyone like Ed King.

But what neither they nor Michael Dukakis heard was the sound of a different drummer in the politics of 1978.

WASH. POST 10/2/78

# Carter Steering Democrats His Way

By Edward Walsh
Washington Post Staff Writer

Jimmy Carter has seen the future his political pollster mapped out almost two years ago and has served notice that he intends to take the Democratic Party in that direction.

Last Wednesday night, before a glittering black-tie audience of party officials and contributors, the president delivered the message that he will be preaching from now through the congressional elections this fall and quite possibly through the 1980 presidential campaign.

"I would like to caution all of you Democrats—those in my administration, those in the Congress—that we here in Washington must set an example," he said. "We cannot pass legislation that is identifiably wasteful . . . This is the future of our Democratic Party, a future in which we maintain our vision, even heighten our vision, while governing with prudence and responsibility that builds the confidence of our people in us."

*The college-educated, white-collar, middle and upper-middle voting groups [are] growing so large that simply doing slightly better [among them] than in the past is not sufficient to guarantee election. If there is a "future" in politics, it is in this massive demographic change. We now have almost half the voting population with some college education, a growing percentage of white-collar workers and an essentially middle-class electorate.*

—Patrick H. Caddell
Dec. 10, 1976, memo to President-elect Carter

Carter's speech to the Democratic National Committee fund-raising dinner was one of several the White House has prepared and tried out during the last several weeks in a search for the right tone for a new basic Carter "stump speech" the president can use this fall while campaigning for Democratic congressional candidates.

Its central message—that Carter and his party stand for "prudent" and "fiscally responsible" management with a heart—is being pushed heavily by presidential adviser Gerald Rafshoon to become the main theme of the Carter presidency through the fall elections and possibly beyond.

It is not a message traditionally associated with Democrats, but White House aides are convinced it is what got Carter elected in 1976 and will get him reelected in 1980.

Underlying that conviction is the belief that the middle-class constituency that Patrick H. Caddell pinpointed in his pre-inaugural memo must be won over and maintained, even at the risk of alienating such

See CARTER, A9, Col. 1

File w/ Ed. Boards

# New Carter Theme: Fiscal

CARTER, From A1

traditional Democratic sources of support as organized labor and black groups.

"There are more people in the middle class now and more of a demand not for great social movements or a redistribution of wealth but to gain control of those things that threaten that way of life," one White House aide said.

Chief among the list of "those things" that now preoccupy the White House is inflation.

"Inflation hurts every one of us, not just the poor, not just the elderly," the president told the DNC dinner. It saps away our national strength and will and confidence. Very soon I will announce a new package of anti-inflation measures. They will be tough. They will require sacrifices from business, from labor, from government, from every family, every segment of our society."

Beyond inflation—the overriding domestic political issue at the moment—Carter will be stressing such themes as government efficiency, administration efforts to root out waste and corruption and to "reform" such aspects of the federal establishment as the Civil Service system and the tax code. They are all themes, White House officials believe, that will appeal primarily to the growing middle class, the people who, out of frustration with the performance of government, voted for Proposition 13 in California and have gotten behind similar across-the-board tax-cut efforts in dozens of other states.

According to White House press secretary Jody Powell, such an approach has always formed the foundation of the president's political philosophy and that, more than ever, he believes it is the direction in which the Democratic Party must move to accommodate itself to a changing electorate.

"One advantage the Republicans have had is that the country viewed them as more responsible, better able to handle money, while the Democrats were seen as sort of flighty," Powell said. "I've heard him say a number of times that if we could cut their legs out from under them on that issue, the Democratic Party would be in great shape for years to come."

Moreover, there is a conviction in the White House that many of Carter's problems—beginning with his astonishing slide in the polls during the 1976 election campaign and continuing during much of his presidency—resulted because he strayed from his basic appeal during the primaries as "a decent guy who could run things competently." As Carter sought to accommodate the demands of the various interest groups that make up the traditional Democratic coalition, one aide said, his image became "blurred" and he began to look like a "tinkerer" who was out of his element in the White House.



# Responsibility With a Heart

Presidential aides insist that the president is not about to abandon Democratic commitments on unemployment, health care and a host of other social-welfare programs, but will demand that those commitments be fulfilled "responsibly." The White House, they say, will continue to try to accommodate itself to the traditional Democratic interest groups, but with limits.

Thus, it was at least symbolically significant that during the same week the president warned his party about "waste," he and Vice President Mondale—his ambassador to the liberal wing of the party—were engaged in intensive negotiations with the Congressional Black Caucus over the Humphrey-Hawkins "full-employment" bill.

Despite a minor spat, it all seemed to end well, with Carter renewing his all-out support for the bill, the top legislative priority of the caucus. What neither side bothered to mention was that the bill the president endorsed several months ago and reendorsed last week was a mere shell of the original Humphrey-Hawkins legislation, named for Rep. Augustus F. Hawkins (D-Calif.) and that towering symbol of traditional Democratic liberal politics, the late senator Hubert H. Humphrey (D-Minn.).

The White House rejected the original version as unaccountably inflationary and insisted on so many changes that the bill's stated goal—reducing the overall unemployment rate to 4 percent by 1983—may become meaningless.

In the White House, presidential aides say they recognize the risks in Carter's "true moderate" approach to social problems—alienating black leaders, organized labor and the liberal establishment even more. But they seem unconcerned.

"As for the blacks and labor, he will never satisfy them to the extent they want, and no Democrat or other president can do that responsibly," one official said.

"The lesson of the [1976] primary campaign was that those days are over," he added. "Labor didn't support him, no group supported him. He beat them all."

And so, Carter's aides believe, the president will win again in 1980 if he continues to aim his primary appeal to a tax-weary, inflation-conscious and growing middle class.

"If anyone thinks they are going to knock off Jimmy Carter by harkening back to LBJ and the Great Society and traditional Democratic coalition politics, I think they have misread the country," one official said.

Said another: "You could get a rebellion in the party that would produce a challenge for the nomination from the left. But when you get out there in the country on the campaign trail, that's exactly where I'd like to take a challenge."

of funding 12 years ago as "underinvestment in the future" and a "loss of the U.S. empire in science and technology." For more than a decade, says Price, "academic research in science and technology has been running effectively at half speed compared with the world growth rate of a 6% per annum increase in scientific and technological activity. Many of the other most developed nations of the world have followed our lead a few years later, but still, relative to the rest of the world, the United States is falling back at about 3% per annum. It is this loss in our 'scientific and technical empire' [I make an analogy with the loss of British empire which I experienced in my youth] which makes itself felt in the adverse balance of our dominant high technology international trade and thereby devalues the dollar in the world exchanges.

"In 1967, at peak, the United States was about 33% of all world science and technology across the board. The decline, due to saturation at the previously mentioned 3% per annum, has been producing a 1% fall in our share of the world's science and technology every year and we are now, so far as I can make a guesstimate, only about 25% world science. Since the United States has only about 7% of the world population, one can express these figures by saying that at peak in 1967 we had about five times the average share of world affluence or per capita GNP. It is now, in 1978, about 3½ times the average and unless heroic measures are taken we will have been reduced to only about double the world average before the year 2000 A.D."

Before taking such "heroic measures," Price thinks that a useful first step would be to "disaggregate" the basic science budget which is now combined with other items, including technology purchases and civil service science, to form a "dangerously misleading aggregation." Then he would treat the basic science budget to "moderate increases instead of decline." He sees the 11 percent boost requested for basic research in the Carter budget as helpful but not sufficient. What academic science needs, he says, is funding over perhaps a 10-year period to make up for the cuts it has suffered. To do this would require an increase of 16 percent a year in the academic science budget and, if funds were provided to compensate for a 6 percent inflation rate, Price calculates a 22 percent increase would be in order.

These would be heroic measures indeed, but Price insists that the choice is between such action or rapid decline.

Price's bid for support of basic science was not subjected to questioning by either legislators or his fellow panelists because he departed immediately after giving his testimony. Price, a versatile academic whose interests and expertise range from the development of scientific instruments to the wilder shores of science policy, was scheduled to chair a session on "Science and the Ism's of the 20th Century," set for the same hour.

Challenges to Price's views seem predictable from those who feel that improvement of U.S. performance in industrial innovation is the main problem for science policy today and that heroic increases in the basic research budget are not the way to solve it. Senate staff members say that Senator Adlai Stevenson III found Price's paper provocative, and Price's analyses have a way of getting noticed in academia, so there could be a delayed reaction.

—JOHN WALSH

## Patent Policy Changes Stir Concern

Acting on recommendations that date as far back as 1971, the General Services Administration (GSA) has amended federal procurement regulations to permit universities to get a larger share of the commercial benefits of federally financed research.

The new regulations were based primarily on suggestions by a subcommittee of the Federal Council for Science and Technology that greater incentives are needed for universities to pursue commercialization of their research. The GSA regulations would provide this incentive by encouraging federal agencies to allow universities to retain possession and control of their federally financed discoveries; universities, in turn, would be encouraged to license these discoveries to private industry.

Specifically, the regulations provide for a standard agreement between federal agencies and universities, known as an Institutional Patent Agreement (IPA). "The agreements permit . . . institutions, subject to certain conditions, to retain the entire right, title, and interest in inventions made in the course of their contracts" with the federal government.

Such agreements are in common use by federal agencies now, but each may have a slightly different form. The GSA regulations require that all new IPA's, meaning any written or rewritten after the effective date of 20 March, must follow a single standard.

Moreover, the standard specified in the regulations is different from the IPA's being used now in several respects, according to several federal patent officials.

1) The new IPA can be used to cover research funded through contracts as well as grants.

2) The new IPA increases the period of exclusive control that a university can give to a licensee from 3 years after the initial marketing of a product to 5 years after the initial marketing.

3) The time that a licensee spends trying to get a federal regulatory agency to approve the product will be exempted from the time limits on exclusive marketing.

4) It permits universities to affiliate with for-profit patent management companies, which are organized to promote the licensing of university discoveries to private industry.

5) It removes the ceiling on the amount of royalties from a discovery that can be returned to the researcher who invented it, essentially allowing each university to set its own policy on the amounts.

Although this patent policy is intended to facilitate the transfer of research results from laboratory to marketplace, there is some concern on Capitol Hill that it goes too far in the direction of allowing profit-making firms to benefit from federally funded research. Also of concern is a provision that could pressure researchers to withhold publication pending patent filings. Senator Gaylord Nelson (D–Wis.), chairman of the Small Business Committee, hopes to hold hearings before the policy goes into effect next week. If that cannot be done, he intends to ask the Office of Management and Budget to delay implementation until hearings can be scheduled.—R. JEFFREY SMITH


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# BIOMEDICAL R&D: SCIENTISTS NEED MORE SAY

Federally sponsored biomedical research needs more stable funding and needs to be left more completely in the hands of scientists, concludes a prestigious Presidential review panel after a 15-month study.

The seven-member President's Biomedical Research Panel was set up early last year to evaluate the impact of federally funded research on biomedical and behavioral sciences. Its report is, in a sense, a review of the system from within, for although none of the members are full-time federal employees, five are physicians affiliated with university medical schools. The chairman, Dr. Franklin D. Murphy, is a corporate executive who was formerly dean of a medical school, and the remaining member is chairman of the three-member President's Cancer Panel, which oversees many of the activities of the National Cancer Institute.

With the right support, the panel sees medical researchers as capable of learning to control or prevent all human diseases. Meeting this goal will require steady, hard work for several decades, the panel says. It cannot be done by any sort of crash program. "What is needed now is some sort of settling down for the long haul," the panel believes. "Most of all, the scientific enterprise needs stability and predictability. It does not require growth and expansion at the rate achieved in the 1950's and 1960's, but it cannot survive being turned on and off."

The panel looked mainly at the planning, policy making, and advisory mechanisms within the National Institutes of Health and the Alcohol, Drug Abuse & Mental Health Administration, the two major institutions responsible for federal support of biomedical and behavioral research. In almost every case, the panel calls for more scientific control.

For instance, on the matter of developing research budgets, the panel believes that Congress and the Office of Management & Budget have been making too many science decisions without "strong scientific guidance." This guidance could come from the new Presidential science adviser, whose staff should include in a senior position an eminent biomedical and behavioral scientist. A strong NIH director would be another source of advice. And the panel recommends expanding the President's Cancer Panel to oversee all NIH institutes.

NIH's peer review system for determining which research proposals receive funding wins high praise from the panel. Calling it one of the most valuable management tools used by NIH, the panel says the system "advances the scientific enterprise with predictable efficiency and therefore gives the taxpayer more for his dollar." As to the charge sometimes heard that the system fosters elitism, the panel finds this charge has some merit but this trait is actually beneficial since "selection on the basis of excellence is elitist."

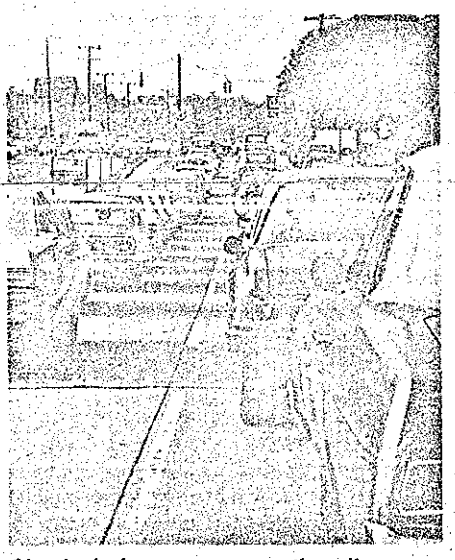
In fact, the panel is more concerned that Congressionally mandated public exposure of peer review proceedings and of preliminary scientific data from federally supported projects will be detrimental to advancing scientific excellence. It calls for amending the Public Health Service Act to allow both peer review hearings and preliminary data from research projects to remain confidential. □

## Auto sulfate hazard less than predicted

Roadside accumulation of sulfate emissions from cars equipped with catalytic exhaust converters is apparently less than previously believed. This finding by General Motors researchers casts doubt on earlier Environmental Protection Agency predictions that there might be a potential hazard from sulfate emissions.

The GM findings come from a study conducted jointly by EPA and GM last October at the company's Milford, Mich., test track. Data were presented two weeks ago to a House Science & Technology Subcommittee. In the study GM scientists compared sulfate emissions measured at the test track with predictions based on EPA's "worst case" mathematical model. Designed to simulate traffic density on a so-called "1985 freeway" (by 1985 most cars are expected to have catalytic converters), the test used a total of 352 catalyst-equipped cars, including vehicles from Ford, Chrysler, and American Motors. Test cars ran on unleaded fuel containing 0.03% sulfur, the U.S. average for unleaded motor fuel.

Catalytic converters, however, have been criticized for producing potentially unacceptable levels of sulfates by oxidizing sulfur normally found in gasoline, just as the converters oxidize unburned hydrocarbons and carbon monoxide to water and carbon dioxide. Under unusual meteorological conditions such as temperature inversions and light winds, a fleet of largely catalyst-equipped cars might produce high sulfate concentrations along heavily traveled roads. EPA initially believed the sulfate question serious enough to be a health hazard for individuals with respiratory disease, but it later backed away from that position.



*Air turbulence apparently disperses sulfate emissions from autos*

Based on the GM tests, says Charles S. Tuesday, technical director of General Motors Research Laboratories, "it has been found that in driving of typical high-density freeways, the sulfate emission rate is considerably lower than EPA's early estimates. Furthermore, there is evidence that the amount of sulfate emitted decreases substantially as the vehicle accumulates mileage." What this means, Tuesday says, is that actual amounts of sulfate emissions from individual vehicles on crowded

was no sound of effort to pronounce a truth of such nature; no tone of truth or falsehood; only indifference.

The prosecutor handed him a sheet of paper. "Is this the agreement you signed?"

Keating held the paper in his hand. "Yes."

"Is that Howard Roark's signature?"

"Yes."

"Will you please read the terms of this agreement to the jury?"

Keating read it aloud. His voice came evenly, well drilled. Nobody in the courtroom realized that this testimony had been intended as a sensation. It was not a famous architect publicly confessing incompetence; it was a man reciting a memorized lesson. People felt that were he interrupted, he would not be able to pick up the next sentence, but would have to start all over again from the beginning.

He answered a great many questions. The prosecutor introduced in evidence Roark's original drawings of Cortlandt, which Keating had kept; the copies which Keating had made of them; and photographs of Cortlandt as it had been built.

"Why did you object so strenuously to the excellent structural changes suggested by Mr. Prescott and Mr. Webb?"

"I was afraid of Howard Roark."

"What did your knowledge of his character lead you to expect?"

"Anything."

"What do you mean?"

"I don't know. I was afraid. I used to be afraid."

The questions went on. The story was unusual, but the audience felt bored. It did not sound like the recital of a participant. The other witnesses had seemed to have a more personal connection with the case.

When Keating left the stand, the audience had the odd impression that no change had occurred in the act of a man's exit; as if no person had walked out.

"The prosecution rests," said the District Attorney.

The judge looked at Roark.

"Proceed," he said. His voice was gentle.

Roark got up. "Your Honor, I shall call no witnesses. This will be my testimony and my summation."

"Take the oath."

Roark took the oath. He stood by the steps of the witness stand. The audience looked at him. They felt he had no chance. They could drop the nameless resentment, the sense of insecurity which he aroused in most people. And so, for the first time, they could see him as he was: a man totally innocent of fear.

The fear of which they thought was not the normal kind, not a response to a tangible danger, but the chronic, uncontrolled fear in which they all lived. They remembered the misery of the moments when, in loneliness, a man thinks of the bright words he could have said, but had not found, and hates those who robbed him of his courage. The misery of knowing how strong and able one is in one's own mind, the radiant picture never to be made real. Dreams? Self-delusion? Or a murdered reality, unborn, killed by that corroding emotion without name —fear—need—dependence—hatred?

Roark stood before them as each man stands in the innocence of his own mind. But Roark stood like that before a hostile crowd—and they knew suddenly that no hatred was possible to him. For the flash of an instant, they grasped the manner of his consciousness. Each asked himself: do I need anyone's approval?—does it matter?—am I tied? And for that instant, each man was free—free enough to feel benevolence for every other man in the room.

It was only a moment; the moment of silence when Roark was about to speak.

"Thousands of years ago, the first man discovered how to make fire. He was probably burned at the stake he had taught his brothers to light. He was considered an evildoer who had dealt with a demon mankind dreaded. But thereafter men had fire to keep them warm, to cook their food, to light their caves. He had left them a gift they had not conceived and he had lifted darkness off the earth. Centuries later, the first man invented the wheel. He was probably torn on the rack he had taught his brothers to build. He was considered a transgressor who ventured into forbidden territory. But thereafter, men could travel past any horizon. He had left them a gift they had not conceived and he had opened the roads of the world.

"That man, the unsubmissive and first, stands in the opening chapter of every legend mankind has recorded about its beginning. Prometheus was chained to a rock and torn by vultures—because he had stolen the fire of the gods. Adam was condemned to suffer—because he had eaten the fruit of the tree of knowledge. Whatever the legend, somewhere in the shadows of its memory mankind knew that its glory began with one and that that one paid for his courage.

"Throughout the centuries there were men who took first steps down new roads armed with nothing but their own vision. Their goals differed, but they all had this in common: that the step was first, the road new, the vision unborrowed, and the response they received—hatred. The great creators—the thinkers, the artists, the scientists, the inventors—stood alone against the men of their time. Every great new thought was opposed. Every great new invention was denounced. The first motor was considered foolish. The airplane was considered impossible. The power loom was considered vicious. Anesthesia was considered sinful. But the men of unborrowed vision went ahead. They fought, they suffered and they paid. But they won.

"No creator was prompted by a desire to serve his brothers, for his brothers rejected the gift he offered and that gift destroyed the slothful routine of their lives. His truth was his only motive. His own truth, and his own work to achieve it in his own way. A symphony, a book, a picture, a philosophy, an airplane or a building—that was his goal and his life. Not those who heard, read, operated, believed, flew or inhabited the thing he had created. The creation, not its users. The creation, not the benefits others derived from it. The creation which gave form to his truth. He held his truth above all things and against all men.

"His vision, his strength, his courage came from his own spirit. A man's spirit, however, is his self. That entity which is his consciousness. To think, to feel, to judge, to act are functions of the ego.

"The creators were not selfless. It is the whole secret of their power—that it was self-sufficient, self-motived, self-generated. A first cause, a fount of energy, a life force, a Prime Mover. The creator served nothing and no one. He lived for himself.

"And only by living for himself was he able to achieve the things which are the glory of mankind. Such is the nature of achievement.

"Man cannot survive except through his mind. He comes on earth unarmed. His brain is his only weapon. Animals obtain food by force. Man has no claws, no fangs, no horns, no great strength of muscle. He must plant his food or hunt it. To plant, he needs a process of thought. To hunt, he needs weapons, and to make weapons—a process of thought. From this simplest necessity to the highest religious abstraction, from the wheel to the skyscraper, everything we are and everything we have comes from a single attribute of man—the function of his reasoning mind.

"But the mind is an attribute of the individual. There is no such thing as a collective brain. There is no such thing as a collective thought. An agreement reached by a group of men is only a compromise or an average drawn upon many individual thoughts. It is a secondary consequence. The primary act—the process of reason—must be performed by each man alone. We can divide a meal among many men. We cannot digest it in a collective stomach. No man can use his lungs to breathe for another man. No man can use his brain to think for another. All the functions of body and spirit are private. They cannot be shared or transferred.

"We inherit the products of the thought of other men. We inherit the wheel. We make a cart. The cart becomes an automobile. The automobile becomes an airplane. But all through the process what we receive from others is only the end product of their thinking. The moving force is the creative faculty which takes this product as material, uses it and originates the next step. This creative faculty cannot be given or received,



or shared or borrowed. It belongs to single, individual men. That which it creates is the property of the creator. Men learn from one another. But all learning is only the exchange of material. No man can give another the capacity to think. Yet that capacity is our only means of survival.

"Nothing is given to man on earth. Everything he needs has to be produced. And here man faces his basic alternative: he can survive in only one of two ways—by the independent work of his own mind or as a parasite fed by the minds of others. The creator originates. The parasite borrows. The creator faces nature alone. The parasite faces nature through an intermediary.

"The creator's concern is the conquest of nature. The parasite's concern is the conquest of men.

"The creator lives for his work. He needs no other men. His primary goal is within himself. The parasite lives second-hand. He needs others. Others become his prime motive.

"The basic need of the creator is independence. The reasoning mind cannot work under any form of compulsion. It cannot be curbed, sacrificed or subordinated to any consideration whatsoever. It demands total independence in function and in motive. To a creator, all relations with men are secondary.

"The basic need of the second-hander is to secure his ties with men in order to be fed. He places relations first. He declares that man exists in order to serve others. He preaches altruism.

"Altruism is the doctrine which demands that man live for others and place others above self.

"No man can live for another. He cannot share his spirit just as he cannot share his body. But the second-hander has used altruism as a weapon of exploitation and reversed the base of mankind's moral principles. Men have been taught every precept that destroys the creator. Men have been taught dependence as a virtue.

"The man who attempts to live for others is a dependent. He is a parasite in motive and makes parasites of those he serves. The relationship produces nothing but mutual corruption. It is impossible in concept. The nearest approach to it in reality—the man who lives to serve others—is the slave. If physical slavery is repulsive, how much more repulsive is the concept of servility of the spirit? The conquered slave has a vestige of honor. He has the merit of having resisted and of considering his condition evil. But the man who enslaves himself voluntarily in the name of love is the basest of creatures. He degrades the dignity of man and he degrades the conception of love. But this is the essence of altruism.

"Men have been taught that the highest virtue is not to achieve, but to give. Yet one cannot give that which has not been created. Creation comes before distribution—or there will be nothing to distribute. The need of the creator comes before

the need of any possible beneficiary. Yet we are taught to admire the second-hander who dispenses gifts he has not produced above the man who made the gifts possible. We praise an act of charity. We shrug at an act of achievement.

"Men have been taught that their first concern is to relieve the suffering of others. But suffering is a disease. Should one come upon it, one tries to give relief and assistance. To make that the highest test of virtue is to make suffering the most important part of life. Then man must wish to see others suffer—in order that he may be virtuous. Such is the nature of altruism. The creator is not concerned with disease, but with life. Yet the work of the creators has eliminated one form of disease after another, in man's body and spirit, and brought more relief from suffering than any altruist could ever conceive.

"Men have been taught that it is a virtue to agree with others. But the creator is the man who disagrees. Men have been taught that it is a virtue to swim with the current. But the creator is the man who goes against the current. Men have been taught that it is a virtue to stand together. But the creator is the man who stands alone.

"Men have been taught that the ego is the synonym of evil, and selflessness the ideal of virtue. But the creator is the egotist in the absolute sense, and the selfless man is the one who does not think, feel, judge or act. These are functions of the self.

"Here the basic reversal is most deadly. The issue has been perverted and man has been left no alternative—and no freedom. As poles of good and evil, he was offered two conceptions: egotism and altruism. Egotism was held to mean the sacrifice of others to self. Altruism—the sacrifice of self to others. This tied man irrevocably to other men and left him nothing but a choice of pain: his own pain borne for the sake of others or pain inflicted upon others for the sake of self. When it was added that man must find joy in self-immolation, the trap was closed. Man was forced to accept masochism as his ideal—under the threat that sadism was his only alternative. This was the greatest fraud ever perpetrated on mankind.

"This was the device by which dependence and suffering were perpetuated as fundamentals of life.

"The choice is not self-sacrifice or domination. The choice is independence or dependence. The code of the creator or the code of the second-hander. This is the basic issue. It rests upon the alternative of life or death. The code of the creator is built on the needs of the reasoning mind which allows man to survive. The code of the second-hander is built on the needs of a mind incapable of survival. All that which proceeds from man's independent ego is good. All that which proceeds from man's dependence upon men is evil.

"The egotist in the absolute sense is not the man who sacrifices others. He is the man who stands above the need of using others in any manner. He does not function through them. He



is not concerned with them in any primary matter. Not in his aim, not in his motive, not in his thinking, not in his desires, not in the source of his energy. He does not exist for any other man—and he asks no other man to exist for him. This is the only form of brotherhood and mutual respect possible between men.

"Degrees of ability vary, but the basic principle remains the same: the degree of a man's independence, initiative and personal love for his work determines his talent as a worker and his worth as a man. Independence is the only gauge of human virtue and value. What a man is and makes of himself; not what he has or hasn't done for others. There is no substitute for personal dignity. There is no standard of personal dignity except independence.

"In all proper relationships there is no sacrifice of anyone to anyone. An architect needs clients, but he does not subordinate his work to their wishes. They need him, but they do not order a house just to give him a commission. Men exchange their work by free, mutual consent to mutual advantage when their personal interests agree and they both desire the exchange. If they do not desire it, they are not forced to deal with each other. They seek further. This is the only possible form of relationship between equals. Anything else is a relation of slave to master, or victim to executioner.

"No work is ever done collectively, by a majority decision. Every creative job is achieved under the guidance of a single individual thought. An architect requires a great many men to erect his building. But he does not ask them to vote on his design. They work together by free agreement and each is free in his proper function. An architect uses steel, glass, concrete, produced by others. But the materials remain just so much steel, glass and concrete until he touches them. What he does with them is his individual product and his individual property. This is the only pattern for proper co-operation among men.

"The first right on earth is the right of the ego. Man's first duty is to himself. His moral law is never to place his prime goal within the persons of others. His moral obligation is to do what he wishes, provided his wish does not depend *primarily* upon other men. This includes the whole sphere of his creative faculty, his thinking, his work. But it does not include the sphere of the gangster, the altruist and the dictator.

"A man thinks and works alone. A man cannot rob, exploit or rule—alone. Robbery, exploitation and ruling presuppose victims. They imply dependence. They are the province of the second-hander.

"Rulers of men are not egotists. They create nothing. They exist entirely through the persons of others. Their goal is in their subjects, in the activity of enslaving. They are as dependent as the beggar, the social worker and the bandit. The form of dependence does not matter.

"But men were taught to regard second-handers—tyrants, emperors, dictators—as exponents of egotism. By this fraud they were made to destroy the ego, themselves and others. The purpose of the fraud was to destroy the creators. Or to harness them. Which is a synonym.

"From the beginning of history, the two antagonists have stood face to face: the creator and the second-hander. When the first creator invented the wheel, the first second-hander responded. He invented altruism.

"The creator—denied, opposed, persecuted, exploited—went on, moved forward and carried all humanity along on his energy. The second-hander contributed nothing to the process except the impediments. The contest has another name: the individual against the collective.

"The 'common good' of a collective—a race, a class, a state—was the claim and justification of every tyranny ever established over men. Every major horror of history was committed in the name of an altruistic motive. Has any act of selfishness ever equaled the carnage perpetrated by disciples of altruism? Does the fault lie in men's hypocrisy or in the nature of the principle? The most dreadful butchers were the most sincere. They believed in the perfect society reached through the guillotine and the firing squad. Nobody questioned their right to murder since they were murdering for an altruistic purpose. It was accepted that man must be sacrificed for other men. Actors change, but the course of the tragedy remains the same. A humanitarian who starts with declarations of love for mankind ends with a sea of blood. It goes on and will go on so long as men believe that an action is good if it is unselfish. That permits the altruist to act and forces his victims to bear it. The leaders of collectivist movements ask nothing for themselves. But observe the results.

"The only good which men can do to one another and the only statement of their proper relationship is—Hands off!

"Now observe the results of a society built on the principle of individualism. This, our country. The noblest country in the history of men. The country of greatest achievement, greatest prosperity, greatest freedom. This country was not based on selfless service, sacrifice, renunciation or any precept of altruism. It was based on a man's right to the pursuit of happiness. His own happiness. Not anyone else's. A private, personal, selfish motive. Look at the results. Look into your own conscience.

"It is an ancient conflict. Men have come close to the truth, but it was destroyed each time and one civilization fell after another. Civilization is the progress toward a society of privacy. The savage's whole existence is public, ruled by the laws of his tribe. Civilization is the process of setting man free from men.

"Now, in our age, collectivism, the rule of the second-hander



and second-rater, the ancient monster, has broken loose and is running amuck. It has brought men to a level of intellectual indecency never equaled on earth. It has reached a scale of horror without precedent. It has poisoned every mind. It has swallowed most of Europe. It is engulfing our country.

"I am an architect. I know what is to come by the principle on which it is built. We are approaching a world in which I cannot permit myself to live.

"Now you know why I dynamited Cortlandt.

"I designed Cortlandt. I gave it to you. I destroyed it.

"I destroyed it because I did not choose to let it exist. It was a double monster. In form and in implication. I had to blast both. The form was mutilated by two second-handers who assumed the right to improve upon that which they had not made and could not equal. They were permitted to do it by the general implication that the altruistic purpose of the building superseded all rights and that I had no claim to stand against it.

"I agreed to design Cortlandt for the purpose of seeing it erected as I designed it and for no other reason. That was the price I set for my work. I was not paid.

"I do not blame Peter Keating. He was helpless. He had a contract with his employers. It was ignored. He had a promise that the structure he offered would be built as designed. The promise was broken. The love of a man for the integrity of his work and his right to preserve it are now considered a vague intangible and an unessential. You have heard the prosecutor say that. Why was the building disfigured? For no reason. Such acts never have any reason, unless it's the vanity of some second-handers who feel they have a right to anyone's property, spiritual or material. Who permitted them to do it? No particular man among the dozens in authority. No one cared to permit it or to stop it. No one was responsible. No one can be held to account. Such is the nature of all collective action.

"I did not receive the payment I asked. But the owners of Cortlandt got what they needed from me. They wanted a scheme devised to build a structure as cheaply as possible. They found no one else who could do it to their satisfaction. I could and did. They took the benefit of my work and made me contribute it as a gift. But I am not an altruist. I do not contribute gifts of this nature.

"It is said that I have destroyed the home of the destitute. It is forgotten that but for me the destitute could not have had this particular home. Those who were concerned with the poor had to come to me, who have never been concerned, in order to help the poor. It is believed that the poverty of the future tenants gave them a right to my work. That their need constituted a claim on my life. That it was my duty to contribute anything demanded of me. This is the second-hander's credo now swallowing the world.

"I came here to say that I do not recognize anyone's right

to one minute of my life. Nor to any part of my energy. Nor to any achievement of mine. No matter who makes the claim, how large their number or how great their need.

"I wished to come here and say that I am a man who does not exist for others.

"It had to be said. The world is perishing from an orgy of self-sacrificing.

"I wished to come here and say that the integrity of a man's creative work is of greater importance than any charitable endeavor. Those of you who do not understand this are the men who're destroying the world.

"I wished to come here and state my terms. I do not care to exist on any others.

"I recognize no obligations toward men except one: to respect their freedom and to take no part in a slave society. To my country, I wish to give the ten years which I will spend in jail if my country exists no longer. I will spend them in memory and in gratitude for what my country has been. It will be my act of loyalty, my refusal to live or work in what has taken its place.

"My act of loyalty to every creator who ever lived and was made to suffer by the force responsible for the Cortlandt I dynamited. To every tortured hour of loneliness, denial, frustration, abuse he was made to spend—and to the battles he won. To every creator whose name is known—and to every creator who lived, struggled and perished unrecognized before he could achieve. To every creator who was destroyed in body or in spirit. To Henry Cameron. To Steven Mallory. To a man who doesn't want to be named, but who is sitting in this courtroom and knows that I am speaking of him."

Roark stood, his legs apart, his arms straight at his sides, his head lifted—as he stood in an unfinished building. Later, when he was seated again at the defense table, many men in the room felt as if they still saw him standing; one moment's picture that would not be replaced.

The picture remained in their minds through the long legal discussions that followed. They heard the judge state to the prosecutor that the defendant had, in effect, changed his plea: he had admitted his act, but had not pleaded guilty of the crime; an issue of temporary legal insanity was raised; it was up to the jury to decide whether the defendant knew the nature and quality of his act, or, if he did, whether he knew that the act was wrong. The prosecutor raised no objection: there was an odd silence in the room; he felt certain that he had won his case already. He made his closing address. No one remembered what he said. The judge gave his instructions to the jury. The jury rose and left the courtroom.

People moved, preparing to depart, without haste, in expectation of many hours of waiting. Wynand, at the back of the room, and Dominique, in the front, sat without moving.



A bailiff stepped to Roark's side to escort him out. Roark stood by the defense table. His eyes went to Dominique, then to Wynand. He turned and followed the bailiff.

He had reached the door when there was a sharp crack of sound, and a space of blank silence before people realized that it was a knock at the closed door of the jury room. The jury had reached a verdict.

Those who had been on their feet remained standing, frozen, until the judge returned to the bench. The jury filed into the courtroom.

"The prisoner will rise and face the jury," said the clerk of the court.

Howard Roark stepped forward and stood facing the jury. At the back of the room, Gail Wynand got up and stood also.

"Mr. Foreman, have you reached a verdict?"

"We have."

"What is your verdict?"

"Not guilty."

The first movement of Roark's head was not to look at the city in the window, at the judge or at Dominique. He looked at Wynand.

Wynand turned sharply and walked out. He was the first man to leave the courtroom.

## 19

Roger Enright bought the site, the plans and the ruins of Cortlandt from the government. He ordered every twisted remnant of foundations dug out to leave a clean hole in the earth. He hired Howard Roark to rebuild the project. Placing a single contractor in charge, observing the strict economy of the plans, Enright budgeted the undertaking to set low rentals with a comfortable margin of profit for himself. No questions were to be asked about the income, occupation, children or diet of the future tenants; the project was open to anyone who wished to move in and pay the rent, whether he could afford a more expensive apartment elsewhere or not.

Late in August Gail Wynand was granted his divorce. The suit was not contested and Dominique was not present at the brief hearing. Wynand stood like a man facing a court-martial and heard the cold obscenity of legal language describing the breakfast in a house of Monadnock Valley—Mrs. Gail Wynand—Howard Roark; branding his wife as officially dishonored, granting him lawful sympathy, the status of injured innocence, and a paper that was his passport to freedom for

# OTHERS ARE SAYING...

Please check why these cures are being withheld

## Ignoring Cancer

If the federal department of Health, Education and Welfare (HEW) really wants a breakthrough in cancer research, it's discovered a unique way of showing it.

The department, over the last two years of Joseph Califano's regime, has become a bottleneck for new discoveries which could hold the promise of early detection — and control — of cancer.

But HEW is hung up on who should retain patent rights over such discoveries — the government or the scientists who develop the pioneering techniques.

Unable to make up its mind, HEW thus prevents the clinical testing of such discoveries by companies that would ultimately manufacture and distribute the compounds.

In this limbo, scientists lose interest as their discoveries languish. And manufacturers turn to other pursuits, leaving the various products unconfirmed as to their value and in short supply if they do have merit.

Two examples have recently come to light.

Two government-funded scientists at opposite ends of the world discovered revolutionary techniques for treating cancer.

In Israel, Dr. Michael Sela found an early detection blood test for breast and digestive-tract cancer.

At the University of Arizona, Dr. Sydney Salmon discovered a simple lab test for cancer that can be conducted in test tubes rather than on patients, thus eliminating painful drugs.

HEW lawyers, apparently arguing that hospital costs will go up if the patents are privately held, won't clear the way for testing while the debate rages.

Now, it can be argued that the scientists are being selfish in pursuit of the profit motive.

It also can be argued that politics is taking precedence over science.

The one irrefutable fact is that something has become lost in the test of wills — the commitment to human life and the preservation of it through cancer-fighting chemicals.

Surely, the government's investment in these discoveries becomes lost as time drags on and more patients die and other techniques come to the fore.

So why the impasse?

Sen. Robert Dole, R-Kansas, made this very serious charge the other day: "HEW has decided to pull the plug on development of biomedical research. They have decided to withhold potential cures and revolutionary new diagnostic techniques for treating such diseases as cancer, arthritis, hepatitis and emphysema."

Is it really too difficult to put priorities where they belong — on human life?

Is it beyond human vision to devise a way whereby government could recover its investment while at the same time rewarding the scientist or the pharmaceutical company for their daring and discovery?

Certainly, to shut and lock the door on such cancer breakthroughs serve neither the cause of science or compassion or profit.

Sensing this, no doubt, and prodded by Senator Dole, Califano the other day ordered a number of potential cures freed for further testing and distribution.

That is the least that an afflicted public should expect.

Cancer poses enough frustrations and heartaches without the HEW adding one, even fractional, delay in delivering treatment to the sick.

—Morning Star, Rockford

the small society

TEXT

PATENT, TRADEMARK & COPYRIGHT JOURNAL

# PRESIDENT'S MESSAGE TO CONGRESS MARCH 16, 1972, ON SCIENCE AND TECHNOLOGY, INCLUDING FACT SHEET

## THE WHITE HOUSE

TO THE CONGRESS OF THE UNITED STATES:

The ability of the American people to harness the discoveries of science in the service of man has always been an important element in our national progress. As I noted in my most recent message on the State of the Union, Americans have long been known all over the world for their technological ingenuity -- for being able to "build a better mousetrap" -- and this capacity has undergirded both our domestic prosperity and our international strength.

We owe a great deal to the researchers and engineers, the managers and entrepreneurs who have made this record possible. Again and again they have met what seemed like impossible challenges. Again and again they have achieved success. They have found a way of preventing polio, placed men on the moon, and sent television pictures across the oceans. They have contributed much to our standard of living and our military strength.

But the accomplishments of the past are not something we can rest on. They are something we must build on. I am therefore calling today for a strong new effort to marshal science and technology in the work of strengthening our economy and improving the quality of our life. And I am outlining ways in which the Federal Government can work as a more effective partner in this great task.

The importance of technological innovation has become dramatically evident in the past few years. For one thing, we have come to recognize that such innovation is essential to improving our economic productivity -- to producing more and better goods and services at lower costs. And improved productivity, in turn, is essential if we are to achieve a full and durable prosperity -- without inflation and without war. By fostering greater productivity, technological innovation can help us to expand our markets at home and abroad, strengthening old industries, creating new ones, and generally providing more jobs for the millions who will soon be entering the labor market.

This work is particularly important at a time when other countries are rapidly moving upward on the scientific and technological ladder, challenging us both in intellectual and in economic terms. Our international position in fields such as electronics, aircraft, steel, automobiles and shipbuilding is not as strong as it once was. A better performance is essential to both the health of our domestic economy and our leadership position abroad.

At the same time, the impact of new technology can do much to enrich the quality of our lives. The forces which threaten that quality will be growing at a dramatic pace in the years ahead. One of the great questions of our time is whether our capacity to deal with these forces will grow at a similar rate. The answer to that question lies in our scientific and technological progress.

As we face the new challenges of the 1970's, we can draw upon a great reservoir of scientific and technological information and skill -- the result of the enormous investments which both the Federal Government and private enterprise made in research and development in recent years. In addition, this Nation's historic commitment to scientific excellence, its determination to take the lead in exploring the unknown, have given us a great tradition, a rich legacy on which to draw. Now it is for us to extend that tradition by applying that legacy in new situations.

In pursuing this goal, it is important to remember several things. In the first place, we must always be aware that the mere act of scientific discovery alone is not enough. Even the most important breakthrough will have little impact on our lives unless it is put to use -- and putting an idea to use is a far more complex process than has often been appreciated. To accomplish this transformation, we must combine the genius of invention with the skills of entrepreneurship, management, marketing and finance.

Secondly, we must see that the environment for technological innovation is a favorable one. In some cases, excessive regulation, inadequate incentives and other barriers to innovation have worked to discourages and even to impede the entrepreneurial spirit. We need to do a better job of determining the extent to which such conditions exist, their underlying causes, and the best ways of dealing with them.

Thirdly, we must realize that the mere development of a new idea does not necessarily mean that it can or should be put into immediate use. In some cases, laws or regulations may inhibit its implementation. In other cases, the costs of the process may not be worth the benefits it produces. The introduction of some new technologies may produce undesirable side effects. Patterns of living and human behavior must also be taken into account. By realistically appreciating the limits of technological innovation, we will be in a better position fully to marshal its amazing strengths.

A fourth consideration concerns the need for scientific and technological manpower. Creative, inventive, dedicated scientists and engineers will surely be in demand in the years ahead; young people who believe they would find satisfaction in such careers should not hesitate to undertake them. I am convinced they will find ample opportunity to serve their communities and their country in important and exciting ways.

The fifth basic point I would make concerning our overall approach to science and technology in the 1970's concerns the importance of maintaining that spirit of curiosity and adventure which has always driven us to explore the unknown. This means that we must continue to give an important place to basic research and to exploratory experiments which provide the new ideas on which our edifice of technological accomplishment rests. Basic research in both the public and private sectors today is essential to our continuing progress tomorrow. All departments and agencies of the Federal Government will continue to support basic research which can help provide a broader range of future development options.

Finally, we must appreciate that the progress we seek requires a new partnership in science and technology -- one which brings together the Federal Government, private enterprise, State and local governments, and our universities and research centers in a coordinated, cooperative effort to serve the national interest. Each member of that partnership must play the role it can play best; each must respect and reinforce the unique capacities of the other members. Only if this happens, only if our new partnership thrives, can we be sure that our scientific and technological resources will be used as effectively as possible in meeting our priority national needs.

With a new sense of purpose and a new sense of partnership, we can make the 1970's a great new era for American science and technology. Let us look now at some of the specific elements in this process.

## STRENGTHENING THE FEDERAL ROLE

The role of the Federal Government in shaping American science and technology is pivotal. Of all our Nation's expenditures on research and development, 55 percent are presently funded by the Federal Government. Directly or indirectly, the Federal Government supports the employment of nearly half of all research and development personnel in the United States.

A good part of our Federal effort in this field has been directed in the past toward our national security needs. Because a strong national defense is essential to the maintenance of world peace, our research and development in support of national security must always be sufficient to our needs. We must ensure our strategic deterrent capability, continue the modernization of our Armed Forces, and strengthen the overall technological base that underlies future military systems. For these reasons, I have proposed a substantial increase for defense research and development for fiscal year 1973.

In this message, however, I would like to focus on how we can better apply our scientific resources in meeting civilian needs. Since the beginning of this Administration, I have felt that we should be doing more to focus our scientific and technological resources on the problems of the environment, health, energy, transportation and other pressing domestic concerns. If my new budget proposals are accepted, Federal funds for research and development concerning domestic problems will be 65 percent greater in the coming fiscal year than they were in 1969.

But increased funding is not the only prerequisite for progress in this field. We also need to spend our scarce resources more effectively. Accordingly, I have moved to develop an overall strategic approach in the allocation of Federal scientific and technological resources. As a part of this effort, I directed the Domestic Council last year to examine new technology opportunities in relation to domestic problems. In all of our planning, we have been concentrating not only on how much we spend but also on how we spend it.

My recommendations for strengthening the Federal role in science and technology have been presented to the Congress in my State of the Union Message, in my budget for fiscal year 1973, and in individual agency presentations. I urge the Congress to support the various elements of this new Federal strategy.

(1) We are reorienting our space program to focus on domestic needs -- such as communications, weather forecasting and natural resource exploration. One important way of doing this is by designing and developing a reusable space shuttle, a step which would allow us to seize new opportunities in space with higher reliability at lower costs.

(2) We are moving to set and meet certain civilian research and development targets. In my State of the Union Message, my Budget Message and in other communications with the Congress, I have identified a number of areas where new efforts are most likely to produce significant progress and help us meet pressing domestic needs. They include:

-- Providing new sources of energy without pollution. My proposed budget for fiscal year 1973 would increase energy-related research and development expenditures by 22 percent.

-- Developing fast, safe, pollution-free transportation. I have proposed spending 46 percent more in the coming fiscal year on a variety of transportation projects.

-- Working to reduce the loss of life and property from natural disasters. I have asked, for example, that our earthquake research program be doubled and that our hurricane research efforts be increased.

-- Improving drug abuse rehabilitation programs and efforts to curb drug trafficking. Our budget requests in this critical area are four times the level of 1971.

-- Increasing biomedical research efforts, especially those concerning cancer and heart disease, and generally providing more efficient and effective health care, including better emergency health care systems.

(3) We will also draw more directly on the capabilities of our high technology agencies -- the Atomic Energy Commission, the National Aeronautics and Space Administration and the National Bureau of Standards in the Department of Commerce -- in applying research and development to domestic problems.

(4) We are making strong efforts to improve the scientific and technological basis for setting Federal standards and regulations. For example, by learning to measure more precisely the level of air pollution and its effects on our health, we can do a more effective job of setting pollution standards and of enforcing those standards once they are established.

(5) I am also providing in my 1973 budget for a 12 percent increase for research and development conducted at universities and colleges. This increase reflects the effort of the past 2 years to encourage educational institutions to undertake research related to important national problems.

(6) Finally, I believe that the National Science Foundation should draw on all sectors of the scientific and technological community in working to meet significant domestic challenges. To this end, I am taking action to permit the Foundation to support applied research in industry when the use of industrial capabilities would be advantageous in accomplishing the Foundation's objectives.

## SUPPORTING RESEARCH AND DEVELOPMENT IN THE PRIVATE SECTOR

The direction of private scientific and technological activities is determined in large measure by thousands of private decisions -- and this should always be the case. But we cannot ignore the fact that Federal policy also has a great impact on what happens in the private sector. Thus influence is exerted in many ways -- including direct Federal support for such research and development.

In general, I believe it is appropriate for the Federal Government to encourage private research and development to the extent that the market mechanism is not effective in bringing needed innovations into use. This can happen in a number of circumstances. For example, the sheer size of some developmental projects is beyond the reach of private firms particularly in industries which are fragmented into many small companies. In other cases, the benefits of projects cannot be captured by private institutions, even though they may be very significant for the whole of society. In still other cases, the risks of certain projects, while acceptable to society as a whole, are excessive for individual companies.

In all these cases, Federal support of private research and development is necessary and desirable. We must see that such support is made available -- through cost-sharing agreements, procurement policies or other arrangements.

One example of the benefits of such a partnership between the Federal Government and private enterprise is the program I presented last June to meet our growing need for clean energy. As I outlined the Federal role in this effort, I also indicated that industry's response to these initiatives would be crucial. That response has been most encouraging to date. For example, the electric utilities have already pledged some $25 million a year for a period of 10 years for developing a liquid metal fast breeder reactor demonstration plant. These pledges have come through the Edison Electric Institute, the American Public Power Association, and the National Rural Electric Cooperative Association. This effort is one part of a larger effort by the electrical utilities to raise $150 million annually for research and development to meet the growing demand for clean electric power.

At the same time, the gas companies, through the American Gas Association, have raised $10 million to accelerate the effort to convert coal into gas. This sum represents industry's first year share in a pilot plant program which will be financed one-third by industry and two-thirds by the Federal Government. When it proves feasible to proceed to the demonstration stage, industrial contributions to this project will be expected to increase.

APPLYING GOVERNMENT-SPONSORED TECHNOLOGIES

An asset unused is an asset wasted. Federal research and development activities generate a great deal of new technology which could be applied in ways which go well beyond the immediate mission of the supporting agency. In such cases, I believe the Government has a responsibility to transfer the results of its research and development activities to wider use in the private sector.

It was to further this objective that we created in 1970 the new National Technical Information Service in the Department of Commerce. In addition, the new incentives programs of the National Science Foundation and the National Bureau of Standards will seek effective means of improving and accelerating the transfer of research and development results from Federal programs to a wider range of potential users.

One important barrier to the private development and commercial application of Government-sponsored technologies is the lack of incentive which results from the fact that such technologies are generally available to all competitors. To help remedy this situation, I approved last August a change in the Government patent policy which liberalized the private use of Government-owned patents. I directed that such patents may be made available to private firms through exclusive licenses where needed to encourage commercial application.

As a further step in this same direction, I am today directing my Science Adviser and the Secretary of Commerce to develop plans for a new, systematic effort to promote actively the licensing of Government-owned patents and to obtain domestic and foreign patent protection for technology owned by the United States Government in order to promote its transfer into the civilian economy.

IMPROVING THE CLIMATE FOR INNOVATION

There are many ways in which the Federal Government influences the level and the quality of private research and development. Its direct supportive efforts are important, but other policies -- such as tax, patent, procurement, regulation and antitrust policies -- also can have a significant effect on the climate for innovation.

We know, for instance, that a strong and reliable patent system is important to technological progress and industrial strength. The process of applying technology to achieve our national goals calls for a tremendous investment of money, energy and talent by our private enterprise system. If we expect industry to support this investment, we must make the most effective possible use of the incentives which are provided by our patent system.

The way we apply our antitrust laws can also do much to shape research and development. Uncertain reward and high risks can be significant barriers to progress when a firm is small in relation to the scale of effort required for successful projects. In such cases, formal or informal combinations of firms provide one means for hurdling these barriers, especially in highly fragmented industries. On the other hand, joint efforts among leading firms in highly concentrated industries would normally be considered undesirable. In general, combinations which lead to an improved allocation of the resources of the nation are normally permissible, but actions which lead to excessive market power for any single group are not. Any joint program for research and development must be approached in a way that does not detract from the normal competitive incentives of our free enterprise economy.

I believe we need to be better informed about the full consequences of all such policies for scientific and technological progress. For this reason, I have included in my budget for the coming fiscal year a program whereby the National Science Foundation would support assessments and studies focused specifically on barriers to technological innovation and on the consequences of adopting alternative Federal policies which would reduce or eliminate these barriers. These studies would be undertaken in close consultation with the Executive Office of the President, the Department of Commerce and other concerned departments and agencies, so that the results can be most expeditiously considered as further Government decisions are made.

There are a number of additional steps which can also do much to enhance the climate for innovation.

1) I shall submit legislation to encourage the development of the small, high technology firms which have had such a distinguished pioneering record. Because the combination of high technology and small size makes such firms exceptionally risky from an investment standpoint, my proposal would provide additional means for the Small Business Investment Companies (SBICs) to improve the availability of venture capital to such firms.

a. I propose that the ratio of Government support to SBICs be increased. This increased assistance would be channeled to small business concerns which are principally engaged in the development or exploitation of inventions or of technological improvements and new products.

b. I propose that the current limit on Small Business Administration loans to each SBIC be increased to $20 million to allow for growth in SBIC funds devoted to technology investments.

c. I propose that federally regulated commercial banks again be permitted to achieve up to 100 percent ownership of an SBIC, rather than the limited 50 percent ownership which is allowed at present.

d. To enhance risk-taking and entrepreneurial ventures, I again urge passage of the small business tax bill, which would provide for extending the eligibility period for the exercise of qualified stock options from 5 to 8 or 10 years, reducing the holding period for non-registered stock from 3 years to 1 year, and extending the tax-loss carry-forward from 5 to 10 years. These provisions would apply to small firms, as defined in the proposed legislation.

2) I have requested in my proposed budget for fiscal year 1973 that new programs be set up by the National Science Foundation and the National Bureau of Standards to determine effective ways of stimulating non-Federal investment in research and development and of improving the application of research and development results. The experiments to be set up under this program are designed to test a variety of partnership arrangements among the various levels of government, private firms and universities. They would include the exploration of new arrangements for cost-sharing, patent licensing, and research support, as well as the testing of incentives for industrial research associations.

3) To provide a focal point within the executive branch for policies concerning industrial research and development, the Department of Commerce will appraise, on a continuing basis, the technological strengths and weaknesses of American industry. It will propose measures to assure a vigorous state of industrial progress. The Department will work with other agencies in identifying barriers to such progress and will draw on the studies and assessments prepared through the National Science Foundation and the National Bureau of Standards.

4) To foster useful innovation, I also plan to establish a new program of research and development prizes. These prizes will be awarded by the President for outstanding achievements by individuals and institutions and will be used especially to encourage needed innovation in key areas of public concern. I believe these prizes will be an important symbol of the Nation's concern for our scientific and technological challenges.

5) An important step which could be of great significance in fostering technological innovations and enhancing our position in world trade is that of changing to the metric system of measurement. The Secretary of Commerce has submitted to the Congress legislation which would allow us to begin to develop a carefully coordinated national plan to bring about this change.

The proposed legislation would bring together a broadly representative board of private citizens who would work with all sectors of our society in planning for such a transition. Should such a change be decided on, it would be implemented on a cooperative, voluntary basis.

## STRONGER FEDERAL, STATE AND LOCAL PARTNERSHIPS

A consistent theme which runs throughout my program for making government more responsive to public needs is the idea that each level of government should do what it can do best. This same theme characterizes my approach to the challenges of research and development. The Federal Government, for example, can usually do a good job of massing research and development resources. But State and local governments usually have a much better "feel" for the specific public challenges to which those resources can be applied. If we are to use science and technology effectively in meeting these challenges, then State and local governments should have a central role in the application process. That process is a difficult one at best; it will be even more complex and frustrating the States and localities are not adequately involved.

To help build a greater sense of partnership among the three levels of the Federal system, I am directing my Science Adviser, in cooperation with the Office of Intergovernmental Relations, to serve as a focal point for discussions among various Federal agencies and the representatives of State and local governments. These discussions should lay the basis for developing a better means for collaboration and consultation on scientific and technological questions in the future. They should focus on the following specific subjects:

1) Systematic ways for communicating to the appropriate Federal agencies the priority needs of State and local governments, along with information concerning locally-generated solutions to such problems. In this way, such information can be incorporated into the Federal research and development planning process.

2) Ways of assuring State and local governments adequate access to the technical resources of major Federal research and development centers, such as those which are concerned with transportation, the environment, and the development of new sources of energy.

3) Methods whereby the Federal Government can encourage the aggregation of State and local markets for certain products so that industries can give government purchasers the benefits of innovation and economies of scale.

The discussions which take place between Federal, State and local representatives can also help to guide the experimental programs I have proposed for the National Science Foundation and the National Bureau of Standards. These programs, in turn, can explore the possibilities for creating better ties between State and local governments on the one hand and local industries and universities on the other, thus stimulating the use of research and development in improving the efficiency and effectiveness of public services at the State and local level.

## WORLD PARTNERSHIP IN SCIENCE AND TECHNOLOGY

The laws of nature transcend national boundaries. Increasingly, the peoples of the world are irrevocably linked in a complex web of global interdependence -- and increasingly the strands of that web are woven by science and technology.

The cause of scientific and technological progress has always been advanced when men have been able to reach across international boundaries in common pursuits. Toward this end, we must now work to facilitate the flow of people and the exchange if ideas, and to recognize that the basic problems faced in each nation are shared by every nation.

I believe this country can benefit substantially from the experience of other countries, even as we help other countries by sharing our information and facilities and specialists with them. To promote this goal, I am directing the Federal agencies, under the leadership of the Department of State, to identify new opportunities for international cooperation in research and development. At the same time, I am inviting other countries to join in research efforts in the United States, including:

-- the effort to conquer cancer at the unique research facilities of our National Institutes of Health and at Fort Detrick, Maryland; and

-- the effort to understand the adverse health effects of chemicals, drugs and pollutants at the new National Center for Toxicological Research at Pine Bluff, Arkansas.

These two projects concern priority problems which now challenge the whole world's research community. But they are only a part of the larger fabric of cooperative international efforts in which we are now engaged.

Science and technology can also provide important links with countries which have different political systems from ours. For example, we have recently concluded an agreement with the Soviet Union in the field of health, an agreement which provides for joint research on cancer, heart disease and environmental health problems. We are also cooperating with the Soviet Union in the space field; we will continue to exchange lunar samples and we are exploring prospects for closer cooperation in satellite meteorology, in remote sensing of the environment, and in space medicine. Beyond this, joint working groups have verified the technical feasibility of a docking mission between a SALYUT Station and an Apollo spacecraft.

One result of my recent visit to the People's Republic of China was an agreement to facilitate the development of contacts and exchanges in many fields, including science and technology. I expect to see further progress in this area.

The United Nations and a number of its specialized agencies are also involved in a wide range of scientific and technological activities. The importance of these tasks -- and the clear need for an international approach to technical problems with global implications -- argues for the most effective possible organization and coordination of various international agencies concerned. As a step in this direction, I proposed in a recent message to the Congress the creation of a United Nations Fund for the Environment to foster an international attack on environmental problems. Also, I believe the American scientific community should participate more fully in the science activities of international agencies.

To further these objectives, I am taking steps to initiate a broad review of United States involvement in the scientific and technological programs of international organizations and of steps that might be taken to make United States participation in these activities more effective, with even stronger ties to our domestic programs.

Finally, I would emphasize that United States science and technology can and must play an important role in the progress of developing nations. We are committed to bring the best of our science and technology to bear on the critical problems of development through our reorganized foreign assistance programs.

## A NEW SENSE OF PURPOSE AND A NEW SENSE OF PARTNERSHIP

The years ahead will require a new sense of purpose and a new sense of partnership in science and technology. We must define our goals clearly, so that we know where we are going.

And then we must develop careful strategies for pursuing those goals, strategies which bring together the Federal Government, the private sector, the universities, and the States and local communities in a cooperative pursuit of progress. Only then can we be confident that our public and private resources for science and technology will be spent as effectively as possible.

In all these efforts, it will be essential that the American people be better equipped to make wise judgments concerning public issues which involve science and technology. As our national life is increasingly permeated by science and technology, it is important that public understanding grow apace.

The investment we make today in science and technology and in the development of our future scientific and technical talent is an investment in tomorrow--an investment which can have a tremendous impact on the basic quality of our lives. We must be sure that we invest wisely and well.

RICHARD NIXON

THE WHITE HOUSE, March 16, 1972.

* * *

## THE WHITE HOUSE

## FACT SHEET

## MESSAGE ON SCIENCE AND TECHNOLOGY

### BACKGROUND

The Message being sent to Congress today is the first Presidential Message on Science and Technology in the nation's history.

Scientific research and development account for some $27 billion worth of goods and services in this country. Approximately $17.8 billion worth will be paid for by the Federal government.

As the President pointed out in the State of the Union Message, the nation has a special bent for science and technology and our ability to harness it for the purposes of man. He is presently evolving a long term strategy "outlining ways in which the Federal Government can work as a more effective partner in this great task."

That strategy's key elements are:

- The maintenance of strong, sensible research and development programs in space and defense;
- The application of our scientific and technological genius to domestic opportunities;
- The stimulation--in an area in which we lack full understanding--of the processes of research and development through both public and private sources;
- The employment of our technologically-oriented agencies in support of agencies with social missions;
- The focusing of our resources on clear targets where breakthroughs are most likely.

Accordingly, the President has asked for $17.8 billion in the FY '73 budget for Research and Development, an increase of $1.4 billion (more than 8 percent) over FY '72. He has also asked for more than $700 million in new money for civilian R&D programs, a growth of 65 percent--from $3.3 billion to $5.4 billion--in civilian sector R&D since 1969.

Today's Message to the Congress resulted from continuing studies by the Office of Science and Technology, the White House R&D arm; special studies by the Domestic Council to identify new areas amenable to technological opportunities; recent consultations with industry, academic, business, scientific and other professional groups; thorough soundings of major Federal agencies and departments; and ongoing reviews of R&D related issues by White House task groups.

### THE MESSAGE IN BRIEF

The President calls for new actions, relationships and legislation designed to enhance research and development in all sectors--government, universities and private industry--with the Federal government playing a catalytic role wherever possible.

The President today proposes actions aimed at enhancing the application of the nation's R&D capacity to civilian needs. "We must appreciate that the progress we seek requires a new partnership in science and technology--one which brings together the Federal government, private enterprise, state and local governments and our universities and research centers in a coordinated, cooperative effort to serve the national interests," he told the Congress.

As part of a multi-faceted approach to such efforts, he pointed out that:

"Even the most important breakthrough will have little impact on our lives unless it is put to use--and putting an idea to use is a far more complex process than has often been appreciated.

"We must see that the environment for technological innovation is a favorable one," one without "impediments of excessive regulation, inadequate incentives or other barriers . . .

". . . We must realize that the mere development of a new idea does not necessarily mean that it can or should be put into immediate use . . . By realistically appreciating the limits of technological innovation we will be in a better position fully to marshal its amazing strengths.

"Creative, inventive dedicated scientists and engineers will surely be in demand in the years ahead . . . I am convinced that they will find ample opportunity to serve . . .

". . . We must continue to give an important place to basic research and to exploratory experiments . . . Basic research in both the public and private sectors is essential to our continuing progress tomorrow. All departments and agencies . . . should support basic research so as to provide a broader range of future options."

The President recognizes that the Federal government is in a position to exert substantial leverage on the entire R&D enterprise since it employs 45-50 percent of the R&D personnel and finances 55 percent or more of all R&D.

### ACTIONS ANNOUNCED IN THE MESSAGE

Actions to stimulate support for R&D and innovation in the private sector:

- The development of plans for a more active patent filing and licensing program for government-owned inventions both at home and abroad.
- The support, through the National Science Foundation, of applied research in industry when its use would be advantageous to accomplish NSF objectives. (Under section 3(c) of the National Science Foundation Act of 1950, as amended.)
- Studies by the NSF of the effects of Federal tax, patent, procurement, regulatory and antitrust policies on technological innovation.
- Submission of legislation soon to increase the ratio of government support to Small Business Investment Companies; to increase the limit on Small Business Administration Loans to SBIC's; to permit Federally regulated commercial banks to achieve 100% ownership of an SBIC.
- New programs in the NSF and the National Bureau of Standards to determine effective ways to stimulate private investment in R&D and its application.
- A program of research and development prizes awarded by the President for achievements in key areas of public concern.
- Designation of the Department of Commerce as the Executive Branch focal point for policy development concerning industrial R&D.

Actions to strengthen collaboration between the Federal agencies and State and local governments:

- Designation of the President's Science Adviser and the White House Office or Intergovernmental Relations as the focal point for Federal agency discussions with representatives of State and local governments in order to examine ways:
  - -- To communicate the priority needs of State and local governments to guide Federal R&D planning.
  - -- To assure State and local government access to the technical resources of major Federal R&D centers concerned with domestic problems.
  - -- To encourage aggregation of State and local markets to stimulate innovation and economies of scale.
- Experimental programs in the NSF and NBS to stimulate the use of R&D by State and local governments and to strengthen their ties to local industry and the universities.

Actions to strengthen cooperation between the United States and other nations in science and technology:

- Direction to Federal agencies to identify new opportunities for international cooperation in R&D;
- Invitation to other countries to join research efforts in the U.S. (in cancer research at NIH and Fort Detrick, Maryland, and in research on the health effects of chemicals and pollutants at the National Center for Toxicological Research at Pine Bluff, Arkansas.
- Initiation of a broad review of U.S. involvement in international scientific and technological organization programs.

## BACKGROUND ON FEDERAL R&D

In his State of the Union Message and in his budget, the President initiated the key elements of his strategy. Here are the highlights as taken from those documents:

## DEFENSE AND SPACE PROGRAMS

The Department of Defense will increase its research and development funding by $767 million in FY 1973. This includes an increase of $123 million for research. The Navy R&D budget is up 14%, the Army 11% and the Air Force 9%.

Oceanography, biomedical research, atmospheric sciences, electronics and materials are important areas of research interest. Significant development thrusts are stronger sea-based strategic deterrents and new capabilities and increased effectiveness for general purpose forces.

He also proposed a new National Aeronautics and Space Administration budget for space sciences research -- an all-time high -- up 25% to $554 million. The space agency's applications research program increased $17 million to $201 million. Funds are requested for a new generation Orbiting Solar Observatory, and National Aeronautics and Space Administration will launch missions to Mars in 1975 and to Jupiter and Saturn in the 1977-78 period.

Manned Apollo missions 16 and 17 are to take place as scheduled this year. In 1973, Skylab, a three-man reusable space station, will be visited by three separate teams of astronauts for periods of up to 56 days. The Space Shuttle program for the late '70's was approved by the President on January 5. The overall cost of developing the reusable, two-part launch vehicle/orbiter is estimated at $5.5 billion over the next six years. Alternative advanced propulsion technologies will also be examined, including a small nuclear engine, for possible unmanned outer planets missions and other applications in the 1980's.

## UTILIZING THE CAPABILITIES OF HIGH TECHNOLOGY AGENCIES

The President in the State of the Union message announced the decision to draw more on the capabilities of the high technology agencies such as the National Aeronautics and Space Administration, the Atomic Energy Commission and the National Bureau of Standards to deal with domestic problems and meet long-range national goals, but without diverting them from their primary missions. For example, our outstanding capabilities in space technology should be used to help the Department of Transportation develop better mass transportation systems.

## TARGETS FOR RESEARCH AND DEVELOPMENT

Of the total civilian R&D increase of more than $700 million, almost $400 million of the increase is focused in five technology opportunity areas identified by the President in the State of the Union Message. As the President stated, these are areas where an extra effort in R&D is "most likely to produce a breakthrough and where the breakthrough is most likely to make a difference in our lives," but they do not represent our total civilian R&D effort.

(1) Abundant and Clean Energy Sources

An additional $88 million is being obligated for work on clean, abundant energy sources, a total of $480 million and some $392 million more than last year. This is an increase of more than 22 percent.

A broad research and development program is crucial to balance environmental and energy needs. Further effort will be devoted to the development of pollution control technologies in order to provide additional options for meeting air quality standards at lower costs. Research and development programs identified in the Energy Message of June 1971 will be expanded, including the fast breeder reactor for nuclear power, coal gasification, magneto-hydrodynamics controlled thermonuclear fusion power, solar energy and mapping and basic assessment of the resources of the Outer Continental Shelf.

The 1973 budget also provides for research by the Atomic Energy Commission on advanced dry cooling towers and large scale energy storage batteries, cryogenic power generation and transmission in the AEC and National Bureau of Standards, greater use of laser technology in fusion power research under the AEC, and research by the Department of the Interior on the uses of low-BTU gas produced -- with less pollution -- from coal.

(2) Safe, Fast Pollution-free Transportation

Obligations for R&D in transportation are being increased 46%, from $456 million in FY '72 to $666 million in FY '73.

New and expanded research and development programs will explore systems which are not only safer and more efficient but which reduce adverse environmental impacts. Programs will be initiated or expanded to attack the problem of truck and aircraft noise, develop more attractive and economical mass transit vehicles, and provide for safer automobiles.

Work will be accelerated on personal rapid transit, which provides individualized, nonstop service for commuters; and new work will be undertaken on dual-mode systems for metropolitan areas which might combine the convenience of the automobile with the efficiency of a rapid transit system and on new tunneling technologies to reduce the cost of underground excavation for mass transit. Work on advanced air traffic control concepts, a short takoff and landing (STOL) aircraft, and quiet aircraft engines will continue at higher levels to provide more efficient, safer air transportation with reduced environmental impact. In these more advanced fields of both ground and air transportation, the capabilities of NASA will assist in meeting R&D program objectives. Similarly, the technical talent of AEC will be utilized in advanced work on tunneling.

(3) Reducing Losses from Natural Disasters

Funding in this area is being increased from $93 million in FY '72 to $136 million in FY '73, or 46%.

Natural disasters take an unwarranted toll on human life and property. In 1969, 12,000 people died from fires alone and $2.4 billion in property was destroyed. While increased warning time has significantly reduced deaths from hurricanes, property damage has increased dramatically to some $2.4 billion during 1965 through 1969.

Research efforts will be accelerated to diminish losses of lives and property from these and other hazards and natural disasters. Particular attention will be focused on research in hurricane modification to reduce damage from surface winds; on the prediction -- and ultimately control -- of earthquakes and on engineering to design safer structures; and on fire research -- including forest fires.

(4) Effective Emergency Health Care

An 88% expansion in funding, from $8 million to $15 million, is proposed for new demonstration projects.

One health need that has yet to be properly addressed is the provision of adequate emergency medical service. New technologies are available which can help in this field. The problem is to pull together these technologies into a system which effectively links communication, transportation of victims, ambulance equipment and services, trained manpower, and emergency room hospital service.

Full-scale demonstration of such integrated emergency treatment systems -- as planned in the 1973 budget -- can be undertaken with relatively small amounts of added Federal funds to act as a catalyst.

(5) Curbing Drug Traffic and Rehabilitating Users

Funds amounting to $60 million have been requested for FY '73, an increase of 20% over the 1972 amount of $50 million. This year's budget provides for an overall fourfold increase in research budgets of a number of agencies over the two-year period since 1971.

The June 1971 message to the Congress on drug abuse prevention and control recognized the need for a major effort to curb a problem that is assuming the dimensions of a national emergency. This message called for the creation of a Special Action Office for drug abuse prevention. The search for new ways to curb drug trafficking and to rehabilitate drug users has been stepped up in both 1972 and 1973.

As the President said of these R&D programs in his State of the Union Message: "And these are only the beginning."

-- End of Section D --

## OTHERS ARE SAYING...

Please check why these cures are being withheld

# Ignoring Cancer

If the federal department of Health, Education and Welfare (HEW) really wants a breakthrough in cancer research, it's discovered a unique way of showing it.

The department, over the last two years of Joseph Califano's regime, has become a bottleneck for new discoveries which could hold the promise of early detection — and control — of cancer.

But HEW is hung up on who should retain patent rights over such discoveries — the government or the scientists who develop the pioneering techniques.

Unable to make up its mind, HEW thus prevents the clinical testing of such discoveries by companies that would ultimately manufacture and distribute the compounds.

In this limbo, scientists lose interest as their discoveries languish. And manufacturers turn to other pursuits, leaving the various products unconfirmed as to their value and in short supply if they do have merit.

Two examples have recently come to light.

Two government-funded scientists at opposite ends of the world discovered revolutionary techniques for treating cancer.

In Israel, Dr. Michael Sela found an early detection blood test for breast and digestive-tract cancer.

At the University of Arizona, Dr. Sydney Salmon discovered a simple lab test for cancer that can be conducted in test tubes rather than on patients, thus eliminating painful drugs.

HEW lawyers, apparently arguing that hospital costs will go up if the patents are privately held, won't clear the way for testing while the debate rages.

Now, it can be argued that the scientists are being selfish in pursuit of the profit motive.

It also can be argued that politics is taking precedence over science.

The one irrefutable fact is that something has become lost in the test of wills — the commitment to human life and the preservation of it through cancer-fighting chemicals.

Surely, the government's investment in these discoveries becomes lost as time drags on and more patients die and other techniques come to the fore.

So why the impasse?

Sen. Robert Dole, R-Kansas, made this very serious charge the other day: "HEW has decided to pull the plug on development of biomedical research. They have decided to withhold potential cures and revolutionary new diagnostic techniques for treating such diseases as cancer, arthritis, hepatitis and emphysema."

Is it really too difficult to put priorities where they belong — on human life?

Is it beyond human vision to devise a way whereby government could recover its investment while at the same time rewarding the scientist or the pharmaceutical company for their daring and discovery?

Certainly, to shut and lock the door on such cancer breakthroughs serve neither the cause of science or compassion or profit.

Sensing this, no doubt, and prodded by Senator Dole, Califano the other day ordered a number of potential cures freed for further testing and distribution.

That is the least that an afflicted public should expect.

Cancer poses enough frustrations and heartaches without the HEW adding one, even fractional, delay in delivering treatment to the sick.

—Morning Star, Rockford

the small society

PATENT BRANCH, OGC
JUN 28 1973

# Cooperative R & D

## Reluctant but Necessary Alliance for Industry and Universities.

STORIES of industrial research centers that use PhDs as clerks and universities that get massive grants to study the sex life of some obscure insect must be filed, along with penny candy and a good nickel cigar, as memories of days not likely to return.

When money was plentiful, a few years back, R&D programs multiplied like rabbits. With the 70s came the cost crunch, foreign competition, and the real bite of inflation. Now industry says: We need new technology but we can't afford to develop our own. Universities say: We have the ability to create new technology, but no one to finance it. And the Government says: We want more practical utilization of the R&D money we spend.

The need to get these parties together, with their matching abilities and needs, seems obvious. Some universities and research centers have had long-standing, mutually profitable relationships with industry. But, in many cases, the business man and the scholar have been aloof and occasionally antagonistic.

"We are like two independent nations that suddenly realize that we need each other to survive," as one sales manager puts it. Such attitudes are, in part, the result of industry and university research programs that flourished with their own independent goals. If a university program came up with something that happened to interest industry, fine. This was an interesting fringe benefit, but certainly not the goal of "pure science." Industry, too, erected its own barriers to cooperation. The axiom was, "It is easier to rediscover it in our own labs than search for it somewhere else." Besides, there is also the NIH factor.

As one professor said, "Industry may be too dumb to know they have an R&D problem—or they're afraid to admit it. I've never had a request from industry stating a specific problem or been asked what the university had to offer."

Similar gripes come from the other side: "Even when we set specific parameters for what we want, university researchers wander all over the place. Our experience is that they can't give us what we ask for."

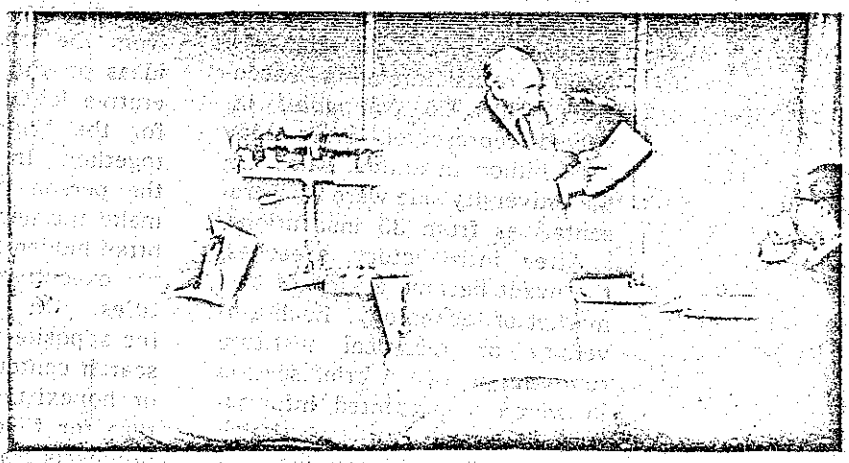
Harsh words and, in some cases, true. But the economic realities of the R&D picture are causing new alliances to form.

In the background is the Government which finances, directly or indirectly, much of the research done in the U. S. It is now Government policy to get more of its R&D back into the economy in the form of useful products. The sometimes-successful Technology Utilization program of NASA is an example.

Although the Government officially backs such a program, many observers feel that any kind of meaningful exchange of technology must occur without Government control. "The Government must act like a government, regardless of its announced policy," says one engineer familiar with the difficulties of dealing with federal programs, "so we can't expect them to guarantee one section of the economy the protection needed to encourage significant investment."

### Meeting of Giants

The necessity for resolving specific differences and common problems was clearly pointed



Industry gets a look at what university researchers have to offer in the way of potential new products. This demonstration, by the University of Missouri, was one of many given at a recent forum sponsored by Dr. Dvorkovitz & Associates, of Ormond Beach, Florida.

File of editorials

TECHNOLOGY

**Four nations launch program to cut energy use in cement making**

Four countries belonging to the 25-member International Energy Agency (IEA), part of the Organization for Economic Cooperation and Development, are starting a $1.5-million, three-year program that could reduce energy use in cement kilns by 80%. Projects will concentrate on four areas: the U.S. and Germany will examine the possibility of using a precalciner compatible with low-alkali cements; the U.S. and Sweden will attempt to determine the amount of waste materials that can substitute for portland cement without affecting structural properties; the United Kingdom and the U.S. will research use of high-sulfur fuels; and the U.S. will investigate ways of making low-alkali cement without increasing energy consumption.

**Wanted: Proposals for new cogeneration systems for industry**

The Dept. of Energy is looking for new ideas for cogeneration systems that can tie into existing facilities in a number of energy-intensive industries (including chemical, petroleum refining, pulp and paper, textile and food processing). The agency is inviting proposals in a Program Opportunity Notice (PON-4135) to be submitted by Sept. 18. DOE's Division of Industrial Energy Conservation is interested in cogeneration as part of its charter to support near-term systems, increase industrial interest, and speed the transfer of technology.

**Congress considers more R&D funds for small companies**

Small companies may get a bigger share of Federal research and development funds. Members of four subcommittees of the Senate and House Small Business Committees held joint hearings last week, saying they intend to watch closely the Administration's review of policies that may hamper research in 28 federal agencies (CW, May 24, p. 37). Testifying before the legislators, Richard S. Morse, just-retired lecturer at the Massachusetts Institute of Technology's Sloan School of Management, warned substantial changes are needed to "reverse the current and extremely dangerous trends" that have cost the U.S. its unique position in technological innovation. In the course of the hearings, a 1977 Office of Management and Budget report was made public. It showed that firms employing fewer than 1,000 accounted for almost half of the major innovations from 1953 to 1973. Their ratio of innovation to sales was about one-third greater than that for larger firms; their ratio of innovation to R&D employment, about four times bigger. Yet, small companies got only 8% of federal funds awarded to industry. Upshot: the committee members say they want to implement recommendations of past studies rather than wait several years for a new report that might exclude small businesses completely or give them only "crumbs from the table."

**H-Coal plant running late, 40% over cost estimates**

Badger Plants will take over construction management of the H-Coal plant being built in Catlettsburg, Ky., a responsibility that had been held by Ashland Synthetic Fuels. The plant is running late and turning out to be 40% more expensive than the original $178-million estimate. But those are not the reasons for the switch, says the Dept. of Energy. The change will enable Ashland to devote its full expertise to technical aspects of the construction and to prepare for eventual operation of the plant, DOE says. Ground was broken in December 1976 (*CW, Dec. 22, 1976, p. 19*). The admittedly tight schedule called for

1830 Larkdale Rd.
Northbrook, IL 60062
July 3, 1978

Mr. John L. Cobbs, Editor
Business Week
McGraw-Hill Building
1221 Avenue of the Americas
New York, New York 10020

Dear Mr. Cobbs:

Reference: "Vanishing Innovation", July 3, 1978 Issue

I, for one, am not ecstatic that the "White House has ordered up a massive 28-agency review of the role government plays in helping or hindering the health of industrial innovation." You quote some diagnostic information from "a 1977 Commerce Department report" co-authored by me and my then principal deputy, Dr. David B. Chang, and prepared at the request of former Secretary of Commerce Elliot Richardson. To be sure, a "thundering herd" did not articulate the policy alternatives to be found in "U. S. Technology Policy" (NTIS document PB-263 806); however, a significant number of the industrial people you quote, or their associates, did contribute to their formulation. Surely further study is not required to demonstrate that "excessive or contradictory federal regulatory policy is the single greatest complaint" (barrier to innovation) as you put it, or "reduction of unnecessary regulatory barriers to innovation is required", as we phrased it. Instead of a "massive review", how about a little action toward implementating an improved climate for industrial innovation?

Our study suggests a number of possible actions the Administration could at least evaluate, if not undertake, to reduce detrimental regulations. And do we really need to spend more taxpayers' money to rediscover that modification of antitrust laws to permit cooperative R&D is desirable (p.49); that substantial

increase in the tax investment credit for R&D plants from the present 10% to, e.g. 25% is overdue (p. 36), that inflation and the low average rate of return are making capital formation very difficult (p. 53), that a uniform Federal patent policy is needed which (among other things) enables contractors to obtain patent rights to inventions resulting from Federally-sponsored research (p.70-1), etc., etc.?

Wouldn't applying a massive effort toward implementing at least one corrective step before vanishing innovation more than just threatens U. S. technological superiority be a lot more useful?

Betsy Ancker-Johnson, Ph.D.
Former Assistant Secretary of
Commerce for Science and
Technology

BAJ:bs

# VANISHING INNOVATION

## A hostile climate for new ideas and products is threatening the technological superiority of the U. S.

A grim mood prevails today among industrial research managers. America's vaunted technological superiority of the 1950s and 1960s is vanishing, they fear, the victim of wrongheaded federal policy, neglect, uncertain business conditions, and shortsighted corporate management. They complain that their labs are no longer as committed to new ideas as they once were and that the pressures on their resources have driven them into a defensive research shell, where true innovation is sacrificed to the certainty of near-term returns. Some researchers are bitter about their own companies' lax attitudes toward innovation, but as a group they tend to blame Washington for most of their troubles. "[Government officials] keep asking us, 'Where are the golden eggs?' " explains Sam W. Tinsley, director of corporate technology at Union Carbide Corp., "while the other part of their apparatus is beating hell out of the goose that lays them."

That message—and its implications for the overall health of the U. S. economy—is starting to get through. Following months of informal but intense lobbying led by such executives as N. Bruce Hannay, vice-president for research and patents at Bell Telephone Laboratories Inc., and Arthur M. Bueche, vice-president for research and development at General Electric Co., the White House has ordered up a massive, 28-agency review of the role government plays in helping or hindering the health of industrial innovation. "Federal policy affecting industrial R&D and innovation must be carefully reconsidered," wrote Stuart E. Eizenstat, the White House's domestic policy adviser, in a recent memo outlining the review's intent.

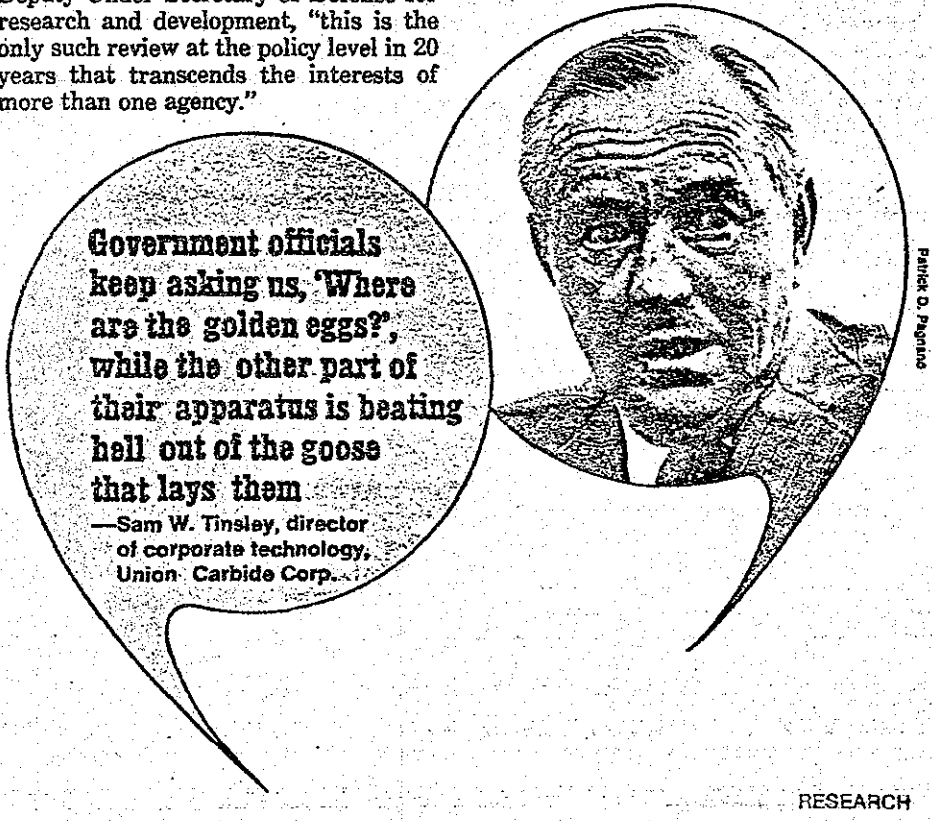
One thing that the study clearly will not accomplish is a quick fix for the deepening innovation crisis. The problem is regarded as immensely complex by the Administration, and is inextricably tied to other economic dilemmas now facing Carter's White House.

"Historically, the government's role has been to buy more science and R&D," says Martin J. Cooper, director of the strategic planning division at the National Science Foundation (NSF). "Now maybe we better go with investment incentives." Says Jordan J. Baruch, Assistant Commerce Secretary for science and technology, who will be the review's day-to-day manager: "This study developed in an environment of people concerned about economics, business, and technology."

The Administration's concern is underscored by the fact that it is organized as a domestic policy review, the highest sort of attention a problem can receive within the executive branch. Among its objectives, such a review must produce options for corrective action by the President. According to Ruth M. Davis, Deputy Under Secretary of Defense for research and development, "this is the only such review at the policy level in 20 years that transcends the interests of more than one agency."

The White House also seems determined not to conduct the study in a governmental vacuum. Baruch is soliciting input from groups such as the Industrial Research Institute (IRI), the Business Roundtable, and the Conference Board. "We want both CEOs and R&D vice-presidents," says a White House official. Labor groups have been asked to participate, too, along with public-interest groups. Congressional leaders such as Senator Adlai E. Stevenson (D-Ill.), chairman of the Senate subcommittee on science, technology, and space, have been brought into the early planning. And the 28 agencies involved extend beyond obvious candidates, such as the Environmental Protection Agency, to the Justice Dept. and even the Small Business Administration.

The study's scope is so sweeping, in




Patrick D. Pagnano

fact, that some federal officials are talking about a "thundering herd" approach to policymaking. But one government science manager demurs. "It beats having one guy write a national energy program in three months," he sniffs.

Philip M. Smith, an assistant to Presidential science adviser Frank Press and an early organizer of the study, concedes that "a lot of people have told us that we are likely to fail." But such skepticism, he believes, does not take into account the considerable clout of those involved in the effort. Commerce Secretary Juanita M. Kreps, for example, is chairing the study, and she heads a coordinating committee whose members include Charles L. Schultze, chairman of the Council of Economic Advisers, Administration inflation fighter and chief trade negotiator Robert S. Strauss, and Zbigniew Brzezinski, Carter's national security adviser. Even more important is the support of Eizenstat, who, says Smith, "is very interested in this particular review."

### Finding 'new directions'

On the other hand, there is already grumbling within the Agriculture Dept., which was left off Kreps's committee. "We are red-faced," says a high-ranking Agriculture official. "We are out of the project because this Administration and those before it do not place any priority on agricultural research." However, Jordan Baruch insists that the department will play a role in the study. Agriculture experts point out that farm commodity exports of over $24 billion play a key role in the U. S. balance of payments. They note also that superior technology is the basis of the commanding American position among world food exporters.

Whatever its outcome, the White House policy review is being undertaken at a time when, as Frank Press puts it, "we badly need some new directions." Many experts view with alarm the declining federal dollar commitment to R&D, which has dropped from 3% of gross national product in 1963 to just 2.2% this year. For its part, industry as a whole has more or less matched the inflation rate and then some with its own spending. But such macroscale indicators do not tell all. "We've got to find out what the story is sector by sector, because each industry is going to be different," says Press. "We also have to find out what's going on abroad."

Better data on the relationship between industrial innovation and the health of the economy are becoming available. According to a 1977 Commerce Dept. report, for instance, technological innovation was responsible for 45% of the nation's economic growth from 1929 to 1969. The study went on to compare the performance of technology-intensive manufacturers with that of other industries from 1957 to 1973, and found that the high-technology companies created jobs 88% faster than other businesses, while their productivity grew 38% faster.

The numbers help to establish the central role of industrial innovation in stimulating economic development, but they also are beginning to reveal the changing character of industrial research. The amount of basic research that industry performs, for instance, has dropped to just 16% two years ago from 38% of the national total in 1956.




And a new IRI survey of member companies for the National Science Foundation demonstrates how federal policy has directly altered the nature of the research effort in another way, making it more and more defensive. The study shows that surveyed companies increased R&D spending devoted to proposed legislation by a striking 19.3%, compounded annually, from 1974 to 1977. And the rate was 16% a year for R&D devoted to Occupational Safety & Health Administration (OSHA) requirements. "When overall R&D spending is not growing nearly this fast," note the survey's authors, George E. Manners Jr. and Howard K. Nason, "other categories of effort—especially research—must be suffering."

Other observers compare the viability of industrial innovation in the U. S. with that of foreign countries. One expert is J. Herbert Hollomon, director of the Center for Policy Alternatives at Massachusetts Institute of Technology. According to Hollomon, a reason the U. S. is losing its leadership is that "we're arrogant—we have an NIH [not invented here] complex at the very time a majority of technological advances is bound to come from outside the U. S." Consequently, he argues, the U. S. has not organized itself to capitalize on these advances, as foreign countries have done for years with American knowhow. Since as much as two-thirds of all R&D is now conducted by foreign laboratories, Hollomon says, it should be no surprise that they have taken the lead in such technologies as textile machinery and steel production.

"We essentially prohibited West Germany and Japan from defense and space research," says Hollomon. "So it's no accident they concentrated on commercial fields." He adds: "I believe other nations better understand that the innovation process is important."

Says a research director for one high-technology company: "For a country like ours, the technology leader of the world, what has been happening is downright embarrassing." Indeed, even the presumed sources of strength in a consum-

er-oriented society are today under intense pressure. "Our experience with Japan in the consumer electronics industry—namely televisions, radios, audio, and transceiver equipment—shows some of our weaknesses," testified Gary C. Hufbauer, a Deputy Assistant Treasury Secretary, before a congressional subcommittee. In 1977, he said, "we had a $3.6 billion trade deficit with Japan in high-technology goods, and about two-thirds of this was accounted for by imports of consumer electronic goods."

### The role of regulation

The cumulative response to these developments has been alarm. "The system has now sharpened its pencils in a way that discourages changes that are major," worries Robert A. Frosch, head of the National Aeronautics & Space Administration. "We have been so busy with other things that we may have inadvertently told the people who think up ideas to go away."

Even labor unions, which historically have left R&D decision-making up to corporate board rooms, now are complaining about lack of innovation. "Having helped to develop and pay for this technology," says Benjamin A. Sharman, international affairs director of the International Association of Machinists, "American workers have a right to demand government responsibility for using it to create new products, more jobs, better working conditions, and general prosperity." And Charles C. Kimble, research director of the Electrical, Radio & Machine Workers union, goes so far as to suggest that labor should now have a say in how industrial research money is spent.

Among research managers themselves, excessive or contradictory federal regulatory policy is the single greatest complaint. Hannay of Bell Labs points to Food & Drug Administration requirements as a case in point. According to one study, says Hannay, a 1938 application for adrenaline in oil was presented to the FDA in 27 pages. In 1958, a treatment for pinworms took 439 pages to describe. "By 1972," he says, "a skeletal muscle relaxant involved 456 volumes, each 2 in. thick—76 ft. in total thickness and weighing one ton."

Regulation, says Tinsley of Union Carbide, has put a bottleneck on new-product development in the chemical industry and has so added to the cost of getting any new chemical approved that only those targeted at a vast, assured market are attempted today. Food and drug industry researchers echo that complaint. "Today," says Al S. Clausi, director of technical research at General Foods Corp., "our industry does work that is fostered by unreal and invalid public concerns."

But regulation can have less obvious impacts, such as forcing an industry to stick with old technology rather than to experiment with new approaches to problems. "The overall effect of regulations on the auto industry has been to build an envelope around the internal-combustion device and the whole car structure," says Harvard Business School Professor William J. Abernathy, who specializes in technology management. " 'Don't do anything really new, don't change.' That's what these regulations say." Paul F. Chenea, vice-president for research at General Motors Corp., agrees. "You just don't have time to explore wild new ideas when a new rule is so closely coupled to your current business," he says.

### 'The science of the matter'

In Congress, where the regulatory laws are written, such thinking has so far found a small audience. "A great number of the regulations that we would call environmental . . . may actually be self-defeating," muses Harrison H. Schmitt, the former astronaut from New Mexico who is the ranking Republican on Stevenson's Senate subcommittee. "Instead of looking at pollution controls, if we were looking at building a more efficient and therefore less-polluting engine, we would not only be solving our environmental problems, but we would be producing a new thing for export."

Schmitt is one of only three federal legislators with the semblance of a science background. "We probably have

## How antitrust charges can limit R&D payoffs

Companies that make it across the development minefield and bring superior technology to market still may find a threat on the other side: monopolization charges that keep them from fully exploiting the technology. As old as that problem is, such charges can come as a shock, as they did to Du Pont Co. last April.

Courts established decades ago that the Sherman act prevents a company with a hammerlock on a particular industry from making sound, otherwise perfectly legal business decisions that would, however, perpetuate its dominance. In 1945, for example, Judge Learned Hand found evidence that Aluminum Co. of America unlawfully monopolized its industry by its tendency to "double and redouble capacity" as demand increased. That, said Hand, locked would-be competitors out of the expanding market.

In a similar vein, the Federal Trade Commission said three months ago that Du Pont had used "unfair means" to keep competitors from increasing their share of the expanding market for titanium dioxide, a widely used paint pigment. "The complaint is wholly without basis," says Irving S. Shapiro, the company's chairman.

**40% share.** Superior technology clearly contributes to Du Pont's dominance. In the 1950s, the company devoted a decade of work—and what a spokesman will peg only at "many millions of dollars"—to develop a new way of making $TiO_2$. Although the highly automated, continuous process went on stream more than 20 years ago, it still tops the processes used by such competitors as NL Industries, SCM, and American Cyanamid, because it uses cheaper raw materials and produces less acid waste.

The problem with the government arises because Du Pont's 40% share of the $700 million-a-year market is still growing. That alone is enough to send government lawyers poking about for actions that can be attacked. According



Joan Sydlow

**Du Pont's Shapiro: The FTC's "complaint is wholly without basis."**

to Alfred F. Dougherty Jr., head of the commission's antitrust arm, even a 30% chunk of the market "could be a dominant position if all the other firms in the market had a much lower share." In fact, Justice Dept. antitrust chief John H. Shenefield asked his staff to look at Du Pont's $TiO_2$ policies only to find the FTC there ahead of him.

Basically, the FTC says that Du Pont keeps its market share by expanding capacity before the market is ready for more production, thereby forestalling competitors' expansion plans. Du Pont, says the FTC, should get rid of one of two current $TiO_2$ facilities and a new plant at De Lisle, Miss., that would begin production next year. The FTC staff also wants the company to take competitors under its wing by giving them, royalty-free, the superior technology and knowhow it has built up over the past 25 years.

exercised very poor judgment in the past," he says, "because the Congress overall—members as well as staff—have not been able to understand what is possible technologically and what is not, and therefore not been able to relate the costs [of legislation]."

Jason M. Salsbury, director of the chemical research division at American Cyanamid Co., pleads, "Before the lawyers write the legislation, let them know the science of the matter." Not only may some mandates be beyond what industry can legitimately perform, he says, but the rules force a conservative approach to science. One key indicator of this trend is the increasing number of toxicologists now employed in chemical company research labs. "Toxicologists don't innovate," notes Frank H. Healey, vice-president for research and engineering at Lever Bros. Co.

Then there is the regulatory bias against new ideas. In the EPA's grant programs for waste-water treatment at the municipal level, for instance, equipment specifications must be written so that gear can be procured from more than one source. That means a company with a unique process is discriminated against. What is more, the mandate for cost effectiveness precludes trying out innovative approaches whose value can only be measured if someone is willing to gamble on them.

If the domestic policy review is to solve such questions, it will depend in large part on the willingness of regulators to see matters in a new light. According to Philip Smith, there is "a sense that people like [EPA Administrator] Doug Costle and [FDA Administrator] Don Kennedy want to work with industry, and they don't want to fight all the time. I think we have a team of people now in government that may be able to do something."




### The investment climate

But industry should not expect a major overhaul of regulatory practices to emerge from the study. EPA Administrator Douglas M. Costle concedes "a tremendous growth in the last decade in health and safety regulations—13 major statutes in our area alone." Though Costle agrees that the economic impact of such rules should be more closely quantified, he contends that "this rapidly widening wedge of regulation has been a response to a massive market failure—failure of the marketplace to put an intrinsically higher value on pollution-free processes."

Most regulators agree that not enough research has been done on the true nature of the environmental problems they are empowered to combat, but they also argue that regulation has led to cost-saving practices, especially in the area of resource recovery, where closed-cycle processes now help capture reusable material. OSHA officials also cite examples where the agency has laid down rules that have led to cost-cutting innovations. But Eula Bingham, the OSHA administrator, emphasizes that the "legislatively determined directive of protecting all exposed employees against material impairment of health or bodily function" requires tough regulation without quantitative weighing of costs and benefits. "Worker safety and health," she insists, "are to be heavily favored over the economic burdens of compliance."

Bingham and her boss, Labor Secretary Ray Marshall, may represent an increasingly isolated view, however. Economic issues have come to dominate thinking within the Carter Administration, and it is precisely these questions that industry has stressed in its discussions with science adviser Press and other White House officials. Just over a month ago, Treasury Secretary W. Michael Blumenthal told a meeting of financial analysts in Bal Harbour, Fla., "We are now devoting a very sizable chunk of our private investment to meeting government regulatory standards . . . and in some of these areas we may well be reaching a breaking point." Blumenthal also noted: "Our technological supremacy is not mandated by heaven. Unless we pay close attention to it and invest in it, it *will* disappear."

A month before the Blumenthal speech, GE's Bueche suggested to an American Chemical Society gathering that "we step back and look at R&D for what it really is: an investment. It is an investment that, like more conventional investments, has become increasingly less attractive."

Bueche, along with most other research managers, rejects the idea of direct federal subsidies to industrial R&D. Instead, he points out that "perhaps 90% of the total investment required for a successful innovation is downstream from R&D, [and thus] it becomes . . . clear why we must concentrate on the overall investment climate." Bueche attacks Administration proposals to eliminate special tax treatment of long-term capital gains, plumps for more

Whether the need for such onerous penalties can be established—before an FTC judge, the full commission, then a court of appeals and, perhaps, the Supreme Court—may take years to determine. But the approach is not unusual in monopolization cases.

**The Xerox case.** Just a year ago, the Justice Dept. ended such a suit against Industrial Electronic Engineers Inc. by getting the California company to promise royalty-free licenses to all comers on patents it had used to dominate the market for rear-projection readout equipment for electronic data-processing systems. And three years ago, the FTC settled a complaint by getting Xerox Corp. to open its portfolio of 1,700 copier patents to competitors. Xerox had to license three patents—chosen by the competitors—free. Fees for use of the rest were strictly limited by the FTC.

As severe as those measures may seem, and as discouraging to innovation, the antitrusters contend that it is the only way rivals can eat into a monopolist's dominance of a market. Says Alan K. Palmer, assistant director of the FTC's antitrust arm: "We have to look to what relief will really be effective."



Peter Yates

**You just don't have time to explore wild new ideas when a new rule is so closely coupled to your current business.**
—Paul F. Chenea, vice-president for research, General Motors Corp.

rapid investment write-offs, and says "it is extremely important to provide stronger incentives for technological innovation by making permanent and more liberal the 10% investment tax credit."

### Critics in industry

Bueche's arguments suggest the broad—yet often indirect—way in which federal policy runs counter to the best interests of innovation. Fear of antitrust moves from the Federal Trade Commission or the Justice Dept., for instance, has prevented many companies from sharing research aimed at a problem common throughout an industry—including new technology aimed at solving regulatory questions. At General Electric, the legal staff must now be notified if a competitor visits a company research facility, even if no proprietary material is involved.

For their part, Justice Dept. trustbusters claim that fears that their policies stifle innovation are not justified. They say they are flexible enough to recognize the differences in the pace of innovation from industry to industry, and that is why they allow a fair number of mergers among electronics companies. "That's an industry where you don't have to worry about someone cornering the market," says Jon M. Joyce, an economist in the Justice Dept.'s antitrust division. "There's just a lot of guys out there with good ideas."

Industry further claims that the inability to secure exclusive licenses on government-sponsored research leaves much good technology on the shelves, while federal attempts to market new products are often silly at best. Richard A. Neshit, director of research at Beckman Instruments Inc., recalls a government circular that waxed rhapsodic over the federal commitment of billions of dollars to R&D. Included with the letter was a syringe for sampling fecal matter, and the suggestion that Beckman might want to license the technology. "I wondered if they spent billions to develop that," Nesbit recalls. "The contrast was ludicrous."

Even national accounting procedures draw criticism from industry. A major target is the 1974 ruling by the Financial Accounting Standards Board that stipulated that R&D spending could no longer be treated as a balance sheet item, but must be listed as a direct profit or loss item in the year spent. R. E. McDonald, president and chief operating officer at Sperry Rand Corp., recently told an executive management symposium, "The ramifications of that rule change are quite complex, but the net effect has been to dry up a lot of potential venture capital investments. . . . I can say quite candidly that Univac would not be here today if we had not had the advantage of the old rule for so many years."

The shortage of risk capital has had a tremendous impact on small, technology-oriented companies trying to arrange new public financing. According to a Commerce Dept. survey, 698 such companies found $1.367 billion in public financing in 1969. In 1975, only four such companies were able to raise money publicly, and their numbers rose to just 30 in 1977. Equally ominous is the experience at Union Carbide, which, according to Tinsley, has not been able to compete for venture capital and has thus canceled plans to start a number of small operations built around interesting new technology. Years ago, says Tinsley, Carbide was reasonably successful at getting such funding. "And you must remember that these ideas are perishable," he says. "They don't have much shelf life."

The Treasury Dept., in fact, has an ongoing capital-formation task force that will be integrated into the policy review under the direction of Deputy Secretary Robert Carswell. Carswell notes that "you can't draw a clear line" between R&D support and investment in general, but "if it turns out that we find some form of capital formation gives the economy a greater multiplier effect than another form, we at the Treasury would not shy away from whatever policy would help most."

### Washington's changing role

Even as it has pursued policies detrimental to industrial R&D, the federal government has withdrawn as a major initiator of innovation. Research managers generally believe that companies are better equipped than government to bring new technology to society because they are more attuned to market pull. But Lawrence G. Franko of Georgetown University, an international trade expert, recently pointed out to a congressional committee that the U. S. government has in the past played an important role "as a source of demand for new products and processes, and as a constant, forbearing customer in computers, semiconductors, jet aircraft, nuclear-power generation, telecommunications, and even some pharmaceuticals and chemicals. . . ."

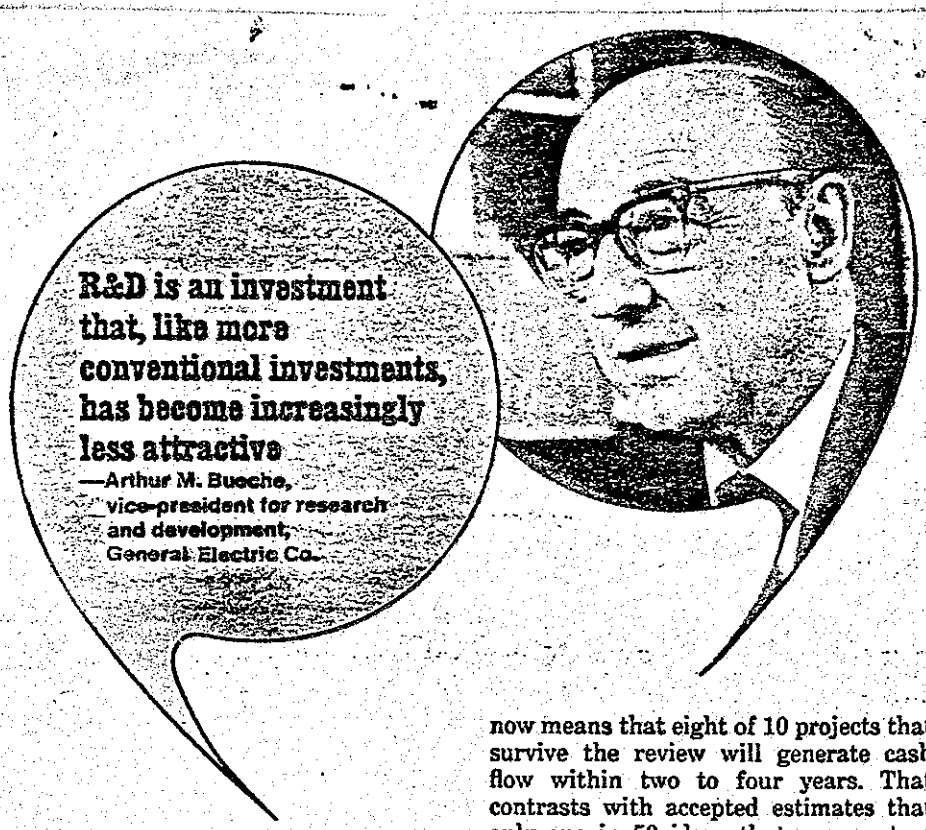
According to the Defense Dept.'s Davis, both Defense and NASA "have faded" in this role, the result of the Vietnam war and concerns over the military-industrial complex. "The consumer marketplace and other government agencies have not been able to pick up where DOD and NASA left off," she says. "The Department of Energy should be able to help with this, but it hasn't yet. And the Department of Transportation just never blossomed in this role." An unreleased IRI study for the Energy Dept. summed up industry's views. The company officers interviewed said government could spur industry's energy R&D only by creating a national energy policy, increasing its managerial competence, and offering financial incentives rather than massive contracts.

On the other hand, there have been some recent, notable government efforts to spur the innovation process. "We've talked to the leading semiconductor companies about our hopes for their innovation," says Davis. She says that the Defense Dept. expects to program $100 million over the next five years for industrial innovation in optical lithography, fabrication techniques involving

electron-beam technology, better chip designing and testing to meet military specifications, and system architecture and software implementation.

At the Transportation Dept., chief scientist John J. Fearnsides wants to involve the private sector much earlier in the government's R&D process, thereby allowing industrial contractors to develop technology alternatives instead of having to cope with rigid specifications at the outset. Such a policy, some believe, might have resulted in major savings for the Bay Area Rapid Transit system, for instance. "It is more expensive to fund a wider range of choices, but only at first," says Fearnsides.

The NSF also has announced a new industry-university grant program for cooperative exploration of "fundamental scientific questions." The aim is to make "a long-term contribution toward product and/or process innovation."




### The failures of business

While agreeing on the need for federal policies that bolster innovation, those knowledgeable about industrial research think that the companies themselves share some of the blame for stagnation and must be willing to examine their practices critically. Alfred Rappaport, a professor of accounting and information systems at Northwestern University's graduate school of management, believes that one reason the U. S. lags in R&D is that the incentive compensation systems that corporate executives live under tend to deter intelligent risk-taking. "Incentive programs are almost invariably accounting-numbers oriented and based on short-term earnings results," he says. "That puts management emphasis on short-term business considerations." Another criticism has been of the haphazard way in which companies have launched new R&D programs. In essence, industry should try to learn how to weed out bad ideas early on, say the detractors. To that end, Dexter Corp. has instituted an eight-factor "innovation index" approach to research management that weighs questions such as effectiveness of communications, competitive factors, and timing, and comes up with an "innovation potential" for new ideas. At Continental Group Inc., D. Bruce Merrifield, vice-president of technology, says that "constraint analysis" of new ideas now means that eight of 10 projects that survive the review will generate cash flow within two to four years. That contrasts with accepted estimates that only one in 50 ideas that come out of research labs ever generates cash flow, and not for seven to 10 years.

Large companies often fail to exploit their own resources effectively. In the 1950s and 1960s, some companies set up centralized research facilities, but many of these did not yield the hoped-for synergism—in many cases, apparently, because the different parts of the company were in businesses too unrelated to one another.

On the other hand, Raytheon Co. was highly successful in transferring its microwave expertise to its newly acquired Amana appliance subsidiary in 1967, resulting in the counter-top microwave oven. That was done through a new-products business group set up specifically for such purposes. And more recently, this group, headed by Vice-President Palmer Derby, brought the company's microwave talent to bear on its Caloric subsidiary's product line, resulting in a new, combination microwave-electric range.

In such ways, industry can maximize its potential for innovation in the most adverse environment. But the future health of the nation's economy, many experts believe, requires a much more benign environment for industrial R&D than has existed over the past decade. And Jordan Baruch, the enthusiastic leader of the multi-agency federal study, believes that such an environment is likely to emerge as a result of the Administration's concern.

"We may have bitten off more than we can chew," notes Frank Press, "and it may be that we can't get much done in a year. But even if it takes three or five or 10 years, I think it is historically very important." ■

## Turning to Japan for venture capital

The recent drag in U. S. venture-capital commitments has opened opportunities for foreign companies to appropriate American ideas. A case in point is the experience of System Industries Inc., a Sunnyvale (Calif.) manufacturer of minicomputer peripherals.

In 1969, System Industries went to work on a new ink-jet printing process, forming a subsidiary, Silonics Inc., to develop and market it. By 1973, the research phase was over, and a cash-short System Industries went looking for venture capital to tool up for production. Unfortunately, none was there. With a depressed stock market, and recent increases in the maximum tax on capital gains that cut the expected return on such investments in half, the usual capital sources "couldn't justify taking the same risks they used to," says Edwin V. W. Zschau, the company's chairman and chief executive officer.

**Keeping only 51%.** Next, he explains, "we were thinking about government funding. But we were discouraged from even making a proposal when we learned the government would get data rights and be able to license it to other people. We didn't see why we should give away those rights just to get a little money." What Zschau finally did give up was 49% of Silonics to Konishiroku Photo Industry Co., the Tokyo-based maker of Konica cameras.

In return, the Japanese company has spent $5.5 million on Silonics, which is enough to bring the new printer to market at the National Computer Conference in Anaheim, Calif., in mid-June. "We have one of the most promising imaging technologies for the 1980s," Zschau now complains. "But we only own 51% of it."

U.S. Department of Energy
ARGONNE NATIONAL LABORATORY
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Office of the Director
Telephone 312/972-3504

July 10, 1978

Dr. Jordan Baruch
Ass't. Sec'y. of Commerce
for Science and Technology
U.S.Dept. of Commerce
Washington, D.C.

Dear Jordan:

Please see the attached letter regarding the July 3 edition of Business Week.

Perhaps you are attempting to overcome the NIH syndrome by this massive effort so that the, by now, long-known policy alternatives are regarded by the current Administration as its own, and then you hope to begin evaluating and implementing. If so, I certainly wish you well.

Sincerely,

Betsy

Betsy Ancker-Johnson, Ph.D.
Associate Laboratory Directory
for Physical Research

BAJ:bs
Attachment (1)

File w/ editorials

*Henry Kissinger, a name identified with national security, recently wrote about the rising "crisis of the spirit" in the U.S. The former Secretary of State said that "without some conception of what security is, you really will be constantly confronted with a series of confusing situations through which you cannot find your way."*

*It is against the backdrop of what security means today that C&EN conducts this "symposium in print" on what, in turn, innovation means today.*

*Man always has used technology most creatively to protect himself from danger—whether man-made such as war and equivalent attacks on society's tranquility of order, or from earthquakes, floods, plagues, and other vagaries of nature.*

*In the broadest sense, the biggest threat to security is disorder, or in the scientific vocabulary, entropy. Mankind's challenge is to arrange institutions and fashion inventions to create a sounder order so that it can evolve with security. The greatest challenge, then, is to establish the right institutions of governance to preserve order with liberty rather than repression. And the technological innovations nutured by government would be those that optimize security and the governance process.*

*Because there are significant nonmilitary threats to national security, there is a need to cast about for broader but workable definitions of innovation during a time of concern about the country's innovative capacity.*

*And now the White House, under assistant secretary of Commerce Jordan Baruch, is beginning an important study for President Carter on how to stimulate that capacity. The study, due to reach the President's desk next April 1, was established out of the decade-long concern that innovation in the U.S. is being stifled by combinations of federal policies and such related economic forces as inflation. The topic is already impossibly broad and the arguments even dated. The question is how the study can be made significant, whether it can help the President and his advisers perceive the kind of threats that politicians and their economic advisers commonly do not perceive.*

*C&EN's approach to the article is a simple one. The author asked some molders of science, technology, and corporate policy what they believe are the five major nonmilitary threats to national security. It was explained that to examine innovation, especially with the high degree of skepticism surrounding the exercise, it makes sense to define some threats to security. It is only logical that when examining innovation, one also should know what society should be innovating for.*

# Innovation and national security:

## Innovation can contribute to both security and anarchy

