entry into Japan included a requirement to license their technology to Japanese concerns.

Even after these laws were relaxed, American companies frequently found it difficult to break into the Japanese market on their own. This has been especially true in such expensive, technologically sophisticated products as telecommunications equipment and commercial aircraft, where the Japanese Government — like the governments of most countries — plays a big role in determining which vendor wins an order. As is still the case in most countries, including Japan, sharing technology and production with local companies is a prerequisite for winning an order.

Cultural differences have also made it virtually impossible for American companies to compete on their own in Japan.

The long-term relationships between suppliers, manufacturers and distributors so valued in Japan hinder American companies. With acquisitions frowned upon in Japan, American companies have often had little choice but to team up with a Japanese company to break into the market.

DESPITE all the dangers, strategic alliances with foreign companies, including the Japanese, seem here to stay. Indeed, even with the reassessment of ventures going on, no one expects any significant slowdown in their formation.

American inventiveness is admired throughout the world, but small companies, which account for so many discoveries, must often turn to foreign partners for help in making or distributing their products — and for the capital needed to stay alive.

Even giants, though, will continue to link up with foreign companies. General Motors, Ford and Chrysler now import not only components but entire cars from Asia. Companies in businesses ranging from appliances to photocopiers to machine tools have resorted to the same tactic. Such arrangements often force the American company to disclose vital design or product information.

Business leaders have also come to view strategic alliances as a necessity in industries where product development costs are exorbitant.

It costs $50 million to $100 million to bring a new drug to market, so pharmaceutical companies have to market it rapidly throughout the world to recoup the investment. That requires strategic alliances, said Henry Wendt, president and chief executive of the SmithKline Beckman Corporation, which has joint development and marketing agreements with Boehringer Mannheim of West Germany, Fujisawa of Japan and Wellcome P.L.C. of Britain.

Similarly, virtually no single company can afford the billions of dollars it costs to develop a new commercial jet — not to mention the $500 million to $700 million to develop the engines to power it. For that reason, international consortiums have become a way of life in the aerospace industry.

In a recent interview, Makoto Kuroda, a senior official of the Japanese Ministry of International Trade and Industry, reiterated his Government's assertion that Japan has abandoned all ambitions to become an independent power in commercial jets. At least publicly, such aerospace companies as Boeing and Pratt & Whitney, the jet engine maker, say the Japanese lack the design and systems ability and the innovativeness to threaten American leadership in aircraft or engines. But privately, industry officials are nervous, said Leslie Denend, a McKinsey consultant.

Whatever their long-term intentions might be, Japanese clout — and expertise — is clearly growing.

Boeing will allow its Japanese partners to design and produce components equal to 25 percent of the value of the 7J7, the 150-seat, fuel-efficent jet that Boeing plans to have in service in the early 1990's. That is about twice the share that the Japanese produced of the 200-seat 767.

Even if the Japanese pose no immediate threat to prime contractors such as Boeing, they are already taking business away from American component suppliers, said David C. Mowery, an aerospace expert at Carnegie-Mellon University. Eventually, they may do the same to the prime contractors, according to many experts.

SLOWLY, painfully, American managers are learning that doing business in a global economy carries enormous dangers along with opportunities. Having been burned by foreign alliances, some managers, at least, have lost the arrogance that made them such easy prey. The question is whether managers in other industries will learn from their example, or have to learn on their own. ■

The Government **Tries to Help**

Government officials are attempting to limit the dangers posed by the proliferating ties between American and foreign companies by enacting new laws and relaxing old ones.

Until a new law was enacted last year, pharmaceutical companies could not sell products for clinical testing or sale abroad unless the Food and Drug Administration had approved them for testing or sale in the United States. That forced such biotechnology companies as Genentech to license their technol to foreign companies instead of supplying their products abroad themselves. "We now have less need to transfer technology," said Thomas D. Kiley, Genentech's vice president for corporate development.

Once it was virtually impossible for American semiconductor companies to protect their mask designs — the "negatives" from which semiconductors are made — from foreign pirates. But new laws have substantially strengthened copyright protection of masks and microcoding, instructions implanted in semiconductors. Combined with the designation of a special Federal court to hear patent-infringement cases, that has had a dramatic effect: 70 to 80 percent of such suits are now upheld, up from 20 to 30 percent before.

A 1984 law enabled semiconductor makers to engage in joint research. A group of electronics companies then formed a reseach consortium, the Microelectronic and Computer Technology Corporation. A Pentagon advisory group is supporting the formation of a semiconductor consortium to develop manufacturing technology and engage in limited production of chips.

To keep the aerospace industry competitive, the President's Office of Science and Technology Policy recommended in February that American companies be allowed to collaborate not only on research for superfast aircraft but also on development — something antitrust laws now bar.

"There is no hysteria now" about the aerospace industry's competitiveness, said Crawford F. Brubaker, Deputy Assistant Secretary of Commerce. "But given what has happened in other industries, we don't want it to happen in this one." ■

The Varieties of Business Alliances

Joint Ventures involve the creation of an enterprise jointly owned by the parent companies to develop or manufacture or sell particular products often in a particular market. In many American-Japanese joint ventures, the Americans contributed the technology, only to find themselves discarded when their Japanese partner had mastered the innovation.

Licensing Agreements typically permit the licensee to manufacture and sell a product incorporating the owner's technology in return for royalty payments. But in electrical power plant equipment, color television sets, machine tools, electronic components and many other industries, agreements have not limited licensees to a given market or product application. By improving on the technology itself, capitalizing on their lower manufacturing costs or applying the technology to new products, Japanese companies have used the license to become strong competitors in the United States and abroad.

Marketing/Manufacturing/Supply Arrangements enable a partner to make or sell and service the other's products. American companies have used these arrangements to import low-cost foreign components or entire products, and to distribute American-made products in foreign markets. Because such alliances often involve sharing American technology and design specifications with the foreign partner, the result has often been one-way technology transfer.

Accusation Expanded

Continued From First Business Page

derstanding. Indeed, the S.E.C, said that Mr. Belzberg had a similar arrangment with Bear, Stearns — and a similar failure to disclose the family's stake — during its earlier attempt to acquire Hartmarx.

The memo gives this account: In January 1986, Mr. Belzberg told Mr. Greenberg that his family had acquired 4.9 percent of Hartmarx, and proposed that Mr. Greenberg buy additional shares of the apparel maker, to be held in a Bear, Stearns account for First City.

Mr. Belzberg said he would protect Bear, Stearns against any loss by agreeing to buy the stock back later. Mr. Greenberg said that he thought such an arrangement would make the Belzbergs the beneficial owner of that stock, and suggested that Mr. Belzberg check with his lawyer before proceeding.

Three hours later, after talking to his lawyers, Mr. Belzberg called back and told Mr. Greenberg that he was correct — and then suggested that Mr. Greenberg buy Hartmarx stock for his own account. Mr. Greenberg then bought up 90,000 shares for a Bear, Stearns investment account, telling Mr. Belzberg of his purchases as he made them.

'Wrong, Wrong, Wrong'

On March 4, Mr. Belzberg and the vice chairman of Hartmarx agreed, tentatively, that Hartmarx would buy back the 4.9 percent stake — and on March 4, Mr. Greenberg began selling his Hartmarx stock. By the time the buyback was officially announced March 17, Mr. Greenberg had liquidated his stake.

Although that account was based on testimony from Mr. Greenberg and Mr. Belzberg, Mr. Greenberg strongly denied several key assertions attributed to Mr Belzberg.

"It's wrong, wrong, wrong," Mr. Greenberg said last night. "Marc Belzberg never suggested that I buy for my own account. I didn't buy Hartmarx for any Bear, Stearns investment account. I didn't know they had 4.9 percent. I didn't know anything about the buyback agreement. And if the document says that, it's a typographical error. It's completely wrong. We're not involved in this, we're not implicated in any way, we've been charged with no wrongdoing. I never bought Hartmarx stock for them that wasn't subject to a put/call agreement."

The agreement Mr. Greenberg referred to was between himelf and Mr. Belzberg, dated Jan. 17, 1986, and covering Hartmarx purchases Mr. Greenberg made earlier in the month. Under the agreement, Mr. Belzberg agreed to bear the financial risk of 118,400 shares of Hartmarx stock Mr. Greenberg had bought. Those shares, added to the Belzberg holdings at the time, were what brought the Belzbergs to the 4.9 percent limit.

five managing directors based in New York.

Mr. Harris, his successor at Morgan Grenfell, is a Briton who has been in the New York office for nearly two years. Morgan Grenfell also named as managing directors Gregory T. K. Hsu, 40; Colin L. MacVeagh, 39, and Neil A. O'Hara, 34.

Morgan Grenfell's parent in London has been entangled in the financial scandal surrounding one of its

As for Mr. Harris, he says he has been particularly busy. He was called out of a meeting the other day because his wife, Judy, was about to have their first baby. Mr. Harris was home yesterday, helping care for their newborn, Francesca. "This is more interesting, and more tiring, than work," he said. "It's been a remarkable few months, and this caps the whole lot of it."

NICHOLAS D. KRISTOF
DANIEL F. CUFF

EXECUTIVE CHANGES

● **American Express Co.** appointed Alan J. Lipner senior vice president, corporate tax.

● **Ampex Corp.**, Redwood City, Calif., appointed Charles A. Steinberg chairman, succeeding Arthur H. Hausman, who is retiring. Replacing Mr. Steinberg as president and chief executive is Max Mitchell.

● **Eaton Vance Distributors Inc.**, Boston, which distributes mutual funds for its parent, Eaton Vance Corp., named Wharton P. Whitaker executive vice president and national sales director.

● **Goodyear Tire and Rubber Co.**, Akron, Ohio, elected Oren G. Shaffer executive vice president of finance and planning, succeeding James R. Glass, who is retiring. It also named John M. Ross general counsel and vice president, to succeed Fredrick S. Myers, also retiring.

● **Gulf and Western Inc.** elected as a director J. Hugh Liedtke, chairman and chief executive of Pennzoil Co., Houston.

Senate Democrats Seek New Rules on Mergers

Continued From First Business Page

guished in large part because they lacked the support of the Senate Democratic leadership, particularly Mr. Proxmire.

"The chairman's bill will be the only vehicle for any takeover legislation in this session," a senior Banking Committee aide said.

For this reason, Mr. Proxmire's approach has been awaited with considerable expectation — and some trepidation — by Wall Street, and especially by the Securities Industry Association, which is likely to mount a strong lobbying effort against the proposals.

Quick Action Expected

Mr. Proxmire signaled his intention to move the bill swiftly today by scheduling several hearings later this month. He said the bill would be considered by the full committee in mid-July.

Perhaps the most striking featue of the Proxmire bill is its attempt to deter corporate raiders, investments bankers and others from "putting companies into play," which sometimes forces managers to buy back stock from the raiders at a premium price. The proposed legislation uses a number of devices to make it more difficult for these investors and others to act together without disclosing that fact.

The proposal also recommends these steps:

¶Forbidding companies that are takeover targets to give "golden parachutes" — large severance bonuses — to executives if they lose control of the company.

¶Prohibiting "greenmail," in which a company tries to fend off a hostile takeover by buying back its stock at a premium over the market price.

¶Closing the so-called 13-D window, which requires that anyone who buys 5 percent or more of a company's stock report the purchase within 10 days and specify future intentions to the Securities and Exchange commission. The Proxmire proposal would reduce the threshold to 3 percent, and require disclosure by the close of business on the next trading day.

¶Lengthening the period in which a tender offer must be kept open, to 35 business days from 20.

¶Sharply restricting "creeping tender offers" — the purchase of stock piecemeal in the open market rather than the announcement of a tender offer to all shareholders. The bill proposes that once a bidder controls 15 percent of a corporation, a tender offer must be made for additional purchases.

Increasing the maximum criminal fines for insider trading violations to $1 million from $100,000, and the maximum prison terms to ten years from five.

¶Restricting the use of so-called poison pills — provisions that foster accumulations of huge amounts of debt or otherwise make a takeover excessively costly.

In introducing the takeover legislation, Senator Riegle stressed that it was a product of compromise, and that none "of the sponsors are completely satisfied with the contents."



BITS OF OWNERSHIP

Growing computer software sales are forcing universities to rethink their copyright and patent policies

By IVARS PETERSON

Item: As a course assignment and using a university's sophisticated computer graphics system, three students create a short animated film. The film wins a prestigious international award, and the students receive lucrative offers from various movie companies. But the question of who holds the film's copyright — the students or the university — stalls possible deals.

Item: A computer science professor develops a clever computer program that a French company wants to use for research purposes. University officials claim that the professor has no right to sell or even give the software to the company without permission from the university.

Item: A graduate student writes a computer program as part of a large, ongoing research project. He copyrights the program and refuses to let other researchers in the department run the software until they agree to pay him a fee for its use.

Item: A team of faculty members and staff programmers puts together a computer program for handling library loans and other functions. The program is so successful that several dozen copies are sold to other libraries. Thousands of dollars accumulate in a bank account while the university tries to establish a policy for handling the twin questions of computer software ownership and the division of royalties.

These incidents, all of which have actually occurred at universities in the United States, reflect some of the sticky copyright issues now befuddling university administrators, faculty, staff and students. Universities are starting to review their "intellectual-property" policies, covering everything from copyrighted textbooks to patented inventions, to see where computer software fits in.

The real issue is money. Traditionally, universities have allowed faculty members who write books and create works of art to hold the copyright and keep any money earned from sales. On the other hand, most universities already enforce patent policies that call for a share of income from inventions.

The debate stems from a 1980 federal law that says computer software should be protected by copyright rather than by patent. Many university administrators, noting the increasing potential commercial value of software developed at universities, want to treat computer programs like inventions. In opposition, some professors argue that software, like any other copyrightable material, should belong to the creator.

Most universities don't yet have a comprehensive copyright policy, says Brian L. Hawkins of Drexel University in Philadelphia. "From the university's perspective, there's been money in patent policy," he says. "But copyrights, until software emerged as a copyrightable entity, didn't matter. Historically, there wasn't much money in them."

Now, universities are scrambling to catch up with technology. The issues surfaced early at places like Stanford University, the California Institute of Technology in Pasadena, Carnegie-Mellon University (CMU) in Pittsburgh and the University of Illinois at Urbana-Champaign, where software development has a long history. These and a few other institutions already have policies in place or are about to implement new policies. In many cases, the policies took years to develop. Bitter arguments often punctuated discussions.

One of the more contentious issues is the concept of "work for hire." Employees of a business usually must agree as a condition of employment to assign to the company all copyrights and patents. Even without a signed agreement, companies automatically own the copyright if the work is done on company time and with company resources.

The response of universities to this issue has been mixed. Some university officials argue that everything that takes place at a university is properly "work for hire" and really belongs to the institution. At a few universities, officials see the software copyright debate as a chance to gain greater control over everything that faculty and staff produce.

Others contend that universities are not like businesses. They say that a university's mission is the generation and dissemination of knowledge. A greedy administration and an overly restrictive copyright or patent policy can impede this function. It can also poison the atmo-

sphere on a university campus.

Several universities are actually heading completely away from the work-for-hire concept. Some policies allow not only faculty but even staff hired to write specific computer programs to collect as much as 60 percent of the income from marketed software, although the university holds the copyright.

"There are arguments on both sides of that issue," says Thomas K. Wunderlich, associate dean of research at Brown University in Providence, R.I. "We're leaning toward a nondiscriminatory policy that says we'll treat faculty, staff and students alike. If there's going to be money made, then there will be sharing whether within the computer science department or within the computer center itself."

"This is a new form of incentive within the academic institution," says Hawkins, "where a different sense of community can be created."

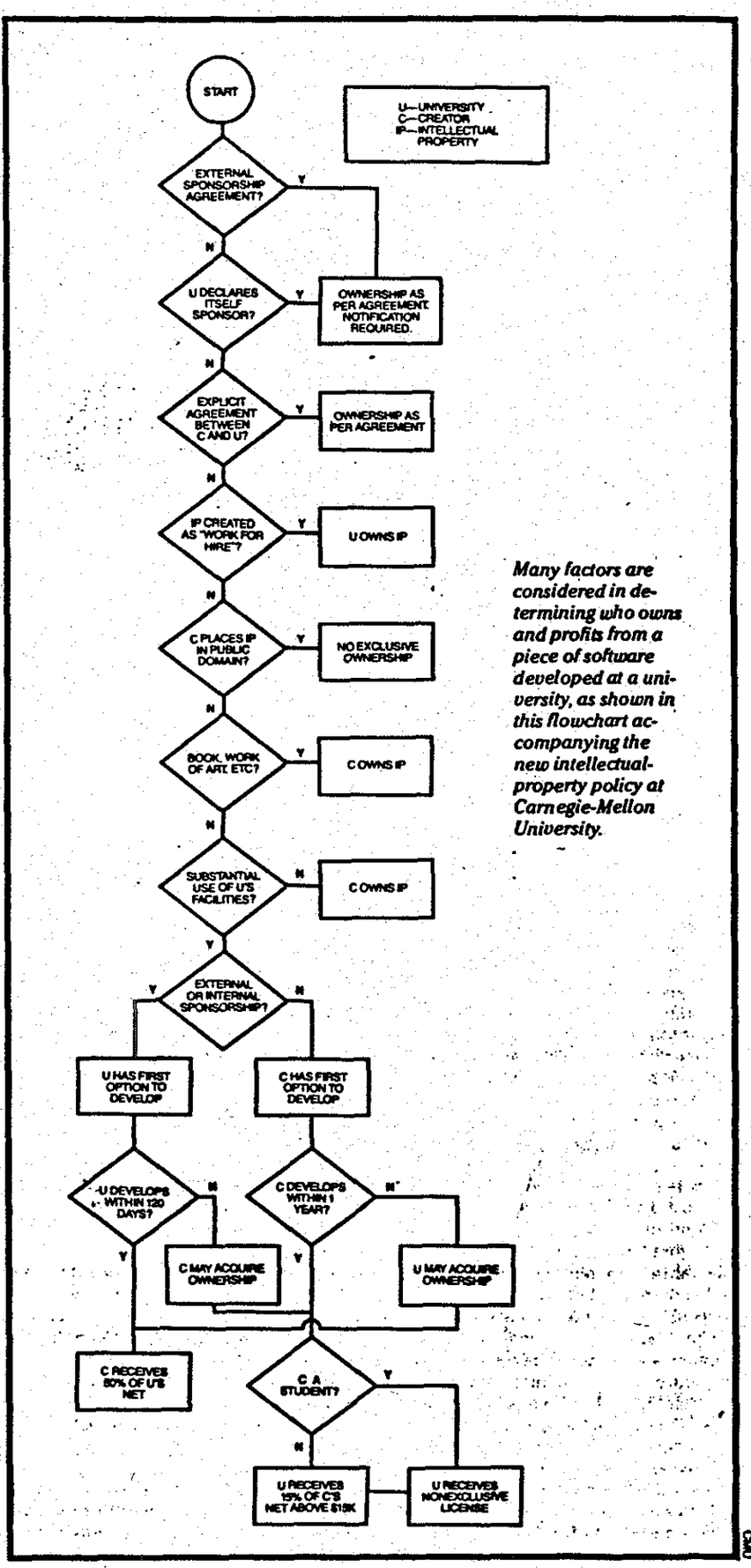
Most university software policies, however, don't go this far. More often, if faculty or staff are hired or assigned time to write a program for a specific purpose, then the university holds the copyright and the creators involved usually don't share in any income from marketing the software.

But establishing ownership can get complicated. "There are so many different scenarios under which creators can develop something," says CMU's Richard M. Stern. The CMU document includes an intricate flowchart showing all the different possibilities.

Software itself also covers a broad spectrum of creations — from "computer courseware," which is often little more than a video textbook, to programs that run scientific instruments and collect data. Also included are operating systems for computers and microcode, which converts commands in a programming language into instructions in a microprocessor chip. Some universities have chosen to divide software into two or more categories, depending on whether the software is more like a book or a patentable invention.

Another sticking point is the definition of "substantial use of university resources" in deciding whether a university holds a copyright. Brown University, in its proposed policy, takes a liberal approach. In general, unless the university's large "mainframe" computer is used extensively, the programmer holds the copyright. Exceptions would occur when research is sponsored by a government agency, industry or foundation and the contract specifically requires the university to claim ownership of any software produced for the project.

"There are concerns about use of university facilities," says Wunderlich, "but you can't police everything." The task becomes overwhelming with the proliferation of computers on campuses. "People use computers the way they would turn on a light switch," says Henry A. Scarton, a



Many factors are considered in determining who owns and profits from a piece of software developed at a university, as shown in this flowchart accompanying the new intellectual-property policy at Carnegie-Mellon University.

CMU

mechanical engineer at Rensselaer Polytechnic Institute in Troy, N.Y. "Using a computer is like having a pencil."

Nevertheless, CMU, in a quest for precision, is one university that has tried to put a dollar figure on "substantial use." In CMU's policy, "extensive" use of university facilities means that the programmer would have had to spend more than $5,000 to buy or lease equipment and services similar to those used at the university.

Wary of potential accounting problems, other schools have included a "substantial use" clause but have chosen to leave it undefined. At the Virginia Polytechnic Institute and State University (VPI) in Blacksburg, a special committee settles the matter.

Another touchy issue concerns the role of graduate and undergraduate students. At places like Ohio State University (OSU) in Columbus, the school has strongly championed students' rights by encouraging students to copyright their work, including class assignments and dissertations. In general, a student's work belongs to the student, unless the student has been hired for a specific project or makes extensive use of university facilities.

Not all universities follow this approach, partly because of differences in state laws governing contracts and related matters. VPI lawyers recently studied the question as it applies in Virginia and concluded that a submitted class assignment, for instance, becomes the property of the professor involved. Students also cannot claim a share in any university software they helped to develop unless the professor, in a written agreement, decides to give them a percentage of any royalties.

The ownership of work done by students is a tricky question, says OSU's Gary L. Kinzel, who discussed the problem at a recent meeting in Boston on computers in engineering. "Students rarely work on a significant piece of software without major supervision from a faculty member," he says, "although the faculty member may or may not actually write part of the code."

In his paper, Kinzel gives an example of what could happen: "An adviser works with a student for several years and provides many of the ideas for a software package. The adviser may also arrange for computer support, financial support through a teaching assistantship and advice on the program development. At the end of the project, the student may decide he would like to start a company based on the program. He can then copyright the program and deny the university access to the source code. Technically, the student is within his rights because he alone did most of the actual programming."

Of course, because a copyright covers only the expression of an idea and not the idea itself, the professor is free to work with another student to redo the program from scratch. "However, with research that is highly associated with computer programming," says Kinzel, "the inability to be assured access to programs for future development has a significant damping effect."



OSU/Computer Graphics Research Group

Three students at Ohio State University last year won several top international awards for their three-minute, computer-animated film "Snoot and Muttly." However, determining who owns the software that generated the images and who benefits from any proceeds from its sale turns out to be a very difficult question to resolve. Now OSU has a copyright policy that in the future may help settle such disputes.

Several new and proposed intellectual-property policies now try to circumvent such problems. At Illinois, for example, users, to get access to major university facilities, in effect agree to give the university a royalty-free license to use, within the university, any software developed using the facilities.

However, the best way to overcome these and other potential copyright problems is to come to some agreement before a project starts. "Contrary to all the good old academic traditions," says Dillon E. Mapother, associate vice chancellor for research at Illinois, "there are certain areas where you've got to put things in writing if you want to avoid trouble."

"Potential conflicts can be avoided if reasonable written agreements are made with students prior to any software development effort," says Kinzel. "Presumably, an important aspect of any such agreement would be that the university should have use of any software developed and this use should include the right to modify the source code."

More and more faculty members are taking this approach, not only with students but also in dealing with a university's administration. The CMU policy, in fact, states that because "it is frequently difficult to meaningfully assess risks, resources and potential rewards, negotiated agreements are to be encouraged whenever possible."

"The purpose of a policy is to establish the ground rules and to set the defaults — in a sense, the starting point for negotiations," says CMU's Stern. "We never really attempted to consider every possible scenario in detail." He adds, "I think it would be foolish to try to do something like that."

Although a few universities have intellectual-property policies that include computer software, most are just starting to wrestle with the problem. And new issues keep coming up.

"I don't think the debate on this is over," says Scarton. "If anything, it's only beginning." Rensselaer Polytechnic Institute started debating the issue several years ago but still has no policy. Now, a faculty committee has proposed that a modified version of CMU's policy be implemented. "CMU did a very nice job," says Scarton, "but their policy is a little bulky. We tried to streamline it a little bit."

Although policies like those at CMU and Stanford University are being used as models, the issues are complicated enough that universities are generally taking somewhat different approaches. "There's not a right way or a wrong way," says Brown's Wunderlich. You need to look for "a path of least resistance" to get a policy through at any particular university, he says.

Even universities that have policies see that changes are needed. Both the Massachusetts Institute of Technology and Stanford, which have had patent and copyright policies for years, are tinkering with their schemes. Commenting on OSU's recently adopted "interim policy," James B. Wilkens of OSU's patent and copyright office says, "This field is sufficiently complex that in two years we probably will find that we want to make a few changes."

"The main point is that if you adopt a policy that alienates the original authors [of a copyrightable piece of work]," says Mapother, "the property that you claim is largely without value." □

The New Cutting Edge In Factories: Education

Workers Lacking Math Skill Fear for Jobs

Third of a series

By Barbara Vobejda
Washington Post Staff Writer

YPSILANTI, Mich.—Lavester Frye works at an assembly table eight hours a day building automobile horns, setting a metal plate on a metal dish with one hand, adding a tiny ring with the other.

In the 22 years he has worked at the Ford Motor Co., it never really has mattered that he didn't finish high school. He always has had jobs like this one, jobs that depend more on his hands than his mind.

RUDE AWAKENINGS
THE CHALLENGE OF THE GLOBAL ECONOMY

But Frye has been told that his job soon will become more complicated. To improve productivity, the company is phasing in an intricate statistical system of quality control.

The news made Frye feel nervous and unprepared, and when he looked at the charts he would be expected to keep under the new system, he was even more troubled by what he saw: decimal points. "A long time ago at school, I had decimals, but it faded out of my mind," he said.

On this factory floor, amidst the assembly lines, the huge hulking furnaces and the din of metal on metal, the ability to put a decimal point in the proper place suddenly has become a ticket to a job.

Like thousands of other workers across the country, Frye is experiencing firsthand the transformation of the American workplace in pursuit of competitive advantage. He also sees—and feels, painfully—that, in this race to keep up with other countries, a critical and often missing factor is education.

In the national debate over declining U.S. competitiveness, education is perhaps the word most often uttered. Plant supervisors blame schools for turning out undisciplined workers whose bad habits drive down productivity. Corporate executives complain that job applicants can't read or write.

Educators warn that American students lag far behind their international counterparts in math skills, signaling trouble in the

See COMPETE, A14, Col. 1

Education: Factories' Cutting Edge

COMPETE, From A1

next generation of technicians. Also looming ahead, social scientists say, is a massive, problem-ridden underclass of high school dropouts that will drain the economy in welfare costs and lost productivity.

Education matters in this new global race because the work force matters more than machinery, more than capital, more than technology.

"Human resources—that's what gives you the competitive edge," said Pam Spence, training coordinator at the Ford plant. "Everybody's buying the high-tech equipment . . . . The only competitive edge we'll have over anyone else is our human assets."

The quality of education, experts agree, is increasingly the most important single determinant of the quality of America's work force, from the high-technology laboratories that rely on engineers with graduate degrees to the Rust Belt industries retraining workers in a struggle to revive. The skills and deficits of the employes determine productivity: an auto worker confused over decimal points slows output and probably overlooks defective products.

"Education is the foundation. If you have a weak dollar and you solve the deficit problem and all those ducks fall into place and you have a poor education system, you're still not going to compete," said Harley Shaiken, a professor who specializes in work and technology at the University of California at San Diego.

Ford's efforts to improve productivity are typical of many employers: the company is automating, introducing more sophisticated quality control and enhancing employe participation in management. And in the low-slung, red-brick building that houses the Ford plant here, there is plenty of evidence that a lot of the workers simply aren't up to it.

Les Walker came to work at the plant four decades ago as a 17-year-old high school dropout. "If you could read or write a little bit, you could get a job," he said of the booming postwar period when he was hired. "Now there's so much change . . . . "

Walker inspects the valves on shock absorbers that will be built into Ford bumpers. Soon, "statistical process control," which is designed to pinpoint and correct defects in manufacturing, will be introduced to his section of the plant. He'll need to use math skills he hasn't needed before and never learned in school: fractions, division, averaging and decimals.

When Frye and Walker complete their afternoon shift at 3, they and several others gather in a converted office off the factory floor, hunching over high school books around a cafeteria table. They have volunteered for free courses, arranged under a 1982 United Auto Workers-Ford agreement, to prepare for the high school equivalency test. They also have taken instruction in computers and basic reading and math.

As the assembly line gears up for the second shift, Frye, 48, learns how to figure a percentage. Walker, 56, scratches out ratios and proportions.

These workers, most of whom could retire in a few years, would not lose their jobs if they failed to learn statistical process control. But they know job promotions depend on their ability to adapt, and many of them believe that they will be better, more productive workers if they learn the new systems. They don't want to be left behind.

"I want to be prepared when it gets here," 55-year-old Daniel Hughes said of the new technology.

Hilton H. Schaarschmidt, who uses a computer to distribute automobile parts to be assembled by other workers, summed up his choices after more than two decades in the factory. "If I can't work the computer, someone else can; I would be back out on the [assembly] line," he said. "I don't want to be back out on the line."

Retraining Workers for the Year 2000

Three-quarters of today's work force will still be working in the year 2000, so the training and retraining of current workers is critical in reviving the nation's standing in the world economy. Many believe that the next 10 or 15 years will be the period of the most intense global competition.

"We're going to make it or break it with these workers," said Pat Choate, director of policy analysis at TRW Inc. and a noted author on the subject of American competitiveness.

But for the long term, competitiveness must rely on the quality of education being offered in elementary and secondary classrooms, to youngsters still years away from their first paycheck.

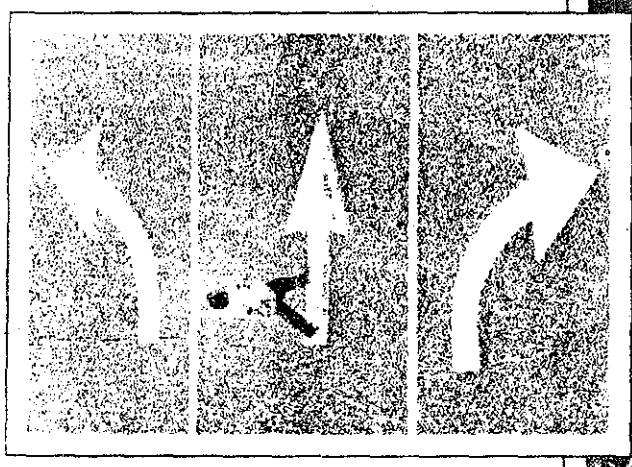
"A failure in basic education in 1987 will be extremely difficult to rectify because of the very large scale and intense kinds of technological changes we know will be taking place in the future," University of California professor Shaiken said.

American schools, however, are doing "very poorly" in supplying a broad basic education, Shaiken said. "Many students graduate from high school without any grasp of basic math or reading skills. To the extent that continues, then competitiveness is just something you talk about."

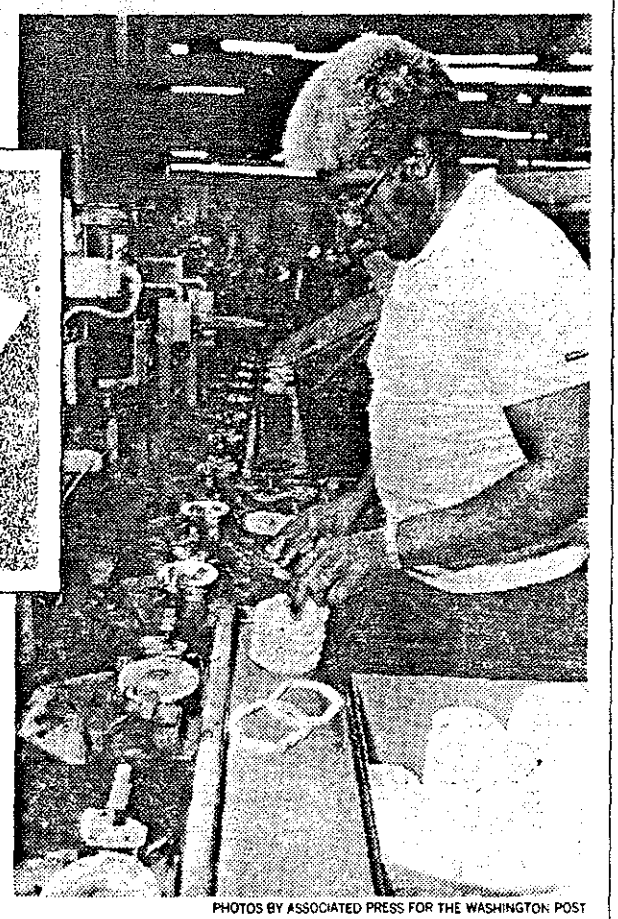
Recent studies comparing the mathematics test scores of American schoolchildren to their international counterparts support Shaiken's pessimism. While Japanese schoolchildren finished first or second in most categories, American scores ranked in the middle in comparisons of eighth-grade arithmetic and algebra skills for 20 countries. U.S. achievement dropped even lower, to the bottom quarter, in geometry and measurement. There was similar low performance among American 12th-graders in algebra and calculus.

"In school mathematics, the United States is an underachieving nation and our curriculum is helping to create a nation of underachievers," according to the

RUDE AWAKENINGS

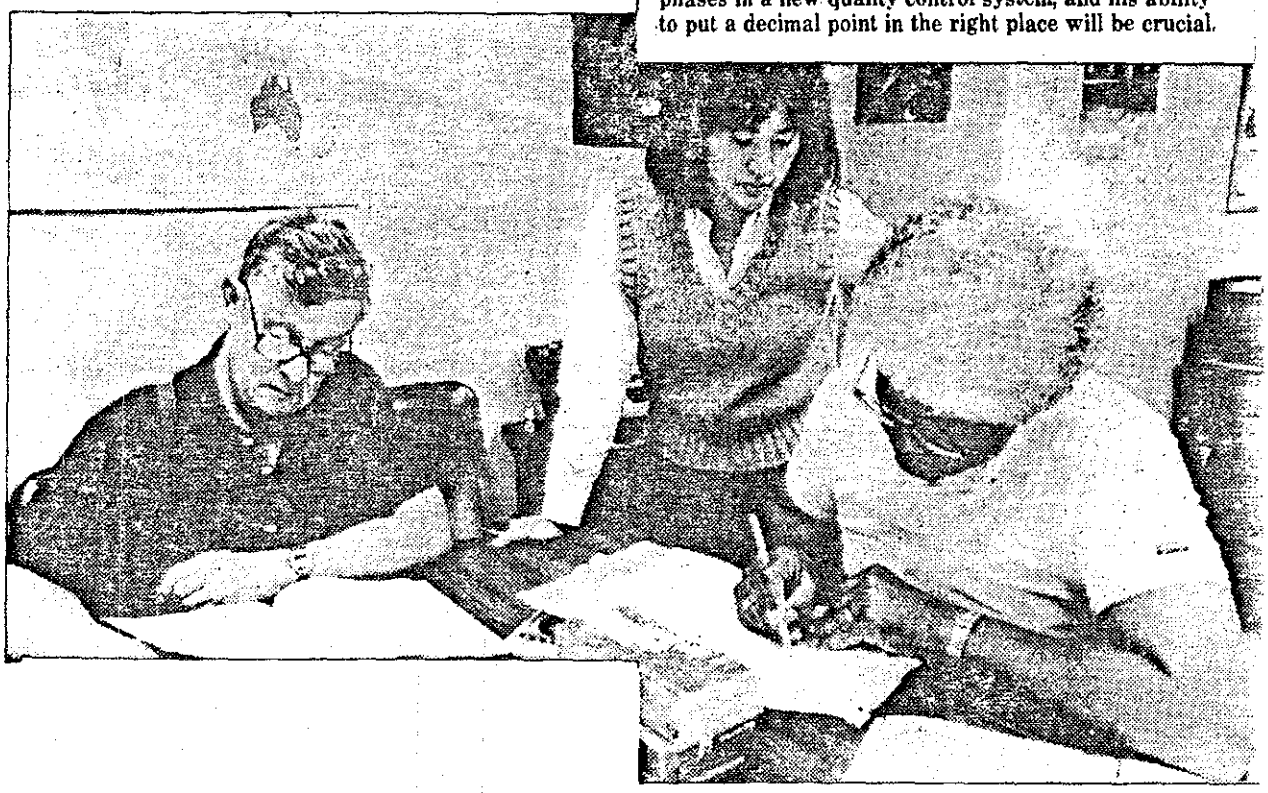


Education matters in this new global race because the work force matters, more than machinery, more than capital, more than technology.



PHOTOS BY ASSOCIATED PRESS FOR THE WASHINGTON POST

Lavester Frye, who assembles automobile horns, will be expected to keep statistical charts once Ford Motor Co. phases in a new quality control system, and his ability to put a decimal point in the right place will be crucial.



To remedy educational deficiencies, Walker, left, and Frye volunteered to take free courses in computers, basic reading and math to prepare for a high school equivalency test. Instructor Emo Honzaki supervises afternoon class.



Les Walker inspects valves on shock absorbers for bumpers. When a system of "statistical process control" to detect and correct manufacturing defects is introduced, he will need to learn new math skills.

Second International Mathematics Study, released this year.

While most experts put heavy emphasis on education as a competitive strategy, there is a minority viewpoint, based primarily on productivity statistics, that plays down education as a factor.

"I don't think we have strong evidence at all that losing competitiveness is due to the lack of a well-educated populace," said Thomas G. Sticht, a San Diego consultant who has studied the link between literacy and productivity and participated in a recent Department of Education study of literacy. The loss of manufacturing jobs to workers overseas, he said, is due to the availability of cheap labor—not to higher educational levels abroad.

"That has nothing to do with the fact that somebody can't calculate a percentage," he said.

Henry Levin, a Stanford University professor in education and economics, agrees that education is overrated as a factor in competitiveness. He asserts that most newly created employment in this country requires relatively low-level skills in service sector jobs, such as clerical work or jobs in the electronics component industry. Few of the new positions are for engineers or highly educated technicians.

And while the sophisticated products of an increasingly high-tech economy may be designed by a few highly skilled engineers, the real profits will come when the product is produced and sold. That will not require a highly sophisticated work force, Levin said.

"It's easy to talk about education as the problem . . . [but] what is it about education that's going to make a difference?" he asked. "Education is part of the solution, but it's not as crucial a solution as people make it to be."

The Japanese Philosophy: Improvement

Down the road from Ford's Ypsilanti building, executives at a new Mazda plant in Flat Rock, Mich., say they have a very clear idea of how education can make a difference.

They want their new employes to be able to work in teams, to rotate through various jobs, to understand how their task fits into the entire process, to spot problems in production, to trouble-shoot, articulate the problem to others, suggest improvements and write detailed charts and memos that serve as a road map in the assembly of the car.

For the Japanese-owned company, it adds up to a management philosophy modeled on the Japanese concept of *kaizen*, roughly translated as "improvement." That means that every employe, executive to custodian, is expected to help find ways to build "the best car at the lowest price."

"The plant of the past required individuals . . . to perform a task within very specific parameters, very routine," said David Merchant, vice president for personnel at the Mazda facility. "The plants of the future, which are the plants of today, require people to do a lot more than that . . . . Education is important in terms of preparing people to do that."

Merchant is overseeing an extraordinary effort to create a work force—mostly American—that matches the Japanese philosophy. In preparation for its assembly line to open this fall, the company is sifting through more than 96,000 applicants to fill 3,100 hourly positions, using what it says is the most complex hiring process in the United States or Canada.

Applicants are given a two-hour written test in reading, writing and math. They are interviewed at length,

The once unquestioned dynamism of the United States in the world marketplace is being tested as never before, forcing Americans to confront dramatic changes in standard of living, expectations and values. This is the third of six articles exploring these changes. Succeeding articles will address the problem of world trade, the debate over "competitiveness" in the political arena and the overall outlook for the future.

asked to undergo a medical exam and given a two-step "assessment." Before they complete the process, successful applicants may have been in the pipeline for two months and will have spent up to six hours being observed in discussion groups and another six hours at a simulated team assignment, assembling an automobile part, for example.

The company, which every week tests 600 applicants and interviews and assesses more than 100, has been "a little disappointed" at the number of applicants who lack the basic math and language skills, but nevertheless has found plenty of qualified people to hire, Merchant said.

Compare that handpicked batch of fresh employes to the work force at Ford, where the average hourly worker has more than 17 years on the job. Financial hard times, largely due to foreign competition, have cut the company's hourly work force nearly in half. The remaining workers are those with the most seniority, hired at a time when little attention was paid to educational skills and the rule of thumb for hiring was, as one union official said, "FBI": friends, brothers, in-laws.

At Mazda, there has been no need to offer remedial programs in reading, writing or math to the hundreds of workers who have so far been hired. But Ford and other longtime employers have found that before they can retrain, they must help substantial numbers of employes become literate.

"It's pretty hard to give somebody computer training if they don't have the three Rs," said Mark Dillon, a spokesman for American Crystal Sugar Co. in Moorhead, Minn.

As his company added computerized testing equipment to its sugar manufacturing process, it became clear that some employes were unable to read and write and could not be trained without remedial courses. But fewer than two dozen employes signed up for the literacy classes the company began offering. "It takes a pretty big person to say, 'I have to learn to read,' " Dillon said.

Fighting U.S. Functional Illiteracy

"Functional illiteracy" among American adults often is cited as one of the biggest obstacles in the nation's efforts to improve productivity. While 95 percent of young adults are literate, there are large numbers who fail at more complicated tasks required to function effectively in most jobs.

A recent survey by the National Assessment of Educational Progress reported that only 43 percent of Americans in their early 20s could decipher a street map, for example.

Donald Fronzaglia, director of personnel for the Polaroid Corp., said his company became aware of the literacy problem years ago when a supervisor was investigating why the rate of scrap—material discarded as unusable—had gone up significantly in one section of the plant.

When the supervisor asked an employe to demonstrate how he was cutting film into sections, he found that the worker couldn't read a tape measure and was throwing away large sheets of film that could have been cut into usable pieces. The supervisor eventually discovered that other workers lacked similar basic skills.

Polaroid has introduced literacy programs, also aimed at preparing workers to participate more in problem-solving on the production line. "We believe the people closest to the problem are in the best position to understand what went wrong," Fronzaglia said. "People who don't have [basic] skills may repeat the same error."

Aside from the challenge of retraining those on the job, there is the problem of the growing number of Americans who, largely because of poor skills, will never find work or will end up moving from one menial, low-paying position to another. The financial drain on society created by this group—in welfare, drug problems, urban crime and incarceration—will have increasingly serious implications for the nation's economic health and competitive position, according to several recent studies.

A report by the National Alliance of Business warns of the dramatic change in the worker pool looming ahead over the next 10 to 15 years.

"Most striking will be the growth of less-well-educated segments of the population that have typically been the least prepared for work," the report said. "The number of minority youth will increase while the total number of youth of working age will decline. The number of high school dropouts will rise as will the number of teen-age mothers."

The report urged businesses and government to improve education, training and retraining. "No [economic] sector can afford a growing underclass that cannot get or keep jobs . . . ."

Despite the dismal predictions, economist Choate and many others argue that the immediate challenge is preparing those already on the job for the changing workplace. "Most of us still think education is for kids," he said, "[but] it's today's adults that face the intense competition." It is their performance that will determine competitive success, "not tomorrow's kids."

At Ford's Ypsilanti plant, UAW local president Bob Bowen echoes the concern for today's work force and the critical need for flexibility. "If you have an educated person, they can adapt to the change," he said, proudly listing fellow workers who have signed up to take high school courses in makeshift factory classrooms. "The only way we can be competitive is to have the best workers."

NEXT: The new world economic order

RUDE AWAKENINGS
THE CHALLENGE OF THE GLOBAL ECONOMY

Brawn Forged Into Brain

Muscles of Steel Atrophied, Pittsburgh Turns to Services

First of a series

By Dale Russakoff
Washington Post Staff Writer

PITTSBURGH—When Larry Prisbylla finished high school in 1972 and traded in childhood dreams of becoming a teacher for a life as a steelworker, he thought it would last forever.

Every vista in his native Monongahela Valley contained a mile-long mass of pipes, sheds and smokestacks where thousands of workers forged raw materials into steel. In his boyhood, the sky in the "Mon" Valley would light up red at night with fires from mill furnaces. Steel built the region, won the wars, secured his future. And it paid as well as jobs reserved for college graduates.

"We thought we were going to be typical Yuppies," said his wife, Laura. "We were going to have it all."

But in less than a decade, time ran out on the Mon Valley. In 1980, Larry Prisbylla's workweek was cut to four days. On Christmas Eve 1981, he arrived at U.S. Steel's sprawling Clairton Works to find this notice posted in his shop:

"No more work scheduled."

At first, he didn't believe it was over. Each month brought fresh rumors that he and his buddies were about to be called back. For six months, his union and government benefits paid 80 percent of his $12 an hour paycheck. When his benefits ran out, Larry Prisbylla was still waiting. One day, Laura Prisbylla came home from her job as a secretary at Pittsburgh National Bank to learn, again, that her husband had heard encouraging grapevine rumors. By now, the talk sounded hollow even to Larry.

"I just looked at him and said: *Listen* to yourself!" Laura Prisbylla said. "Wake *up*! It's *finished*! It's time to do something else."

Laura Prisbylla's warning to her husband sounds remarkably like those issuing across the country from business and labor leaders, educators and politicians as the national economy experiences its most dramatic upheaval since the Industrial Revolution.

In less than a decade, the world's largest creditor nation has become its leading debtor, foreign competition has humbled America's mightiest companies, hundreds of thousands of manufacturing jobs have disappeared and middle-class living standards have declined in many communities.

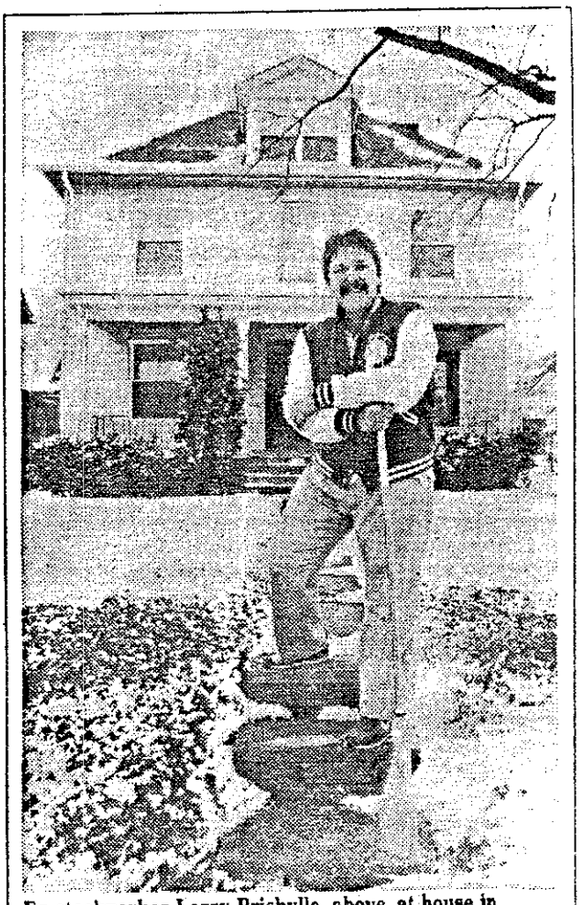
On the surface, the debate is about economics, but its roots are in the nation's social fabric and its people. Families and communities are confronting unprecedented dislocations; scientists and inventors are braving frontiers, though often ignored by American managers; educators are moving from the classroom to the workplace to guide workers into a new, highly technological economy; business leaders are paying a price for decades of complacency, and politicians are reassessing the federal government's role in the economy.

See COMPETE, A12, Col. 1



BY RAY LUSTIG—THE WASHINGTON POST

Ex-steelworker Larry Prisbylla dines with his wife, Laura, and children, Sara, 2, Michael, 12.



Ex-steelworker Larry Prisbylla, above, at house in suburban Pittsburgh. Below right, at work in new profession, he checks on Daniel Martin at Mercy Hospital.

Deputy Treasury Secretary Richard G. Darman likens this collective American soul-search to the atmosphere of the late 1950s, when the Soviet Union launched the Sputnik satellite and the United States suddenly found itself No. 2 in the space race.

It is a search that Larry Prisbylla and his city began years earlier than the rest of the country.

At 28, Prisbylla faced a stark choice: Accept the end of the world as he knew it and prepare for the new one, or become resigned to a life of permanent dislocation. He opted for the first and spent four difficult years getting there, an experience that embodies lessons for the nation.

His city, former steelmaking capital of the world, is in the midst of a painful process of adaptation to the new economic order—one in which manufacturing is less important, while more resources go to services and "knowledge" industries.

Said Carnegie-Mellon University President Richard M. Cyert, a leading force in high technology here: "We are moving from a labor force called upon to use its muscle to one called upon to use its brains."

In the lingo of Washington's debate over the declining "competitiveness" of American industries, this requires what the pundits call a national "transition to a service economy," in which fewer and fewer workers, in automated plants, shoulder more and more of manufacturing output.

But "transition" is a misnomer for what happened here. More accurately, one sector declined and another arose, upending traditional notions of who wins and who loses. Even the winners have absorbed enormous shocks to values and habits.

Because the transformation is still under way, a traveler here has something of an archeologist's view: a new civilization being planted atop an old one.

On the city's eastern end, an idled Jones & Laughlin (J&L) steel plant is being bulldozed to make way for a high-tech industrial park, backed by the city and its two research-rich universities, Carnegie-Mellon and the University of Pittsburgh. The firms being lured to the park have work forces numbering in the dozens—contrasted with thousands who worked at J&L. Their employes tend to have advanced degrees; few millworkers went beyond high school.

A downtown subway stop still bears the name "Steel Plaza," but two of the three tallest towers around it, including the former U.S. Steel headquarters, are now occupied by Mellon Bank, a leader in the expanding service sector. Steel employed only 2 percent of the labor force last year, far behind health and education, the leaders of Pittsburgh's new economy.

Pittsburgh, known for blackened skies and muscular monikers—"Hell with the lid taken off" and "Forge of the universe"—now has a smaller proportion of workers employed in mills and factories than the nation as a whole. (The ratio here is 1 in 6; nationally it is 1 in 5.)

Change has not come easily. The five-county area lost 125,000 manufacturing jobs from 1979 to 1986—70,000 of them in basic steel—as Pittsburgh's key industries lost markets here and abroad. A surge in the service field and in high technology, powered by research at the city's universities, filled much of the gap. But figures compiled by Pennsylvania's Department of Labor and Industry show that almost 70,000 jobs have disappeared since 1979.

An Unusual McDonald's—It Was Closed

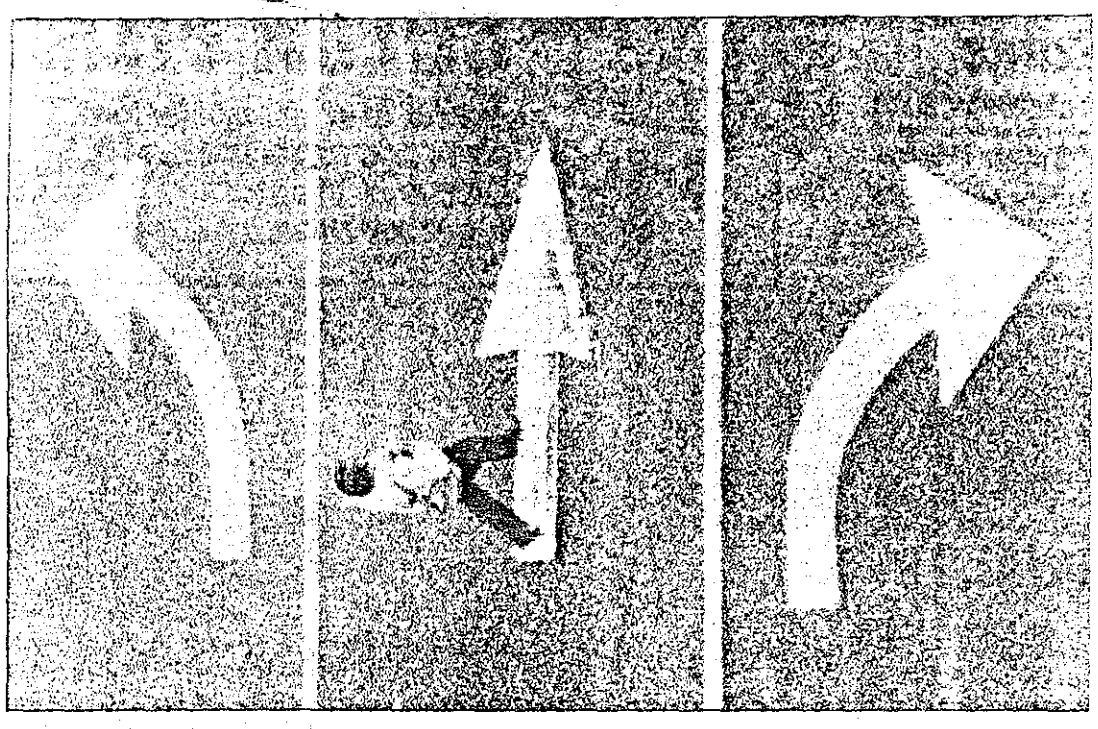
The new jobs generally have not gone to those who lost the old ones. A boomlet in openings for computer technicians at banks and local colleges was quickly oversubscribed as former steelworkers poured into technical schools, hoping to train for the new era. A Mellon Bank vice president said 50 people, at least a third of them ex-steelworkers, now apply for every computer technician opening at the bank.

While downtown Pittsburgh glistens with office towers, the Mon Valley resembles a deserted battlefield; mile after mile of mills lie mute. Mental health workers report increases in suicide, spouse abuse and other yardsticks of despair. McKeesport, site of U.S. Steel's idled National Tube Works, has the dubious distinction of being home to one of the few McDonald's ever to close down. (McDonald's says it was "relocated.") The fallen Golden Arches outlet, near two shuttered department stores, is being turned into a state unemployment office.

"It's very painful and ugly. There's nothing pleasant about it," said Thomas C. Graham, president of USX Corp., the renamed U.S. Steel. Graham's industry and its unions are widely blamed for choices that fostered the current devastation. "Transition is a slow process," Graham said.

When Larry Prisbylla began looking for work in

RUDE AWAKENINGS



Larry Prisbylla faced a stark choice: Accept the end of the world as he knew it and prepare for the new one; or become resigned to a life of dislocation. He opted for the first and spent four difficult years getting there, an experience that embodies lessons for the entire country.

1982, he had nothing to offer but a high school diploma and nine years in a mill. "I was a dime a dozen," he said. He applied for 50 jobs, with no results.

He had insulated gas and water lines for U.S. Steel so he applied to be an insulator. But he got nowhere because he had no experience on equipment used outside the mill. He also had driven trucks at the Clairton Works so he applied to be a truck driver, but lost out because he hadn't driven on roads outside the mill.

Prisbylla came to see the mill as a trap. Like many of his generation, he said, he had never wanted to work there but took the job for the money—among the highest manufacturing wages of any union, accepted by management as a price of labor peace. "Once you were in, you made as much as any college graduate," Prisbylla said. "You'd say you were going to get out, but by the time you got around to it, you had seniority. That's hard to give up."

Just having "steelworker" on his resume after 1981 was a drawback: Employers assumed he would quit at the first chance to return to the mill and higher wages. Prisbylla's only break occurred when an 11 p.m.-to-7 a.m. dishwashing detail opened up at an all-night diner called Eat 'n Park. He took it—at $3.35 an hour, less than a third of his Clairton wage. He doesn't recall thinking that the job was beneath him; after 50 rejections, he thought maybe this was his place.

College Provides a Turning Point

"We didn't know what his abilities were," Laura Prisbylla said. "All he'd done since high school was work in the mill."

In the new order of things, the hard-won money and benefits of millwork came to seem like narcotics, lulling would-be achievers into lives that never tested their limits. Now everyone was forced to go cold turkey.

The Prisbyllas' visions of life in the middle class were fading. Plans to have more children were deferred indefinitely (Laura has a son from an earlier marriage). In late 1982, their mortgage and utility bills swallowed most of their monthly earnings. (They had bought a house—at 16½ percent interest, two months before Larry's layoff—in Pittsburgh's South Hills, a working-class neighborhood being taken over by young professionals.) They looked to their mothers to bring by a bag of food now and then. Larry's parents were hit hard. His father, a machinist, lost his job when his plant closed. The elder Prisbylla later was hired as a janitor at the church Larry and Laura attend.



Many of those better off acted unconcerned, Laura Prisbylla said, as if steelworkers somehow had brought it on themselves. She solicited United Way contributions in her department at the bank and took it personally when people didn't give generously in the face of such widespread dislocation.

The turning point came in a public service announcement that flashed across Larry Prisbylla's television screen in the fall of 1983, during Pittsburgh's peak unemployment of 14.8 percent. It said the Community College of Allegheny County would retrain laid-off workers free. The county government and several private sources would pick up the tab.

The announcement ran for only a week on television and in newspapers, but almost 13,000 laid-off workers (one-eighth of the unemployed population) called the college. Larry Prisbylla was one of them.

After thinking over his future, the former steelworker decided to try to become a nurse. "My first concern was job security, so I saw two ways to go in Pittsburgh—health and computers," he recalled. "It looked like all the technical schools were pushing computers, so I picked the health industry. We've got all these hospitals, we're world-renowned for organ transplants. It seemed like nursing would give me lots of options."

Gambling everything on a career he hadn't even started, he quit the hard-won dishwashing job, making Laura the sole breadwinner. "A lot of guys had trouble doing that, but I just told everybody: She's taking care of me." They gave up all frills, including Christmas presents. Larry studied almost every night until 11:30 with six fellow students, struggling to take in chemistry, anatomy and physiology after being out of school 10 years. His first-semester grades amazed him: a perfect 4.0.

Soon after, the Prisbyllas decided to have a baby. Sara Prisbylla was born as Larry finished Nursing II. Laura, who had wanted to stay home with Sara, instead returned to work in six weeks to keep her paychecks coming. Their mothers took on the daytime child care.

When Larry Prisbylla graduated last spring as a registered nurse, hospitals throughout the area came to interview him and his classmates before they could even apply for jobs, a testament to the value of their education. "They would pump your hand and shove an application into it. What a switch!" Larry said. "I told Laura I would've loved to turn down the first five or six, just to get back at all the people who turned me down, just to see how it felt."

But the first offer he received was one he hoped for: Mercy Hospital, which had a specialty he wanted in orthopedics. He took it, at $28,000 a year, about the same as he was getting in the mill on Christmas Eve 1981.

Larry Prisbylla's story is a rare one—few former steelworkers land service-industry jobs at their old pay—but his experience says much about Pittsburgh's shifting values and the price of economic change.

The new jobs that pay well—in finance, health and high technology—generally require advanced degrees; at the least, high school plus vocational education. Some advanced technology firms require a doctorate plus business experience.

Bruce Davis, 33, who retrained as a computer technician after being laid off by U.S. Steel, repairs electronic equipment for Mellon Bank at wages about one-third lower than he was paid in the mill. A college graduate who took a mill job largely for the money, Davis said he will pass this lesson to his son, born the day of his layoff: "There's no easy job anymore when you get out of high school. You have to know exactly what you want to do because there's nothing to fall back on to support a family. That's gone."

The once unquestioned dynamism of the United States in the world marketplace is being tested as never before, forcing Americans to confront dramatic changes in standard of living, expectations and values. This is the first of six articles exploring these changes and their causes. Succeeding articles will address the problems of scientific research and development, education, trade, the "competitiveness" debate in the political arena and the long-term economic questions that lie ahead.



Twice a week Prisbylla attends community college at night to keep pace with changes in nursing. Education was a key to regaining employment after being laid off.

Photos by Ray Lustig—The Washington Post

For Lack of Assistance, No Retraining

The anxiety of falling behind was palpable on a recent night at a packed McKeesport union hall across the street from the stilled National Tube Works, where a banner still proclaims to an empty parking lot: "Help Curb Imported Steel." There, the Mon Valley Unemployed Committee—organizing arm of laid-off steelworkers whose slogan is, "If you think the system is working, ask someone who isn't"—held a meeting of workers who had been denied federal retraining benefits, which were supposed to help those displaced by competition from imports.

More than 600 men and women, all of them laid off in the last six years from the Tube Works, turned out. Some remained unemployed, but most were working part-time or full-time for much lower pay. Most said they wanted to be retrained. But without extra assistance, they couldn't afford to stop work to be retrained because their families needed two paychecks to pay the bills. Some tried retraining, only to find no jobs at the other end.

Here is what has become of a sample of them:

Tom Buck, 34, laid off 1982 as a tool and die maker at $10.50 an hour, now a computer programmer at $7 an hour; Ron Janicki, 31, laid off 1982 at $10.50 an hour as a pipe inspector, now working six months a year as a bakery production-line worker making $11.25 an hour; Mike Jacobs, 30, laid off 1982 at $10 an hour ("Get this: I was operating a lathe for U.S. Steel that was made in Japan"), now working five days as a carpenter at $5 an hour, two days as a janitor at $3.60 an hour; Don Hodge, 30, laid off as a crane operator in 1982 at $14 an hour, now a maintenance worker at a county hospital at $7 an hour. ("It's the best-paying job in McKeesport. You have to know somebody to get in. I knew a county commissioner," Hodge said.) Ernie Zsemko, 47, laid off 1982 at $12.82 an hour, now a machine repairman for a boiler-tube company, making $7.25 an hour. All of them had generous health benefits as steelworkers; now they have none.

Downtown leaders emphasize that the metropolitan area's unemployment rate fell below 7 percent last December, a dramatic drop from the 1983 peak of 14.8 percent. But the new figure overlooks those whose unemployment benefits have expired or who have given up looking for work. Nor does it distinguish between those in high-paid jobs and those in part-time, minimum-wage work.

As the pace of economic change quickens nationally, such dislocations are becoming more common. In Pittsburgh, where everyone was hit by the steel collapse or knows someone who was, there is keen awareness of the costs of change and who bears them.

"There isn't any question that in our society, blue-collar workers have been forced to absorb the uncertainty of the economy," Cyert said. "Part of being free also means taking some of the risks of uncertainty, and all of us as individuals have to learn to live with it. But when there's a lot of uncertainty, we tend to shove it off on blue-collar workers, and I think there are ways we can all share it a little more effectively."

Expanded Commitment to Education

"The facts of life are that when turmoil like this occurs, the companies are already in pretty desperate shape," said Graham, who led USX through a one-third reduction of its steelmaking capacity. "To ask Wheeling-Pitt or LTV [two steelmakers now reorganizing under the bankruptcy laws] what are their overarching social obligations to the communities they've abandoned is a pretty hollow question . . . . We are involved in a 24-hour-a-day struggle to survive. It's that brutal; it's that simple."

The solution embraced by almost everyone here is an expanded commitment to education. Economist Jean-Jacques Servan-Schreiber, a former French cabinet minister and now international chairman at Carnegie-Mellon University, said: "Education, including of course computer literacy, must reach everyone and it will have to go all through life. If you stop, you become obsolete, you cease to be competitive. You lose your talent, you lose your value. Constantly up-dated, educated people, on the other hand, find new jobs as the economy changes."

Even for those who weather it, though, economic transition is wrenching. Consider Larry Prisbylla, who made the move from a steel mill to a nursing station after five years of uncertainty. Now that he is reestablished, he finds himself thinking about trade-offs.

True, the mill job was deadly dull, but it took only eight hours a day. Nursing, by contrast, requires constant study. Prisbylla now takes pathophysiology two nights a week and expects to be taking courses as long as he stays in the field, trying to keep pace with change. "I'm not able to spend the time I want with my family. That's the part I regret," he said.

Two bookshelves in his living room tell the story of his changed life: One is filled with well-thumbed novels by Stephen King, his evening entertainment while in the mills; the other displays such titles as "General Chemistry" and "Microbiology," his current preoccupation. The latest Stephen King novel, a Christmas present from Laura, has not been touched.

The steel experience has made Prisbylla as skeptical of relying on the hospital as he did on U.S. Steel. He and his wife are setting up their own pensions, in case he leaves this job. He also plans to take courses in administration and in education, in case he revives his dream of becoming a teacher.

Prisbylla said it was not hard to shift to a "caring" profession from one known for brawn. The stereotype of the macho steelworker was overdone anyway, he said, as is the stereotype of the nurse as a motherly female. What tempers the bias, he said, is a collective desire by people here to recover from hard times.

"Patients look at you sort of funny at first and they'll say, 'How come you're a nurse?' " Prisbylla said. "They act like something's wrong with you. That's when I use my old steelworker stereotype. I sort of puff up my chest and say, 'Well, when I lost my job in the mill five years ago . . . .'

"And they sit up and say, 'Wow, you were a *steel*worker? And you found a good job? That's *great*!"

NEXT: The VCR and competitiveness

RUDE AWAKENINGS



UNITED PRESS INTERNATIONAL

For decades, blast furnaces along the Monongahela River lit Pittsburgh's night skies, above; today, no longer the steelmaking capital of the world, the city is becoming a center for industries based on service and brainpower.

THE OLD

'Life Was Simple' When Mills Roared

McKEESPORT, Pa.—Ray Piechowicz, 50, had spent his adult life working in a steel mill. Large and proud, with bushy, white eyebrows that bristle defiantly over the top of his glasses, he gives this description of the world as he knew it:

"Men went to work, women had babies and if politicians didn't take care of us, we threw 'em out of office. Life was simple."

Life began and ended in those days in the Monongahela Valley, where 10 huge steel mills belched smoke and fire along 23 miles of the "Mon" River east of Pittsburgh. Now most of the mills are silent, casting long shadows in towns that once depended on them. Piechowicz says the valley has lost more than jobs.

"People don't work with their hands anymore, and that's sad for this country," he said.

"Look at this—a once-proud union," he said on a recent night, waving his hand across the crowded local union hall of the United Steelworkers of America, where more than 600 laid-off workers had gathered after being denied federal retraining benefits. A collection plate was passed for a soup kitchen for laid-off workers.

"Look at 'em—collecting money to feed their old members. My heart thumps when I think of the destruction of our unions. They're taking it away from us."

Piechowicz, who went to work straight out of high school, is sending his children to the University of Pittsburgh on money saved from his steel wages. His wife works part-time as a dental assistant to help pay tuition and bills.

"I told my kids, 'Education is like a union card. It doesn't mean you know anything. It means they have to talk to you.' We had to get a union card to get in the door. They have to get an education . . . . I told those kids: 'Get out of this valley and don't look back.' Do you know how that hurts? I hate it; it's a sin. But it's no good for them here. There was a day when this whole place was lit up in the middle of the night with fire from these mills: National, Duquesne, Homestead, J&L. Now it makes me cry just riding down there. They're just dark and dead. It's pathetic, pathetic."

Piechowicz, like many others in the room, blamed "politicians," in particular President Reagan, for the downfall of basic manufacturing. He does not buy the argument that steelworkers' high wages were a significant factor.

"I'm sure this was all guided by a handful of people behind closed doors far away, figuring out how we're going to live down here," Piechowicz said. "The powers that be have plans for this valley: They're going to level it. A once-proud community!"

A 30-year veteran of U.S. Steel's National Tube Works here, Piechowicz was laid off in 1983. At the time he was being paid $14 an hour as a mechanic, specializing in the repair of hydraulic machinery. Now he is head of security at the Community College of Allegheny County, being paid $6 an hour. "I hire people every day at $3.50 an hour," he said. "It's terrible; it's exploitation."



BY RAY LUSTIG—THE WASHINGTON POST

"I told my kids, 'Education is like a union card. It doesn't mean you know anything. It means they have to talk to you.' We had to get a union card to get in the door. They have to get an education."

—Ray Piechowicz

THE NEW

Artificial Intelligence And Flexible Time

PITTSBURGH—The "new Pittsburgh" of booming banks, thriving hospitals, expanding universities and more than 600 advanced-technology companies bears little resemblance to the factories and mills that dominated the city's past.

Walk into the headquarters of Carnegie Group, founded by four computer science professors at Carnegie-Mellon University to market "artificial intelligence" to manufacturers. Through "AI," as it is known, computers are programmed to behave autonomously: diagnosing problems on a factory floor, prescribing repairs for faulty cars, even pinpointing human illness.

Carnegie Group is developing artificial intelligence systems for Ford, Boeing, Digital Equipment Corp. and other manufacturers—in the name of making them more productive and thus more competitive. Carnegie Group's "knowledge engineers" interviewed Ford's top mechanics, dissected their know-how and created an "expert system"—putting the knowledge of an expert mechanic in a computer—to guide repairs at dealerships. The system aims to cut warranty costs, according to Larry Geisel, former president of the firm, and to improve customer satisfaction.

The decor at Carnegie Group's headquarters is Danish modern superimposed on a turn-of-the-century railroad freight depot overlooking the Monongahela River. Clock-punching has given way to flex time. And, in contrast to the factory work force, whose jobs are under siege, here it is the executives who fear the loss of employes—scientists with multiple degrees whose expertise is coveted in the United States and abroad.

"We are a $16 million company with a $60 million research and development program," said Geisel, referring to the firm's open line to Carnegie-Mellon's computer science department, a pioneer in AI. "After working here for a very short time, our employes know more than all but a handful of people in the world. These people get very valuable very quickly."

The company is growing rapidly, but American manufacturers are not the only users of its technology. Carnegie Group has established an arm in Japan, selling systems to Japanese manufacturers and training engineers from that country in artificial intelligence. Geisel, who recently left the firm to start another, acknowledged that this may look to some like aiding the adversary, since the United States has a techological lead over Japan in AI. But to him, it reflects a new economic world order.

"There are two problems: competitiveness and balance of trade," Geisel said. "The solution is not to say, 'Nobody sell to Japan.' Whether we make Japanese firms more competitive is another matter. We are open for business. To the extent American firms aren't interested, somebody else . . . is."

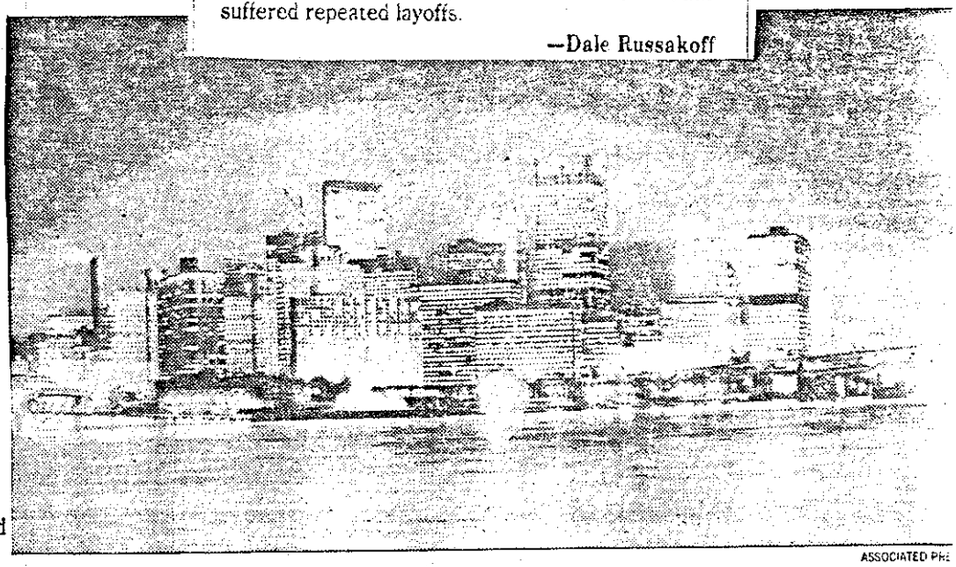
"In our marketplace, there's a major new release every year," said Glen F. Chatfield, president and cofounder of Duquesne Systems Inc., a fast-growing $29 million-a-year company that custom designs software to make IBM mainframe computers run more efficiently. "No matter what the new product is, if we don't make it better, we're a sitting target. If you're constantly improving, you're a moving target. And it can come from anywhere, Australia, Germany, anywhere."

An important catalyst to the growth of high technology here is the presence of two major universities: Carnegie-Mellon, pioneer of computer science, robotics and artificial intelligence, and the University of Pittsburgh, a leader in biotechnology with a world-renowned medical center.

Mellon Bank has taken over data processing for 450 banks round the country, and in the last five years has hired 400 computer technicians to service its equipment. These jobs average about $23,000 a year plus benefits, according to George P. DiNardo, a Mellon executive vice president.

"My main goal was to get with a big company that wouldn't lay people off," said Cathie Williamson, 27, a recently hired Mellon computer technician whose father, a construction worker, has suffered repeated layoffs.

—Dale Russakoff



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Japan's Closed Door Brings Hard Knocks

By William McGurn

TOKYO — When Commodore Matthew Calbraith Perry sailed home from this bay in 1854, his fleet of seven men-of-war carried an accord that put the first crack in Japan's centuries of self-imposed isolation. Four years later the efforts of America's first consul here, Townsend Harris, led to a commercial treaty between the two nations. All without firing a shot.

Today, alas, Washington appears to have neither the vision of the commodore nor the horse sense of the consul, if one can judge by the $300 million in punitive tariffs that are scheduled to go into effect tomorrow. A dubious response to the breakdown of what was itself a dubious attempt to "monitor" the international semiconductor market, America's new-found determination to Teach Japan a Lesson has encouraged similar menacing talk from other nations.

Whether the goal is a guaranteed American share of the Japanese semiconductor market or a specific British stake in a Japanese telecommunications venture, in an integrated world economy such bilateral efforts tend to expand the cartel rather than open the market. This in turn has disastrous ripple effects even for those not directly involved, as the howls now emanating from Hong Kong, Singapore, Australia and Europe attest. Despite earnest talk from all sides about avoiding the economic hara-kiri of an all-out trade war, no one scruples about the multilateral damage wrought by even a few sharp thrusts in that direction.

"It's a street fight out there," says Kenichi Ohmae, a managing director with McKinsey & Co., a consulting firm. "You no longer know who is hitting whom."

Bureaucratic Shogunate

Although economically inexplicable, the increasing resort to protectionism is an emotionally understandable response to mounting frustration at a Japan that moves in on everyone else's open doors but keeps its own relatively closed. Despite having less-onerous tariffs than even the Common Market or the U.S., Japan's infamous "non-tariff barriers"—chiefly its vertical distribution system, array of niggling regulations and pernicious "administrative guidance" from the bureaucratic shogunate—restrict access to almost all foreign goods save those locally produced. On top of this is a pricing and tax structure that makes most Japanese manufactured goods more expensive here than abroad.

American chip makers are neither the only nor even the most significant victims. Complaints come from a wide variety of foreign businessmen and diplomats in Tokyo. Producers of Thai boneless chicken, European liquor, Canadian lumber, Philippine papaya, South Korean light electrical goods, Taiwanese pork and Australian beef are just some who can't get through the door.

Japan might protest against America's "voluntary" quotas, but it eagerly imposes them on others, most recently on Korean and Taiwanese textiles. This does not begin to get at the exclusion of foreigners from the financial service sector or the Tokyo Stock Exchange. Says Rikkyo University's Chiaki Nishiyama: "The real problem here is the domestic controls aimed at controlling market entry, regarded as natural in Japan."

Even newly industrialized countries such as Korea and Taiwan complain more about Japan's restrictions on foods than about those on electrical and machine parts.

Take alcohol. Unlike other countries, Japan does not tax by alcoholic content but according to a grading system that places foreign products like Scotch in the high-tax top grade. The upshot of this structure is that even the cheapest bottle of Scotch must sell for at least 2,600 yen ($18.60)—up to three times as much as the cheapest Japanese whiskey, which, of course, escapes the onerous tax burden by being in the lowest grade. Set against this background, the vaunted Japanese preference for Japanese goods appears the outcome less of blind nationalism than of rational economic choice.

Under EC pressure, including a personal complaint from British Prime Minister Margaret Thatcher to Prime Minister Yasuhiro Nakasone at last year's summit here, the Japanese in December announced a reform in their alcohol grading structure. Although foreign wine and beer were freed up, the discrimination against foreign whiskey relative to the local competitors was left intact, mostly by just calling the lowest grade "spirits" instead of whiskey.

"They never tried to solve the problem," says Warren W. Williams of Burson-Marsteller, a public-relations firm. "They tried to defuse the problem by driving a wedge between the whiskey and wine producers. That's more a tactic of a trade war than participation in a world trading system."

Even more damaging are Japan's barriers against goods from developing countries, especially its Asian neighbors, to whom access to Japan's vast market is crucial to future prosperity and stability. Developing countries have it doubly tough because more often than not they offer agricultural goods, which go up against Japan's most protected market, one that is tough even for the developed world to crack.

The premier of the province of Saskatchewan complained last week, for example, that the Japanese government buys Canadian wheat at $122.60 per ton and Japanese wheat at $1,226.00 per ton, selling both at $574.60 per ton. The relative numbers are staggering: Hiroshi Kato of Keio University writes that 1985 farm support programs and subsidies to special interest groups amounted to $56 billion, equivalent to Japan's entire trade surplus that year.

Then there's Philippine papaya, today banned from Japan. To kill flies, Philippine papaya growers treat the fruit with the chemical EDB, as do Hawaiian papaya growers, who currently are able to sell their papaya in Japan. But in June new Ministry of Health and Welfare regulations will prohibit all EDB-treated papaya, and Filipinos worry that their mangoes—for which Japan is their largest buyer—will be the next fruit targeted. The damage such regulations can do to struggling economies such as the Philippines is immense.

Even newly industrialized countries such as South Korea and Taiwan complain more about the restrictions on foods than about the restrictions on electrical and machine parts for which they are better known. "Japan should be more sympathetic to its Asian trading partners rather than getting angry at the unreasonable demands of the U.S.," says Kiyohiko Fukushima, a senior economist at Nomura Research Institute.

Although past U.S. administrations have threatened sanctions, they at least did not exhibit the current zest for determining the "fair" share of a given market or the "true" value of the dollar. In 1983, moreover, U.S. officials scored a notable success in getting the Japanese to change 17 laws in the famous baseball-bat case. The change permitted designated "registered" U.S.-based factories to manufacture "self-certified" bats. It was the first time anyone but the Japanese government was permitted to put approval stickers on

True, the scales remain grossly lopsided. The U.S., for example, permits several thousand factories in Japan to certify their goods for the U.S. market, while Japan licenses only a few dozen worldwide. The American victory on baseball bats was a real market-opening measure, and Korea, Taiwan and France have used the U.S. opening to get their own factories licensed. Working to change laws and regulations may not lend itself to the current wave of congressional jingoism, but it's more effective.

In trading in this approach for tit-for-tat protectionism, moreover, the U.S. has launched a kamikaze attack on its own industries by raising the price of semiconductor chips and some electronic goods while compounding the distortions in the international markets. Mrs. Thatcher probably would not have dreamed of threatening to boot some of the world's biggest lenders out of London's fledgling world financial market had President Reagan refrained from imposing sanctions. The American indulgence in protectionism against Japan traditionally has been followed by similar European moves, from steel to cars to videotape equipment.

Indiscriminate Discrimination

In a world economy that's gone far beyond bilateral relationships, the real problem is that it's impossible to confine punishment to the guilty. Europe, for example, lodged a complaint with the General Agreement on Tariffs and Trade that the attempt to guarantee America 20% of the Japanese chip market discriminated against European semiconductors, and Hong Kong's director of trade quite rightly slammed the same accord for trying to prevent Hong Kong firms from acquiring chips for less than the fixed price of 22. Similarly, when the dust clears from the latest American sally, all we are likely to find is a rise in prices for Americans, no change in the much-misunderstood trade balances, an increased say for Japanese regulators—and bad feelings all around.

It has yet to dawn on the bureaucrats in the Land of the Rising Sun how inefficient their actions make their own economy. Nor do they appear to appreciate that trade wars are seldom declared outright. They are, rather, the cumulative effect of protectionist blunders. More than a century ago, Commodore Perry convinced the Japanese it was time to come join the rest of the world. His heirs have yet to persuade them to let the rest of the world in.

Mr. McGurn is [illegible] editorial page staff.

of yttrium, for example, and labs must wait three weeks for orders to be filled.

'The Real Thing'

Prof. Uchida's lab has been flooded by calls and visits from companies. Sumitomo Electric Industries Ltd. researchers brought in some rudimentary wire made from superconducting ceramic. Engineers from Toshiba, Fujitsu Ltd. and Hitachi have visited the lab to keep watch on developments. "Company people have the conviction that this is finally the real thing. A lot are starting to pick it up. . . . They see that superconductivity is a sure thing and they want to get on to application," says Prof. Uchida.

Of course, there is scientific and commercial excitement in the U.S., too, but it's less frenetic and isn't centrally controlled. Scientists say indications of an incipient breakthrough came as early as April 1986, when researchers at IBM's laboratory in Zurich, Switzerland, reported they had achieved superconductivity in a new class of materials, the metal oxide ceramics. This galvanized researchers throughout the world. By November, the Japanese and Chinese had confirmed the IBM discovery and by December, scientists in Houston and at American Telephone & Telegraph Co.'s Bell Laboratories were reporting important advances with the new materials.

About 5,000 physicists jammed the ballroom of the Hilton Hotel in New York Wednesday night for an unprecedented special session on superconductors at the annual meeting of the American Physical Society. They listened to the presentation of 60 papers on superconductivity research done largely within the last two to three months. Although scientists from U.S. universities dominated the program, there were reports from IBM, Bell Labs, Westinghouse Electric Corp. and Exxon Corp. as well as from Japanese, Chinese and Canadian scientists.

The breakthrough generated tremendous excitement among Bell Labs scientists, says Robert A. Laudise, director of the laboratories' inorganic chemistry branch. "Usually, research managers are coaching people to do this or that," Mr. Laudise notes. "But in this case we had people coming around from all different disciplines wanting to know if there was anything in this for their area," he says.

Too Soon for Applications

"We've had a lot of people going without sleep," Mr. Laudise says. But he agrees with IBM's Mr. Armstrong that it's still too soon for anyone to settle on specific applications of the superconductors. "We're not trying to make any specific devices or systems," he says.

Bell Labs researchers are, however, trying to fabricate various superconducting materials into experimental devices. At Wednesday's APS meeting they displayed a superconductor in the form of a flexible ceramic tape that can be formed and then hardened into a shape to fit a superconducting device.

Researchers at General Electric Co.'s big research and development center in Schnectady, N.Y., agree that it's too soon to jump into an industrial competition with anyone, including the Japanese.

Jury Is Still Out

"In the materials field, the events of the last several weeks have been quite spectacular, but in the applications sense, the jury is still very much out," says Michael Jefferies, manager in the center's engineering physics laboratory.

Until recently, the GE lab didn't have a group of scientists working on superconducting materials. "But we're now trying to confirm and duplicate the results that are being reported," Mr. Jefferies says.

Guy Donaruma, vice president for research at the University of Alabama in Huntsville, says governmental agencies and private concerns have shown a keen interest in the university's superconductivity research, which duplicated the Houston breakthrough.

"Wherever I go around town somebody buttonholes me and asks how we're coming along or when can we use this," Mr. Donaruma says. Some inquiries have come from the space and defense related agencies in the area, including the Marshall Space Flight Center and the U.S. Army Missile Command, he says.

In Palo Alto, Calif., where Stanford University recently announced a breakthrough in fabricating a superconducting thin film, useful in electronic devices, a news conference last week was packed with industry people. Several other scientists have called for more information for use in making a superpowerful magnet used by geological researchers. Niels Reimers, director of Stanford's technology licensing office, said, however, that he hasn't been fielding many industry inquiries.

Crash Programs

In Japan, however, companies that already sell conventional superconducting wire to the U.S. have begun crash programs to commercialize the new discovery. Fujikura Ltd. and Sumitomo Electric, for example, say they have developed rudimentary wire out of the new ceramic, despite skepticism among some scientists that the material won't lend itself to wire-making.

Like their U.S. counterparts, Japanese makers temper their euphoria with warnings that too little is known about the new ceramic superconductor to tell when and how the material will be commercialized.

Aside from possible problems in forming brittle ceramic into wire, the new superconductor still can't handle enough current to be used in heavy applications such as power plants. Superconductors also don't work well with alternating current, the type of electricity used in most of the world's power equipment.

But Japanese labs are convinced they can solve the problems over the next several years. Now that the West has made the basic breakthrough, they say, the ball is in their court. "It will be difficult and will take time," says Kasumasa Togano, a government scientist. "But that's precisely where Japan's labs and makers have the edge."

Still, he and other researchers admit to a twinge of hurt pride. "To be honest, we're following in the footsteps of the U.S.," Mr. Togano says. "Here, again, the originality is coming from the West. We have a measure of sadness about that."

JERRY E. BISHOP IN NEW YORK
CONTRIBUTED TO THIS ARTICLE

America, the 'Diminished Giant'

As Rivals Strengthen, U.S. Dominance in World Marketplace Fades

Fourth of a series

By Stuart Auerbach
Washington Post Staff Writer

The first made-in-Korea Hyundai automobile rolled into the United States 14 months ago, driven off a Japanese freighter at the port of Jacksonville, Fla.

To those who still regard Korea as the underdeveloped nation depicted in the sitcom M*A*S*H, instead of a budding industrial giant, what happened next was perhaps a surprise.

The low-priced Hyundai swept through this country, setting a record for first-year sales by an imported car—168,882 sold in 1986—and quickly became a name to be reckoned with in the world auto industry.

The Hyundai sailed on winds of change that have drastically transformed the economic shape of the globe—establishing an entirely new relationship between the United States and the rest of the world, making it vastly more difficult for U.S. industries to compete in crucial global markets.

The changes have been so sweeping and have taken place with such astonishing speed—over just 15 years—that they are only partly understood by the American public and policy-makers in government.

RUDE AWAKENINGS
THE CHALLENGE OF THE GLOBAL ECONOMY

But virtually all the experts agree that the era of overwhelming U.S. dominance of the international economy—an era that began after World War II when much of the rest of the world was devastated—is over.

"We have come to a divide," said University of California political scientist John Zysman. "The economic changes we are watching will reshape the international security system. They are fundamental shifts of the power relations among nations."

In the United States, these changes have contributed to serious economic dislocation: the closing of steel mills and auto plants, the conversion of the industrial heartland into the Rust Belt, a loss of millions of manufacturing jobs.

They have raised questions, as C. Fred Bergsten, director of the Institute for International Economics, wrote recently in Foreign Affairs magazine, as to whether

See COMPETE, A18, Col. 1

U.S. Faces Up to Erosion Of Economic Supremacy

COMPETE, From A1

the United States can keep its mantle of world leadership.

At the same time, many experts believe that for all the pain caused in the United States by these changes, the world as a whole is a better place. "We have built a world system where we are now beginning to bring into membership at the highest levels countries which 25 years ago were in poverty," said Henry Nau, professor of political science and international relations at George Washington University.

The most visible symbol of America's loss of global economic supremacy is four years of towering trade deficits, which reached $170 billion last year, coupled with the transformation of the United States in the last year from a creditor nation into what Bergsten called "the largest debtor nation ever known to mankind." The United States now owes about $220 billion more abroad than foreign countries owe the United States.

By the end of this decade, he said, the United States will owe more than a half-trillion dollars and will be paying tens of billions of dollars a year in interest to foreign investors.

Many more signs illustrate how the United States is no longer the preeminent player in the world economy, and how other nations are coming up:

- In 1950, the United States produced 40 percent of the world's goods and services. By 1980, the U.S. share had dropped almost by half, to 22 percent. Meanwhile, Japan's share climbed from less than 2 percent to about 9 percent, and Europe's share rose from 21 percent to almost 30 percent.
- For the first time since World War II, the United States last year lost its position as the world's leading exporter, supplanted by West Germany, with Japan pressing on the United States in third place.
- Last year, again for the first time, the United States ran a trade deficit in high-technology products, considered the wave of the future for the U.S. economy and critical for U.S. national security.
- In 1974 the United States was responsible for the design of 70 percent of the advanced technology in the world. By 1984, this figure had dropped to 50 percent. According to estimates, it will slide further, to 30 percent by 1994.

The 'Four Tigers'

Most surprisingly, at least to Americans who were not paying attention, has been the emergence of a whole new phalanx of competitive nations—the "Four Tigers" of the Pacific Rim—Hong Kong, Singapore, Taiwan and South Korea.

These newly industrialized countries (NICs) join Japan, which a generation ago was considered a developing country, as the most vital growth forces in the world economy. Western Europe, meanwhile, is going through a period of sluggish growth, and most Third World nations have grown relatively poorer.

"The real stakes are the wealth and power of the United States," said Stephen S. Cohen, a Berkeley economist who is codirector with Zysman of the Berkeley Roundtable on the International Economy.

"We will have to get used to living in a world in which we are no longer No. 1 . . . , or at least not No. 1 by much," said Herbert Stein, chairman of the Council of Economic Advisers under Presidents Nixon and Ford who now is a senior fellow at the American Enterprise Institute.

The country, experts say, will also have to get used to a greater dependency on trade with the rest of the world than ever before. In 1960, sales abroad and U.S. purchases from foreign countries amounted to just 7 percent of gross national product. Twenty years later, trade accounted for 15 percent of U.S. GNP. Government officials estimate that 5.5 million jobs now depend on exports, and one in four farm acres produces crops for sale abroad.

The decline in both power and standard of living is difficult to accept in this country, which was born out of the limitless optimism of pioneers who saw the American dream as one of continued economic and social enrichment, said former deputy treasury secretary Richard Darman, a former specialist in public policy and management in Harvard University's department of government.

The American psyche, said Darman, is rooted in being No. 1, and most Americans alive today have never lived in a world in which they were not clearly the dominant force.

And, he added, "The day you accept being No. 2, psychologically you are on the way down."

This reordering of the world economomy generally is measured from 1971, when the United States registered its first merchandise trade deficit. But the seeds were planted much earlier, many of them by the United States itself.

There was, of course, the Marshall Plan, to reconstruct war-ravaged Europe.

In Japan, the U.S. occupation authorities set an artificially low exchange rate for the yen to boost Japanese competitiveness. The theory, expressed by then-Secretary of State John Foster Dulles, was that Japan made nothing that any other country wanted to buy.

The postwar institutions set up by the United States to mirror its view of the world also contributed. These included the World Bank and the International Monetary Fund, formed to finance a stable world, and the General Agreement on Tariffs and Trade, established to perpetuate free trade and make sure the world economy did not fall prey to protectionism as it did between the world wars.

"It's a remarkable story of postwar success," Nau said.

The dominance of the United States in world trade, many experts say they believe, was destined from the beginning to be temporary, because it stemmed from unique circumstances following the war, when the country "sat astride the world economy as the only large industrial power undamaged by war," said Commerce Undersecretary Bruce Smart.

Nevertheless, he continued, "we believed our national economic superiority was entirely of our own making, an inalienable right or entitlement, rather than a temporary phenomenon conferred upon us by a unique confluence of circumstances for which we could claim only limited responsibility."

This abnormal situation, some historians and economists believe, lulled the United States into complacency.

But if the United States thought it was entitled to economic preeminence, other countries refused to stand pat. In the new global environment, Japan, not the United States, is the model for other nations.

Korea and Taiwan, for instance, have achieved success following the Japanese model: a combination of free enterprise and competition among domestic producers; heavy protectionism to keep foreign goods out, and strong government guidance to develop the exports-oriented industries that fueled growth. Zysman and Cohen call this system of development "state-centered capitalism."

"Korea and Taiwan had the advantage of seeing Japan develop," said Lawrence Krause, a professor of international relations at the University of California at San Diego.

Singapore Ambassador Tommy T.B. Koh pointed out in a speech last February that the "Four Tigers" of Asia supplied 19 percent of U.S. imports of manufactured goods in 1980, compared with just 5 percent in 1962.

"The world is going to start looking like Japan, not the United States," Krause said. "The less-developed countries see that the way to succeed is through closed home markets and export-led growth," commented GWU's Nau.

Like anyone who has a good deal going, neither the Japanese nor the Asian NICs appear willing to modify their fast-growth economies for the greater good of the global system.

"Just as the U.S. citizen feels entitled to 1950-like preeminence in every field," observed Smart, "the Japanese citizen believes that the tilted playing field of the last 40 years is his by national right."

The current U.S.-Japan battle over semiconductor trade reflects the realization that retaliation may be the only way to force Japan to live up to its new global responsibilities.

The Reagan administration drew the line on semiconductors because they are the building blocks of all high technology. Without a strong semiconductor industry, a country loses the ability to develop more powerful computers and the supercomputers that are vital for national defense.

Underlying the trade dispute are fears within the administration that U.S. national security is at stake if American high-technology innovation is thwarted by Japanese protectionist policies at home and aggressive discount pricing in the United States—the heart of the semiconductor dispute.

A 'Diminished Giant'

The situation is painful for Americans, and the country may be suffering from what has been called the "diminished giant syndrome." But many experts believe that it is better for the world than what came before.

"I think the United States has got to recognize that if we can create a community of common political values and economic growth, it will be worth it even if it costs us a relative share of economic and political power," said Nau. "We may have less power today, but we live in a world that is more peaceful, more stable. We live in a better world than the 1930s."

"The rest of the world is coming of age," said William T. Archey, international vice president of the U.S. Chamber of Commerce.

How America responds to these changes is the subject of the competitiveness debate going on in academia, Congress and the executive branch of government; between business and labor as they try to define new sets of work rules to meet heightened competition from other countries, some of which have added technological advances and high degrees of education to lower wages and less opulent standards of living, and among industrialists seeking a niche in this new economic order of the world.

In Congress, much of the debate concerns changes in U.S. laws to stop what is seen as other countries' unfair trade practices. But the larger issues of competitiveness are being framed beneath the jockeying for trade legislation.

"It depends on how much we invest, how much research and development we do, how well we educate ourselves, how we use our capital," said C. Michael Aho, senior fellow of economics at the Council on Foreign Relations. "Those things never used to matter. Now that we are no longer predominant, they do matter."

The once unquestioned dynamism of the United States in the world marketplace is being tested as never before, forcing Americans to confront dramatic changes in standard of living, expectations and values. This is the fourth of sixth articles exploring these changes. Succeeding articles will address "competitiveness" as a political issue and the outlook for the future.

The concerns stretch beyond economic vitality to the international security arena. "As we get less competitive, the burden of maintaining the U.S. policy of national security will get more onerous on the economy," said Cohen, the Berkeley economist.

National Security Concerns

Stephen Krasner, a specialist in international economics and politics at Stanford University, agreed. "You can't think of the United States as the dominant power as it was in the past," he said. "That has to have military implications. It doesn't make sense for the United States to maintain the defense commitment it has in a world in which it is not the hegemonic power in the West."

Does it pay, for instance, for the United States to increase its naval presence in the Persian Gulf, as it did this month, to protect the sea lanes so that Western Europe and Japan can get the oil their economies need? "It would be better if Japan and Europe were protecting interests that are much more vital to them than to the United States," Krasner said.

"Can the world's largest debtor nation remain the world's leading power?" asked Bergsten in his Foreign Affairs article.

"Can a small island nation [Japan] that is now militarily insignificant and far removed from the traditional power centers provide at least some of the needed global leadership? Can the United States continue to lead its alliance systems as it goes increasingly into debt to countries that are supposed to be its followers? Can it push those countries hard in pursuit of its economic imperatives while insisting on their allegiance on issues of global strategy? Can it hold its allies together in managing the security system?"

There is new pressure on the United States to change, to end what some see as a complacency and weakening of the human spirit and to begin to compete fully in the new world environment.

Now, Aho said, "we will see how much vibrancy this economy has."

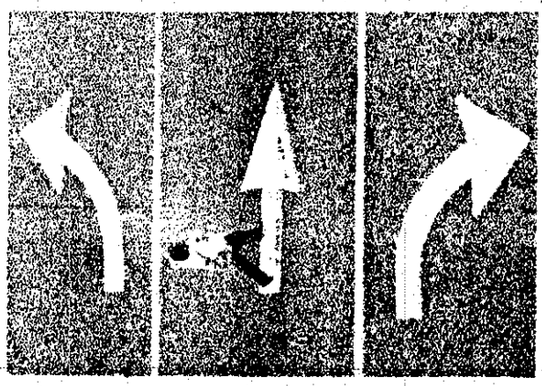
NEXT: Politics of "competitiveness"

RUDE AWAKENINGS



BY JAMES M. THRESHER—THE WASHINGTON POST

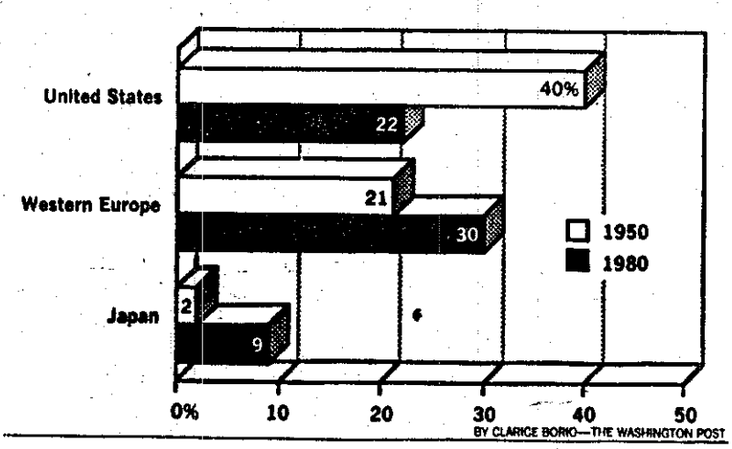
Korean workers prepare Hyundais for export to the United States and Canada. In the United States, the car set a first-year sales record for imports.



Virtually all the experts agree that the era of overwhelming U.S. dominance of the international economy, which began after World War II, is over.

A CHANGING BALANCE: THE U.S. SHARE OF WORLD GNP

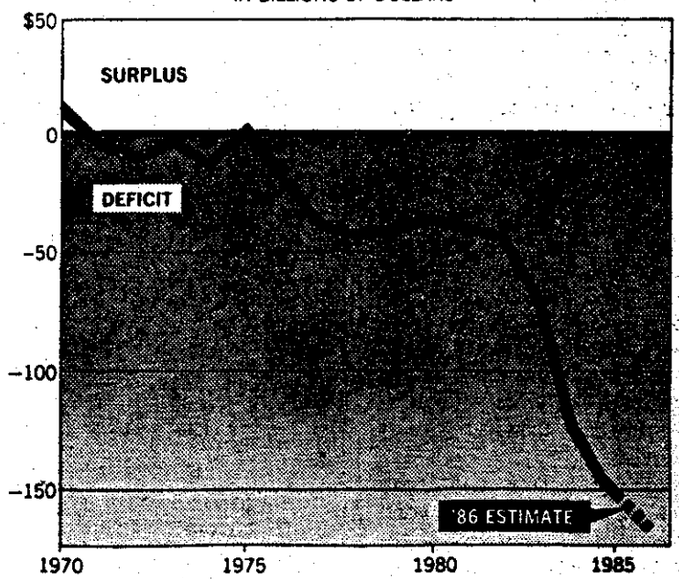
IN PERCENT



BY CLARICE BORIO—THE WASHINGTON POST

U.S. MERCHANDISE TRADE BALANCE

IN BILLIONS OF DOLLARS



SOURCE: U.S. Department of Commerce

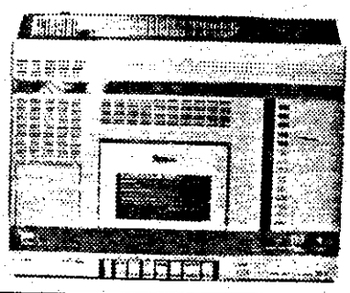
BY JO ELLEN MURPHY—THE WASHINGTON POST

Lessons of the VCR Revolution

How U.S. Industry Failed to Make American Ingenuity Pay Off

Second of a series

By Boyce Rensberger
Washington Post Staff Writer



RUDE AWAKENINGS
THE CHALLENGE OF THE GLOBAL ECONOMY

The videocassette recorder is an American invention, conceived in the 1960s by Ampex and RCA. The first VCR for home use to reach the U.S. market, in 1971, was the American-made Cartri-Vision.

By the mid-1970s, however, every American manufacturer had judged the VCR a flop and had left the business.

Today not one American company makes VCRs. All of the 13.2 million units sold in the United States last year—36,000 every day for a total of $5.9 billion—were made in Japan or Korea.

Even RCA, once a proud, patent-holding pioneer of the new technology, is now simply a middleman, buying Japanese VCRs and reselling them under its own label.

The story of the VCR, according to many experts, illustrates some of the reasons why American industry is losing its global competitiveness. It challenges the popular notion that a loss of innovative capacity lies at the heart of this country's eroding economic position. While there is evidence that American innovation may have lost some vigor and that other nations are gaining fast, many experts believe the United States is still the world leader in scientific and technological innovation.

"The problem is not so much with American innovation," said Harvey Brooks, a specialist in technology and public policy at Harvard University. "Our scientists and engineers still lead the world in the origination of new ideas. The problem is what happens after that point. Where we're falling behind is in the ability to develop new ideas into products and to manufacture them to the high standards that we've come to expect from the Japanese."

The VCR is an example.

In the early '70s several companies in the United States, Holland and Japan unveiled VCR prototypes with great fanfare. Industrial-sized video recorders were already common in television studios, and the key to the home market seemed to be scaling down size, cost and complexity of operation. Most of the problems seemed near solution when the prototypes were demonstrated.

One hitch, it developed, was that the cassette would record only one hour of program. Market research showed that people wanted to get two hours on a tape, enough to record a movie. Cartri-Vision, named when cassettes were cartridges, was a one-hour machine that industry analysts say failed for that reason and because the recorder came built into a 25-inch TV set.

Despite the Japanese and Dutch activity in VCR development, the American firms did not think of

See COMPETE, A10, Col. 1

COMPETE, From A1

themselves as involved in an important global competition. It was an insular stance, common in many U.S. industries, that would later be seen as one of the causes of America's mounting trade deficit.

"Around 1974 RCA aborted its VCR project," said Frank McCann of the company's Consumer Electronics Division, now owned by General Electric. "It seemed clear the consumer just wouldn't buy it. What we didn't appreciate back then was that the Japanese would keep working on the VCR."

Within two years, both Sony and JVC (Japanese Victor Corp.) developed two-hour VCRs. Rising to beat the competition, Matsushita came out with a four-hour machine.

Pattern of U.S. Reluctance

What would come to be called the VCR revolution, accounting for an appreciable share of the U.S.-Japan trade imbalance, had been won by the Japanese. The United States lost, according to many analysts, not because American scientists and engineers had abandoned their heritage of Yankee ingenuity but because American industrial managers were unwilling to invest the resources to apply that ingenuity long enough to make a good idea pay off.

"It's not as if the United States is caught by surprise by what the Japanese or anybody else is doing," Brooks said. "Our people know what's possible. What we've been surprised by is the rapid commercialization of ideas in Japan."

Brooks said a common U.S. pattern is to avoid investing in new products that aren't fairly sure to return profits quickly and to withhold marketing a new advance in an existing product line as long as its predecessor is selling well. And, until recently, U.S. companies have not planned seriously to compete in international markets.

Japan, by contrast, holds global economic dominance to be a national goal, invests long and heavily in research and development and devotes far more of its best engineering expertise to sophisticated manufacturing methods.

Such factors have given Japan the advantage even though its scientific and technological innovativeness remain well behind that of the United States in all but a few narrow fields.

Although the United States spends more in total dollars on research and development (R&D) than Japan and the next two closest competitors, West Germany and France, combined, according to figures gathered by the National Science Foundation, those competitors have been increasing their spending dramatically in recent years.

In relation to the size of each country's economy, all four countries are now investing about the same in science and engineering research.

In 1986 the United States spent 2.8 percent of its gross national product on R&D, only a modest increase from the 2.6 percent spent in 1970.

Japan, by contrast, has increased its spending faster. In 1970 it invested 1.9 percent in R&D, but climbed steadily to match the United States' 2.8 percent by 1985, the last year for which figures are available. West Germany spent 2.1 percent in 1970 and grew to 2.6 by 1985. France went from 1.9 percent in 1970 to 2.4 percent in 1986.

Many analysts say, however, that the U.S. figures are misleadingly high because this country spends nearly one-third of its R&D money on military research, a far greater proportion than is spent by Japan or West Germany. If military spending is subtracted for the most current figures, the United States spends only 1.9 percent of its GNP on research and development, while Japan spends 2.6 percent and West Germany 2.5 percent.

Some experts note that it is not necessary to be the creator of a marketable idea to make money manufacturing the product. "Americans and especially members of the scientific community have exaggerated the purely economic benefits that flow from leadership at the scientific frontier," Stanford economist Nathan Rosenberg said.

As the costs of high-tech innovation rise, he said, the economic advantage goes to the imitator who can skip the costs of basic research, learn from the innovator's mistakes and come to market quickly with an improved version of the product.

Britain and the jet engine offer an older illustration. Although widely cited as an example of a major industrial power that has slid into global economic impotence and, in some ways, a declining standard of living, Britain continues to be one of the world's leading scientific innovators—second only to the United States as an originator of important fundamental technological advances.

"When a country falls behind in competitiveness, the last thing they fall behind in is innovation," Harvard's Brooks said. "The first thing is manufacturing and marketing."

Although Britain invented the jet engine, U.S. imitators—doing to Britain what Japan now does to the United States—reaped most of the economic benefits.

Britain's pioneer jet airliner, the Comet 1, turned out to be a financial disaster. Only when Boeing and Douglas picked up the idea, added some improvements and manufactured it to higher standards, did jet airliners sweep the world's aviation market.

What has slipped in the United States, Rosenberg contends along with many others, is the ability of industry to capitalize on "next generation" improvements in good ideas, regardless of where the idea originated.

"To a far greater degree than we once believed," Rosenberg said, "a first-rate, domestic scientific research capability is neither sufficient nor even necessary for economic growth." More critical is the sophistication of the nation's manufacturing ability.

Different Cultures at Work

Many observers attribute much of Japan's rise to what amounts to a cultural difference between the way U.S. and Japanese scientists and engineers work.

American engineers often prefer to work in research and development rather than in manufacturing. In the United States, the engineer who invents a product holds higher status and earns more money than the engineer who figures out how to manufacture it to high standards and keep it profitably low in cost.

One painfully obvious result, according to many, is that while the United States still spawns plenty of brilliant ideas, there are too few first-rate engineers to design good products based on the ideas. And when they are designed, those products often contain many times more defects than do Japanese counterparts.

"The relatively lower status and lower pay that have characterized careers in [U.S.] manufacturing represent an impediment to attracting first-rate people. Engineering departments in colleges and universities have largely ignored the field until very recently," a panel of the National Academy of Engineering concluded in a 1985 report. "In sharp contrasts, in both Europe and Japan the status of technical education and of careers in manufacturing is higher."

By having better brains in manufacturing, the Japanese and the Europeans are able to develop superior manufacturing methods and technology.

A related difference that yields poorer quality American products, according to a study of computer manufacturers done jointly by two experts in technology management, one an American and the other a Japanese, is that Japanese engineers move easily back and forth between R&D and manufacturing.

American R&D engineers, according to the study, not only come up with a new product idea, they produce the final specifications and simply turn them over to a separate manufacturing division. Japanese R&D engineers design only to a rough prototype stage, leaving the final specifications to manufacturing engineers.

Often a key R&D engineer will then move with the product to the manufacturing division, a step rare in the United States but part of the normal career ladder in many Japanese firms.

Under the Japanese system, experts in manufacturing technology

are free to complete the design in accordance with their knowledge of sophisticated manufacturing methods. They may modify the product design to ensure more reliable quality after manufacture. They may even invent new methods to make the product. As a result, the Japanese product can be made more easily, more cheaply and with much lower risk of defects.

The study was done by D. Eleanor Westney of the Massachusetts Institute of Technology's Sloan School of Management and Kiyonori Sakakibara of Hitotsubashi University in Tokyo.

Other key differences between the Japanese and American styles of managing engineering talent, according to Westney and Sakakibara, include:

- Japanese firms invest far more time and money in advanced training for their engineers than do American firms, partly because they have little fear that highly talented individuals will be hired away by rival firms. It is traditional for Japanese engineers to stay with an employer for life. One result is that hundreds are sent abroad to study for months or years—most often at American universities, which many Japanese regard as the best in high-technology fields. At MIT, for example, there are more than 100 Japanese engineers taking classes at any given time. Japan's much vaunted "fifth generation" computer project, in which the country hopes to leapfrog American computer technology, is based largely on innovations borrowed from U.S. computer scientists at MIT.
- While many Japanese engineers are soaking up the most advanced R&D skills and knowledge in U.S. universities, far fewer American engineers go to Japan, even to learn what Japan does best, advanced manufacturing technology.
- Although engineers everywhere often engage in "bootleg research," using company resources to pursue personal projects on the side, American firms try to discourage such activities because the engineers may then leave to exploit their ideas in new, spinoff entrepreneurial firms. Japanese companies encourage such sideline research, confident that the engineers will stay and turn the new ideas into valuable products for the company.

Another important difference, cited by many analysts and illustrated by the history of the VCR, is the greater willingness of Japanese firms to spend money over longer periods of time to bring a new product idea to fruition. U.S. firms are often run by professional business managers, untrained in engineering, who make decisions to maximize short-term profits.

In Japan, which has no business schools, high-technology firms are more likely to be run by engineers who showed management skills and who have advanced up the corporate ladder. They plan much further ahead and are willing to forgo short-term profits for a long-term advantage.

"American investors need earnings trends quarter to quarter. The Japanese are much more patient," said G. Stephen Burrill, head of a high-technology consulting group at Arthur Young, an accounting firm.

Next Battle: Biotechnology

Electronics has been one of Japan's oldest arenas of high-tech competition. One of the newest is biotechnology, another field pioneered chiefly in the United States and which promises a multibillion-dollar market supplying medicine with more effective drugs and diagnostic tools and supplying agriculture with various products to enhance crop yields. Japan's approach to biotechnology illustrates what many scientists see as another of that nation's advantages—Japan's method of creating government-supported consortiums of private corporations.

U.S. biologists invented gene splicing, also called recombinant DNA technology, and developed most of the methods of applying the technology. Although a swarm of new American entrepreneurial biotech firms has emerged, the Japanese are pushing hard to capture much of the market. Many leaders of U.S. biotech firms believe it will be hard, though not impossible, to stay ahead of Japan.

The once unquestioned dynamism of the United States in the world marketplace is being tested as never before, forcing Americans to confront dramatic changes in standard of living, expectations and values. This is the second of six articles exploring these changes and their causes.

As in many other fields, a key feature of Japan's drive is its unusual degree of cooperation among related industries and universities and the Japanese government's strong encouragement and financial support for a coherent national program in this area.

While antitrust laws prevent U.S. biotech firms from collaborating and while tradition leads many to pursue their goals apart from federal labs, Japan's Ministry of International Trade and Industry (MITI) has created a consortium of 14 major corporations to collaborate on biotech. Global domination in biotechnology is an official national goal under one of Japan's 10-year "Next Generation Projects."

Howard A. Schneiderman, vice president for R&D at Monsanto, a major biotech firm, sees his company as having to compete not just with other firms but with all of Japan.

"Monsanto, du Pont and Eli Lilly cannot cooperate in biotechnology," Schneiderman said. "We must be competitive, at arm's length. Yet Monsanto must be able to compete scientifically and commercially in biotechnology with MITI's consortium of 14 great companies in biotechnology and must compete with Japan's national commitment to biotechnology."

Monsanto's answer, and that of many other firms, is to seek collaboration with U.S. science-oriented universities.

"No MITI consortium in Japan, no industrial combine in the U.S. or elsewhere can duplicate or compete with the basic research capabilities of America's great research universities," Schneiderman said.

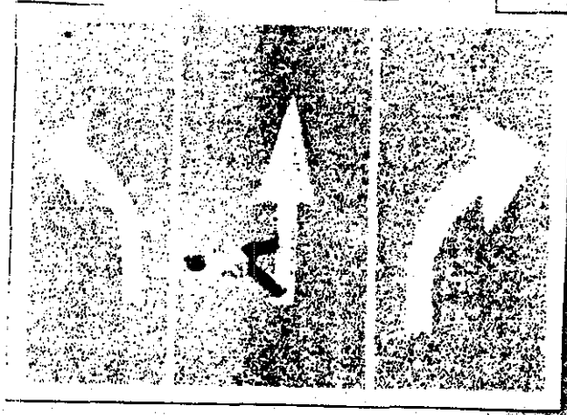
While such corporate-university collaborations are developing, there is controversy as to whether industry's need for proprietary secrecy conflicts with the traditional openness of university research.

Most university-based research in biotechnology is funded by federal grants and some industry leaders, such as Ronald E. Cape, chairman of Cetus Corp., a California biotech firm, worry that spending in this area has not grown significantly in several years. Because Japan's spending on basic biotech research is continuing to grow, Cape forecasts that Japan will take the world lead in biotechnology in the 1990s.

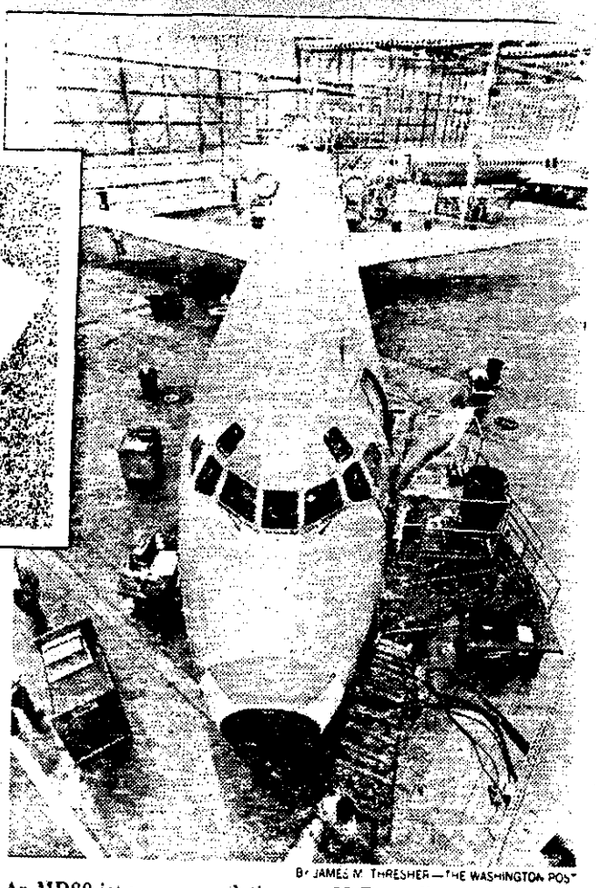
"In 10 years, if what I'm saying is correct," Cape says, "I bet we'll have hearings in Congress and a lot of American industrialists will bitch and moan about how the Japanese have done unfair things in trade. But that is not the case with biotechnology. The Japanese are doing the right thing."

NEXT: The role of education

RUDE AWAKENINGS



The United States may have lost the VCR revolution because industrial managers were unwilling to invest resources long enough to make a good idea pay off.

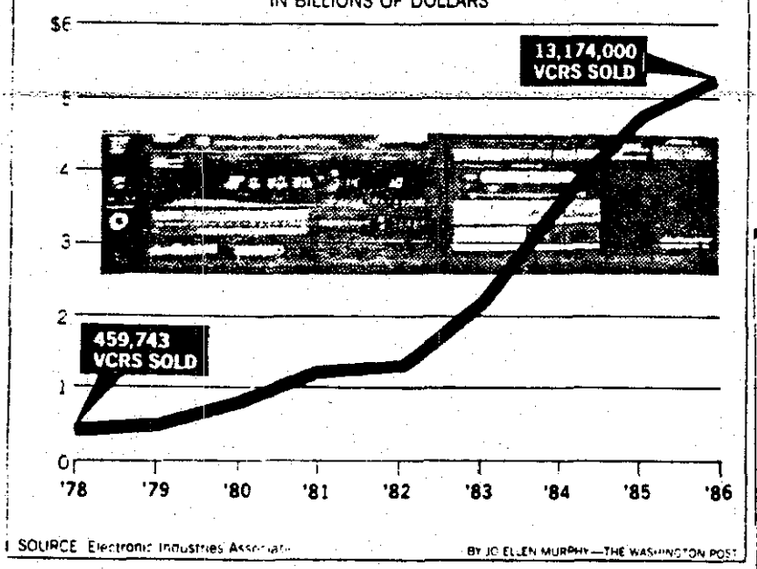


BY JAMES M. THRESHER—THE WASHINGTON POST

An MD80 jet nears completion at a McDonnell Douglas plant in Long Beach, Calif. Britain invented the jet engine, but U.S. imitators, including McDonnell Douglas, improved on the idea and reaped most of the economic benefits—doing to Britain what Japan now does to the United States.

MISSED OPPORTUNITY

VCR SALES FROM MANUFACTURERS TO U.S. DEALERS IN BILLIONS OF DOLLARS

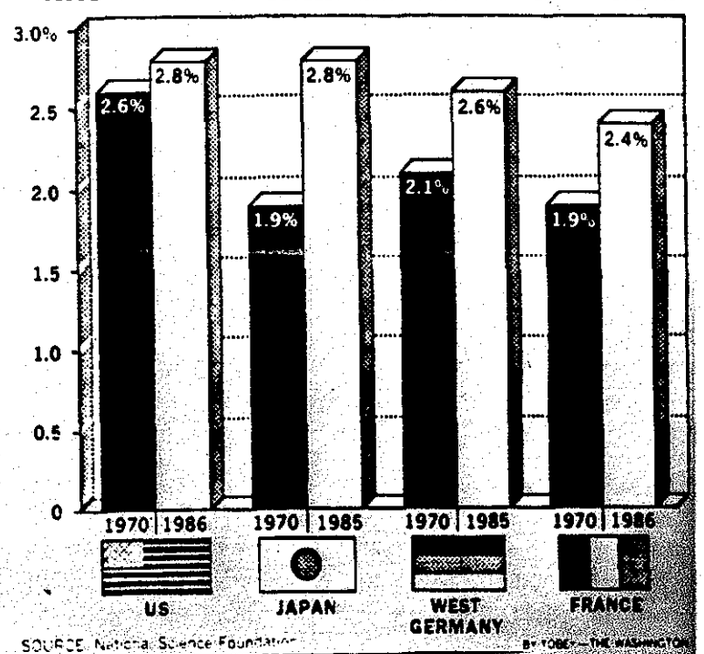


SOURCE Electronic Industries Association

BY JO ELLEN MURPHY—THE WASHINGTON POST

PERCENTAGE OF GNP SPENT ON RESEARCH AND DEVELOPMENT

INCLUDES RESEARCH AND DEVELOPMENT FUNDS FOR MILITARY RESEARCH



SOURCE National Science Foundation

BY TOBEY—THE WASHINGTON

America, the 'Diminished Giant'

As Rivals Strengthen, U.S. Dominance in World Marketplace Fades

Fourth of a series

By Stuart Auerbach
Washington Post Staff Writer

The first made-in-Korea Hyundai automobile rolled into the United States 14 months ago, driven off a Japanese freighter at the port of Jacksonville, Fla.

To those who still regard Korea as the underdeveloped nation depicted in the sitcom M*A*S*H, instead of a budding industrial giant, what happened next was perhaps a surprise.

The low-priced Hyundai swept through this country, setting a record for first-year sales by an imported car—168,882 sold in 1986—and quickly became a name to be reckoned with in the world auto industry.

The Hyundai sailed on winds of change that have drastically transformed the economic shape of the globe—establishing an entirely new relationship between the United States and the rest of the world, making it vastly more difficult for U.S. industries to compete in crucial global markets.

The changes have been so sweeping and have taken place with such astonishing speed—over just 15 years—that they are only partly understood by the American public and policy-makers in government.

RUDE AWAKENINGS
THE CHALLENGE OF THE GLOBAL ECONOMY

But virtually all the experts agree that the era of overwhelming U.S. dominance of the international economy—an era that began after World War II when much of the rest of the world was devastated—is over.

"We have come to a divide," said University of California political scientist John Zysman. "The economic changes we are watching will reshape the international security system. They are fundamental shifts of the power relations among nations."

In the United States, these changes have contributed to serious economic dislocation: the closing of steel mills and auto plants, the conversion of the industrial heartland into the Rust Belt, a loss of millions of manufacturing jobs.

They have raised questions, as C. Fred Bergsten, director of the Institute for International Economics, wrote recently in Foreign Affairs magazine, as to whether

See COMPETE, A18, Col. 1

U.S. Faces Up to Erosion Of Economic Supremacy

COMPETE, From A1

the United States can keep its mantle of world leadership.

At the same time, many experts believe that for all the pain caused in the United States by these changes, the world as a whole is a better place. "We have built a world system where we are now beginning to bring into membership at the highest levels countries which 25 years ago were in poverty," said Henry Nau, professor of political science and international relations at George Washington University.

The most visible symbol of America's loss of global economic supremacy is four years of towering trade deficits, which reached $170 billion last year, coupled with the transformation of the United States in the last year from a creditor nation into what Bergsten called "the largest debtor nation ever known to mankind." The United States now owes about $220 billion more abroad than foreign countries owe the United States.

By the end of this decade, he said, the United States will owe more than a half-trillion dollars and will be paying tens of billions of dollars a year in interest to foreign investors.

Many more signs illustrate how the United States is no longer the preeminent player in the world economy, and how other nations are coming up:

- In 1950, the United States produced 40 percent of the world's goods and services. By 1980, the U.S. share had dropped almost by half, to 22 percent. Meanwhile, Japan's share climbed from less than 2 percent to about 9 percent, and Europe's share rose from 21 percent to almost 30 percent.
- For the first time since World War II, the United States last year lost its position as the world's leading exporter, supplanted by West Germany, with Japan pressing on the United States in third place.
- Last year, again for the first time, the United States ran a trade deficit in high-technology products, considered the wave of the future for the U.S. economy and critical for U.S. national security.
- In 1974 the United States was responsible for the design of 70 percent of the advanced technology in the world. By 1984, this figure had dropped to 50 percent. According to estimates, it will slide further, to 30 percent by 1994.

The 'Four Tigers'

Most surprisingly, at least to Americans who were not paying attention, has been the emergence of a whole new phalanx of competitive nations—the "Four Tigers" of the Pacific Rim—Hong Kong, Singapore, Taiwan and South Korea.

These newly industrialized countries (NICs) join Japan, which a generation ago was considered a developing country, as the most vital growth forces in the world economy. Western Europe, meanwhile, is going through a period of sluggish growth, and most Third World nations have grown relatively poorer.

"The real stakes are the wealth and power of the United States," said Stephen S. Cohen, a Berkeley economist who is codirector with Zysman of the Berkeley Roundtable on the International Economy.

"We will have to get used to living in a world in which we are no longer No. 1 . . . , or at least not No. 1 by much," said Herbert Stein, chairman of the Council of Economic Advisers under Presidents Nixon and Ford who now is a senior fellow at the American Enterprise Institute.

The country, experts say, will also have to get used to a greater dependency on trade with the rest of the world than ever before. In 1960, sales abroad and U.S. purchases from foreign countries amounted to just 7 percent of gross national product. Twenty years later, trade accounted for 15 percent of U.S. GNP. Government officials estimate that 5.5 million jobs now depend on exports, and one in four farm acres produces crops for sale abroad.

The decline in both power and standard of living is difficult to accept in this country, which was born out of the limitless optimism of pioneers who saw the American dream as one of continued economic and social enrichment, said former deputy treasury secretary Richard Darman, a former specialist in public policy and management in Harvard University's department of government.

The American psyche, said Darman, is rooted in being No. 1, and most Americans alive today have never lived in a world in which they were not clearly the dominant force.

And, he added, "The day you accept being No. 2, psychologically you are on the way down."

This reordering of the world economomy generally is measured from 1971, when the United States registered its first merchandise trade deficit. But the seeds were planted much earlier, many of them by the United States itself.

There was, of course, the Marshall Plan, to reconstruct war-ravaged Europe.

In Japan, the U.S. occupation authorities set an artificially low exchange rate for the yen to boost Japanese competitiveness. The theory, expressed by then-Secretary of State John Foster Dulles, was that Japan made nothing that any other country wanted to buy.

The postwar institutions set up by the United States to mirror its view of the world also contributed. These included the World Bank and the International Monetary Fund, formed to finance a stable world, and the General Agreement on Tariffs and Trade, established to perpetuate free trade and make sure the world economy did not fall prey to protectionism as it did between the world wars.

"It's a remarkable story of postwar success," Nau said.

The dominance of the United States in world trade, many experts say they believe, was destined from the beginning to be temporary, because it stemmed from unique circumstances following the war, when the country "sat astride the world economy as the only large industrial power undamaged by war," said Commerce Undersecretary Bruce Smart.

Nevertheless, he continued, "we believed our national economic superiority was entirely of our own making, an inalienable right or entitlement, rather than a temporary phenomenon conferred upon us by a unique confluence of circumstances for which we could claim only limited responsibility."

This abnormal situation, some historians and economists believe, lulled the United States into complacency.

But if the United States thought it was entitled to economic preeminence, other countries refused to stand pat. In the new global environment, Japan, not the United States, is the model for other nations.

Korea and Taiwan, for instance, have achieved success following the Japanese model: a combination of free enterprise and competition among domestic producers; heavy protectionism to keep foreign goods out, and strong government guidance to develop the exports-oriented industries that fueled growth. Zysman and Cohen call this system of development "state-centered capitalism."

"Korea and Taiwan had the advantage of seeing Japan develop," said Lawrence Krause, a professor of international relations at the University of California at San Diego.

Singapore Ambassador Tommy T.B. Koh pointed out in a speech last February that the "Four Tigers" of Asia supplied 19 percent of U.S. imports of manufactured goods in 1980, compared with just 5 percent in 1962.

"The world is going to start looking like Japan, not the United States," Krause said. "The less-developed countries see that the way to succeed is through closed home markets and export-led growth," commented GWU's Nau.

Like anyone who has a good deal going, neither the Japanese nor the Asian NICs appear willing to modify their fast-growth economies for the greater good of the global system.

"Just as the U.S. citizen feels entitled to 1950-like preeminence in every field," observed Smart, "the Japanese citizen believes that the tilted playing field of the last 40 years is his by national right."

The current U.S.-Japan battle over semiconductor trade reflects the realization that retaliation may be the only way to force Japan to live up to its new global responsibilities.

The Reagan administration drew the line on semiconductors because they are the building blocks of all high technology. Without a strong semiconductor industry, a country loses the ability to develop more powerful computers and the supercomputers that are vital for national defense.

Underlying the trade dispute are fears within the administration that U.S. national security is at stake if American high-technology innovation is thwarted by Japanese protectionist policies at home and aggressive discount pricing in the United States—the heart of the semiconductor dispute.

A 'Diminished Giant'

The situation is painful for Americans, and the country may be suffering from what has been called the "diminished giant syndrome." But many experts believe that it is better for the world than what came before.

"I think the United States has got to recognize that if we can create a community of common political values and economic growth, it will be worth it even if it costs us a relative share of economic and political power," said Nau. "We may have less power today, but we live in a world that is more peaceful, more stable. We live in a better world than the 1930s."

"The rest of the world is coming of age," said William T. Archey, international vice president of the U.S. Chamber of Commerce.

How America responds to these changes is the subject of the competitiveness debate going on in academia, Congress and the executive branch of government; between business and labor as they try to define new sets of work rules to meet heightened competition from other countries, some of which have added technological advances and high degrees of education to lower wages and less opulent standards of living, and among industrialists seeking a niche in this new economic order of the world.

In Congress, much of the debate concerns changes in U.S. laws to stop what is seen as other countries' unfair trade practices. But the larger issues of competitiveness are being framed beneath the jockeying for trade legislation.

"It depends on how much we invest, how much research and development we do, how well we educate ourselves, how we use our capital," said C. Michael Aho, senior

The once unquestioned dynamism of the United States in the world marketplace is being tested as never before, forcing Americans to confront dramatic changes in standard of living, expectations and values. This is the fourth of sixth articles exploring these changes. Succeeding articles will address "competitiveness" as a political issue and the outlook for the future.

fellow of economics at the Council on Foreign Relations. "Those things never used to matter. Now that we are no longer predominant, they do matter."

The concerns stretch beyond economic vitality to the international security arena. "As we get less competitive, the burden of maintaining the U.S. policy of national security will get more onerous on the economy," said Cohen, the Berkeley economist.

National Security Concerns

Stephen Krasner, a specialist in international economics and politics at Stanford University, agreed. "You can't think of the United States as the dominant power as it was in the past," he said. "That has to have military implications. It doesn't make sense for the United States to maintain the defense commitment it has in a world in which it is not the hegemonic power in the West."

Does it pay, for instance, for the United States to increase its naval presence in the Persian Gulf, as it did this month, to protect the sea lanes so that Western Europe and Japan can get the oil their economies need? "It would be better if Japan and Europe were protecting interests that are much more vital to them than to the United States," Krasner said.

"Can the world's largest debtor nation remain the world's leading power?" asked Bergsten in his Foreign Affairs article.

"Can a small island nation [Japan] that is now militarily insignificant and far removed from the traditional power centers provide at least some of the needed global leadership? Can the United States continue to lead its alliance systems as it goes increasingly into debt to countries that are supposed to be its followers? Can it push those countries hard in pursuit of its economic imperatives while insisting on their allegiance on issues of global strategy? Can it hold its allies together in managing the security system?"

There is new pressure on the United States to change, to end what some see as a complacency and weakening of the human spirit and to begin to compete fully in the new world environment.

Now, Aho said, "we will see how much vibrancy this economy has."

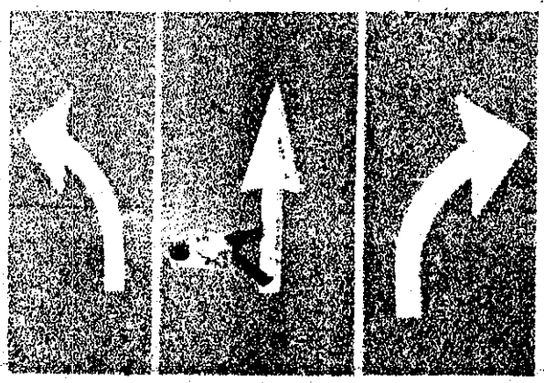
NEXT: Politics of "competitiveness"

RUDE AWAKENINGS



BY JAMES M. THRESHER—THE WASHINGTON POST

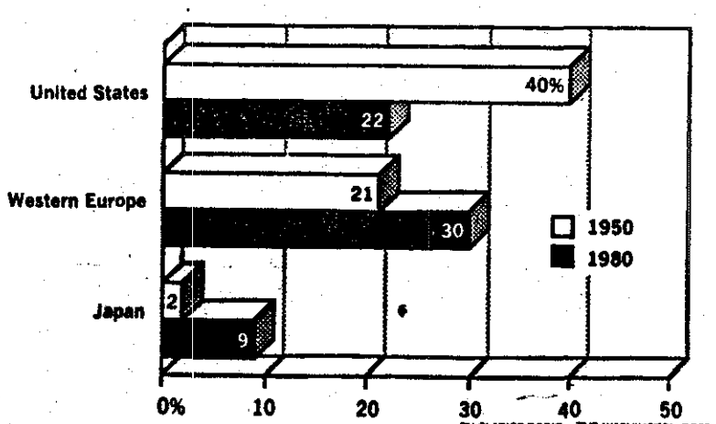
Korean workers prepare Hyundais for export to the United States and Canada. In the United States, the car set a first-year sales record for imports.



Virtually all the experts agree that the era of overwhelming U.S. dominance of the international economy, which began after World War II, is over.

A CHANGING BALANCE: THE U.S. SHARE OF WORLD GNP

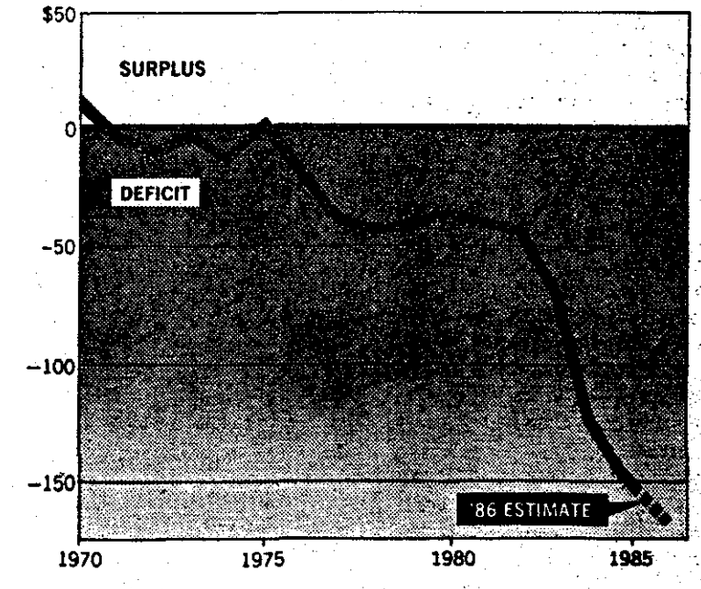
IN PERCENT



BY CLARICE BORIO—THE WASHINGTON POST

U.S. MERCHANDISE TRADE BALANCE

IN BILLIONS OF DOLLARS



SOURCE: U.S. Department of Commerce

BY JO ELLEN MURPHY—THE WASHINGTON POST

Lessons of the VCR Revolution

How U.S. Industry Failed to Make American Ingenuity Pay Off

Second of a series

By Boyce Rensberger
Washington Post Staff Writer

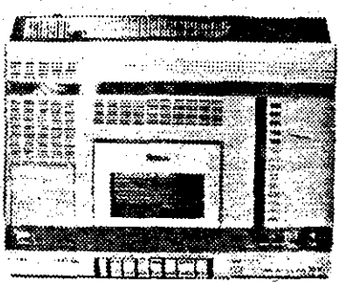
The videocassette recorder is an American invention, conceived in the 1960s by Ampex and RCA. The first VCR for home use to reach the U.S. market, in 1971, was the American-made Cartri-Vision.

By the mid-1970s, however, every American manufacturer had judged the VCR a flop and had left the business.

Today not one American company makes VCRs. All of the 13.2 million units sold in the United States last year—36,000 every day for a total of $5.9 billion—were made in Japan or Korea.

Even RCA, once a proud, patent-holding pioneer of the new technology, is now simply a middleman, buying Japanese VCRs and reselling them under its own label.

The story of the VCR, according to many experts, illustrates some of the reasons why American industry is losing its global competitiveness. It challenges the popular notion that a loss of innovative capacity lies at the heart of this country's eroding economic position. While there is evidence that American innovation may have lost some vigor and that other nations are gaining fast, many experts believe the United States is still the world leader in scientific and technological innovation.



RUDE AWAKENINGS
THE CHALLENGE OF THE GLOBAL ECONOMY

"The problem is not so much with American innovation," said Harvey Brooks, a specialist in technology and public policy at Harvard University. "Our scientists and engineers still lead the world in the origination of new ideas. The problem is what happens after that point. Where we're falling behind is in the ability to develop new ideas into products and to manufacture them to the high standards that we've come to expect from the Japanese."

The VCR is an example.

In the early '70s several companies in the United States, Holland and Japan unveiled VCR prototypes with great fanfare. Industrial-sized video recorders were already common in television studios, and the key to the home market seemed to be scaling down size, cost and complexity of operation. Most of the problems seemed near solution when the prototypes were demonstrated.

One hitch, it developed, was that the cassette would record only one hour of program. Market research showed that people wanted to get two hours on a tape, enough to record a movie. Cartri-Vision, named when cassettes were cartridges, was a one-hour machine that industry analysts say failed for that reason and because the recorder came built into a 25-inch TV set.

Despite the Japanese and Dutch activity in VCR development, the American firms did not think of

See COMPETE, A10, Col. 1

themselves as involved in an important global competition. It was an insular stance, common in many U.S. industries, that would later be seen as one of the causes of America's mounting trade deficit.

"Around 1974 RCA aborted its VCR project," said Frank McCann of the company's Consumer Electronics Division, now owned by General Electric. "It seemed clear the consumer just wouldn't buy it. What we didn't appreciate back then was that the Japanese would keep working on the VCR."

Within two years, both Sony and JVC (Japanese Victor Corp.) developed two-hour VCRs. Rising to beat the competition, Matsushita came out with a four-hour machine.

Pattern of U.S. Reluctance

What would come to be called the VCR revolution, accounting for an appreciable share of the U.S.-Japan trade imbalance, had been won by the Japanese. The United States lost, according to many analysts, not because American scientists and engineers had abandoned their heritage of Yankee ingenuity but because American industrial managers were unwilling to invest the resources to apply that ingenuity long enough to make a good idea pay off.

"It's not as if the United States is caught by surprise by what the Japanese or anybody else is doing," Brooks said. "Our people know what's possible. What we've been surprised by is the rapid commercialization of ideas in Japan."

Brooks said a common U.S. pattern is to avoid investing in new products that aren't fairly sure to return profits quickly and to withhold marketing a new advance in an existing product line as long as its predecessor is selling well. And, until recently, U.S. companies have not planned seriously to compete in international markets.

Japan, by contrast, holds global economic dominance to be a national goal, invests long and heavily in research and development and devotes far more of its best engineering expertise to sophisticated manufacturing methods.

Such factors have given Japan the advantage even though its scientific and technological innovativeness remain well behind that of the United States in all but a few narrow fields.

Although the United States spends more in total dollars on research and development (R&D) than Japan and the next two closest competitors, West Germany and France, combined, according to figures gathered by the National Science Foundation, those competitors have been increasing their spending dramatically in recent years.

In relation to the size of each country's economy, all four countries are now investing about the same in science and engineering research.

In 1986 the United States spent 2.8 percent of its gross national product on R&D, only a modest increase from the 2.6 percent spent in 1970.

Japan, by contrast, has increased its spending faster. In 1970 it invested 1.9 percent in R&D, but climbed steadily to match the United States' 2.8 percent by 1985, the last year for which figures are available. West Germany spent 2.1 percent in 1970 and grew to 2.6 by 1985. France went from 1.9 percent in 1970 to 2.4 percent in 1986.

Many analysts say, however, that the U.S. figures are misleadingly high because this country spends nearly one-third of its R&D money on military research, a far greater proportion than is spent by Japan or West Germany. If military spending is subtracted for the most current figures, the United States spends only 1.9 percent of its GNP on research and development, while Japan spends 2.6 percent and West Germany 2.5 percent.

Some experts note that it is not necessary to be the creator of a marketable idea to make money manufacturing the product. "Americans and especially members of the scientific community have exaggerated the purely economic benefits that flow from leadership at the scientific frontier," Stanford economist Nathan Rosenberg said.

As the costs of high-tech innovation rise, he said, the economic advantage goes to the imitator who can skip the costs of basic research, learn from the innovator's mistakes and come to market quickly with an improved version of the product.

Britain and the jet engine offer an older illustration. Although widely cited as an example of a major industrial power that has slid into global economic impotence and, in some ways, a declining standard of living, Britain continues to be one of the world's leading scientific innovators—second only to the United States as an originator of important fundamental technological advances.

"When a country falls behind in competitiveness, the last thing they fall behind in is innovation," Harvard's Brooks said. "The first thing is manufacturing and marketing."

Although Britain invented the jet engine, U.S. imitators—doing to Britain what Japan now does to the United States—reaped most of the economic benefits.

Britain's pioneer jet airliner, the Comet 1, turned out to be a financial disaster. Only when Boeing and Douglas picked up the idea, added some improvements and manufactured it to higher standards, did jet airliners sweep the world's aviation market.

What has slipped in the United States, Rosenberg contends along with many others, is the ability of industry to capitalize on "next generation" improvements in good ideas, regardless of where the idea originated.

"To a far greater degree than we once believed," Rosenberg said, "a first-rate, domestic scientific research capability is neither sufficient nor even necessary for economic growth." More critical is the sophistication of the nation's manufacturing ability.

Different Cultures at Work

Many observers attribute much of Japan's rise to what amounts to a cultural difference between the way U.S. and Japanese scientists and engineers work.

American engineers often prefer to work in research and development rather than in manufacturing. In the United States, the engineer who invents a product holds higher status and earns more money than the engineer who figures out how to manufacture it to high standards and keep it profitably low in cost.

One painfully obvious result, according to many, is that while the United States still spawns plenty of brilliant ideas, there are too few first-rate engineers to design good products based on the ideas. And when they are designed, those products often contain many times more defects than do Japanese counterparts.

"The relatively lower status and lower pay that have characterized careers in [U.S.] manufacturing represent an impediment to attracting first-rate people. Engineering departments in colleges and universities have largely ignored the field until very recently," a panel of the National Academy of Engineering concluded in a 1985 report. "In sharp contrasts, in both Europe and Japan the status of technical education and of careers in manufacturing is higher."

By having better brains in manufacturing, the Japanese and the Europeans are able to develop superior manufacturing methods and technology.

A related difference that yields poorer quality American products, according to a study of computer manufacturers done jointly by two experts in technology management, one an American and the other a Japanese, is that Japanese engineers move easily back and forth between R&D and manufacturing.

American R&D engineers, according to the study, not only come up with a new product idea, they produce the final specifications and simply turn them over to a separate manufacturing division. Japanese R&D engineers design only to a rough prototype stage, leaving the final specifications to manufacturing engineers.

Often a key R&D engineer will then move with the product to the manufacturing division, a step rare in the United States but part of the normal career ladder in many Japanese firms.

Under the Japanese system, experts in manufacturing technology

are free to complete the design in accordance with their knowledge of sophisticated manufacturing methods. They may modify the product design to ensure more reliable quality after manufacture. They may even invent new methods to make the product. As a result, the Japanese product can be made more easily, more cheaply and with much lower risk of defects.

The study was done by D. Eleanor Westney of the Massachusetts Institute of Technology's Sloan School of Management and Kiyonori Sakakibara of Hitotsubashi University in Tokyo.

Other key differences between the Japanese and American styles of managing engineering talent, according to Westney and Sakakibara, include:

- Japanese firms invest far more time and money in advanced training for their engineers than do American firms, partly because they have little fear that highly talented individuals will be hired away by rival firms. It is traditional for Japanese engineers to stay with an employer for life. One result is that hundreds are sent abroad to study for months or years—most often at American universities, which many Japanese regard as the best in high-technology fields. At MIT, for example, there are more than 100 Japanese engineers taking classes at any given time. Japan's much vaunted "fifth generation" computer project, in which the country hopes to leaptrog American computer technology, is based largely on innovations borrowed from U.S. computer scientists at MIT.
- While many Japanese engineers are soaking up the most advanced R&D skills and knowledge in U.S. universities, far fewer American engineers go to Japan, even to learn what Japan does best, advanced manufacturing technology.
- Although engineers everywhere often engage in "bootleg research," using company resources to pursue personal projects on the side, American firms try to discourage such activities because the engineers may then leave to exploit their ideas in new, spinoff entrepreneurial firms. Japanese companies encourage such sideline research, confident that the engineers will stay and turn the new ideas into valuable products for the company.

Another important difference, cited by many analysts and illustrated by the history of the VCR, is the greater willingness of Japanese firms to spend money over longer periods of time to bring a new product idea to fruition. U.S. firms are often run by professional business managers, untrained in engineering, who make decisions to maximize short-term profits.

In Japan, which has no business schools, high-technology firms are more likely to be run by engineers who showed management skills and who have advanced up the corporate ladder. They plan much further ahead and are willing to forgo short-term profits for a long-term advantage.

"American investors need earnings trends quarter to quarter. The Japanese are much more patient," said G. Stephen Burrill, head of a high-technology consulting group at Arthur Young, an accounting firm.

Next Battle: Biotechnology

Electronics has been one of Japan's oldest arenas of high-tech competition. One of the newest is biotechnology, another field pioneered chiefly in the United States and which promises a multibillion-dollar market supplying medicine with more effective drugs and diagnostic tools and supplying agriculture with various products to enhance crop yields. Japan's approach to biotechnology illustrates what many scientists see as another of that nation's advantages—Japan's method of creating government-supported consortiums of private corporations.

U.S. biologists invented gene splicing, also called recombinant DNA technology, and developed most of the methods of applying the technology. Although a swarm of new American entrepreneurial biotech firms has emerged, the Japanese are pushing hard to capture much of the market. Many leaders of U.S. biotech firms believe it will be hard, though not impossible, to stay ahead of Japan.

The once unquestioned dynamism of the United States in the world marketplace is being tested as never before, forcing Americans to confront dramatic changes in standard of living, expectations and values. This is the second of six articles exploring these changes and their causes.

As in many other fields, a key feature of Japan's drive is its unusual degree of cooperation among related industries and universities and the Japanese government's strong encouragement and financial support for a coherent national program in this area.

While antitrust laws prevent U.S. biotech firms from collaborating and while tradition leads many to pursue their goals apart from federal labs, Japan's Ministry of International Trade and Industry (MITI) has created a consortium of 14 major corporations to collaborate on biotech. Global domination in biotechnology is an official national goal under one of Japan's 10-year "Next Generation Projects."

Howard A. Schneiderman, vice president for R&D at Monsanto, a major biotech firm, sees his company as having to compete not just with other firms but with all of Japan.

"Monsanto, du Pont and Eli Lilly cannot cooperate in biotechnology," Schneiderman said. "We must be competitive, at arm's length. Yet Monsanto must be able to compete scientifically and commercially in biotechnology with MITI's consortium of 14 great companies in biotechnology and must compete with Japan's national commitment to biotechnology."

Monsanto's answer, and that of many other firms, is to seek collaboration with U.S. science-oriented universities.

"No MITI consortium in Japan, no industrial combine in the U.S. or elsewhere can duplicate or compete with the basic research capabilities of America's great research universities," Schneiderman said.

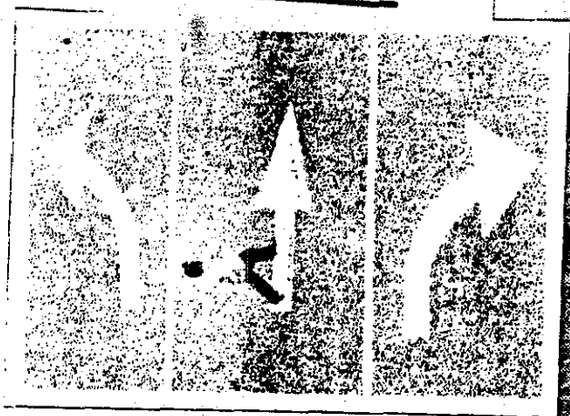
While such corporate-university collaborations are developing, there is controversy as to whether industry's need for proprietary secrecy conflicts with the traditional openness of university research.

Most university-based research in biotechnology is funded by federal grants and some industry leaders, such as Ronald E. Cape, chairman of Cetus Corp., a California biotech firm, worry that spending in this area has not grown significantly in several years. Because Japan's spending on basic biotech research is continuing to grow, Cape forecasts that Japan will take the world lead in biotechnology in the 1990s.

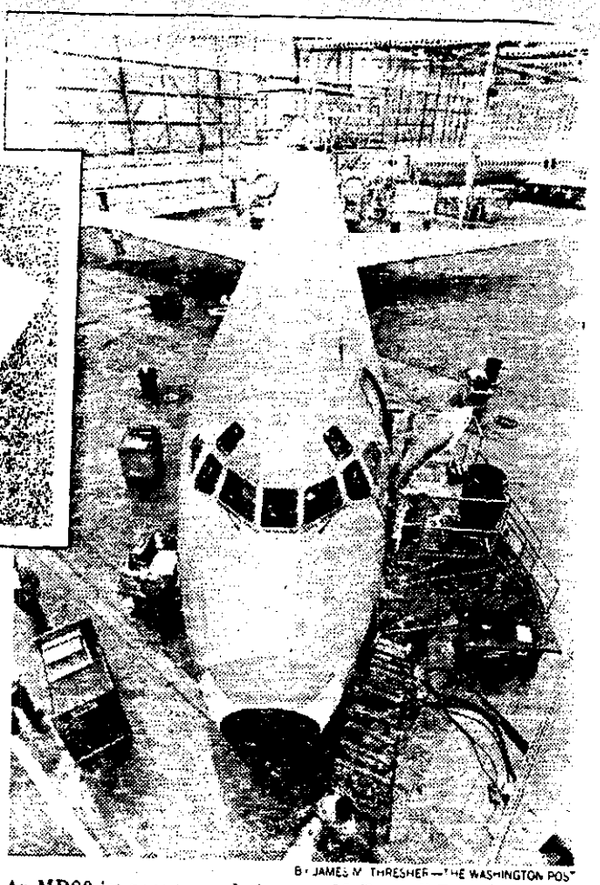
"In 10 years, if what I'm saying is correct," Cape says, "I bet we'll have hearings in Congress and a lot of American industrialists will bitch and moan about how the Japanese have done unfair things in trade. But that is not the case with biotechnology. The Japanese are doing the right thing."

NEXT: The role of education

RUDE AWAKENINGS



The United States may have lost the VCR revolution because industrial managers were unwilling to invest resources long enough to make a good idea pay off.

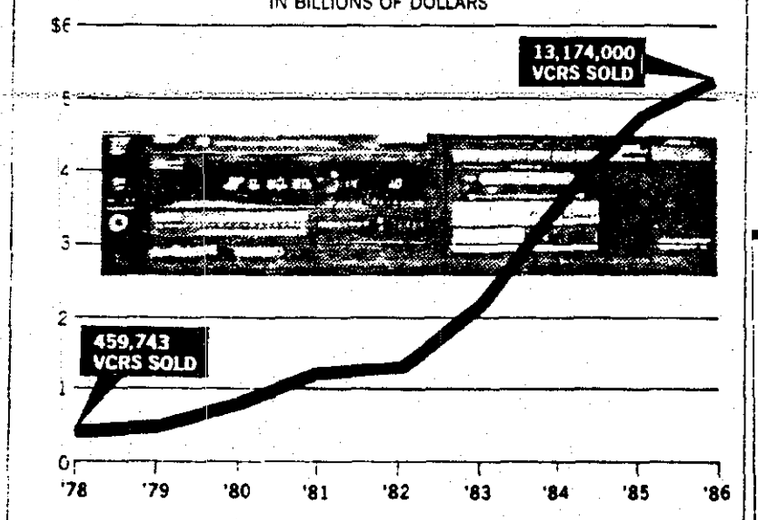


BY JAMES M. THRESHER—THE WASHINGTON POST

An MD80 jet nears completion at a McDonnell Douglas plant in Long Beach, Calif. Britain invented the jet engine, but U.S. imitators, including McDonnell Douglas, improved on the idea and reaped most of the economic benefits—doing to Britain what Japan now does to the United States.

MISSED OPPORTUNITY

VCR SALES FROM MANUFACTURERS TO U.S. DEALERS IN BILLIONS OF DOLLARS

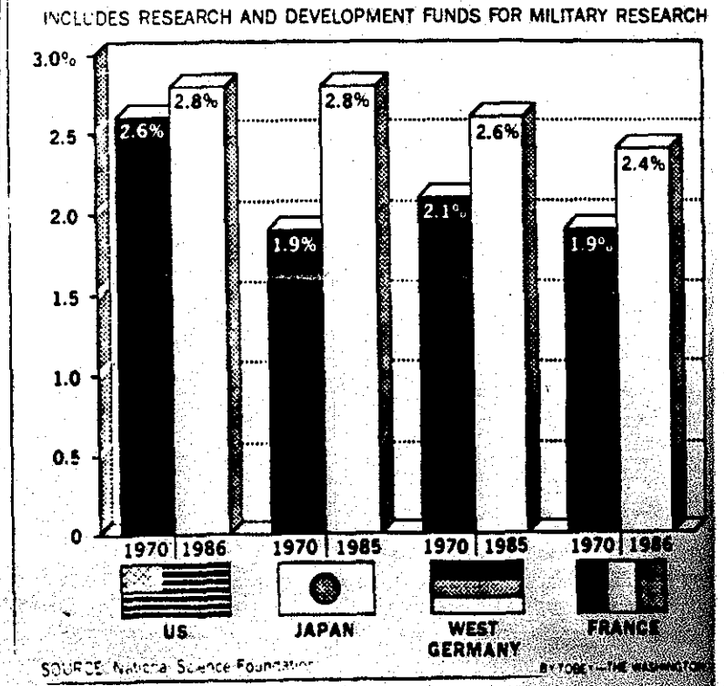


SOURCE Electronic Industries Association

BY JC ELLEN MURPHY—THE WASHINGTON POST

PERCENTAGE OF GNP SPENT ON RESEARCH AND DEVELOPMENT

INCLUDES RESEARCH AND DEVELOPMENT FUNDS FOR MILITARY RESEARCH



SOURCE National Science Foundation

BY TOM T—THE WASHINGTON

America, the 'Diminished Giant'

As Rivals Strengthen, U.S. Dominance in World Marketplace Fades

Fourth of a series

By Stuart Auerbach
Washington Post Staff Writer

The first made-in-Korea Hyundai automobile rolled into the United States 14 months ago, driven off a Japanese freighter at the port of Jacksonville, Fla.

To those who still regard Korea as the underdeveloped nation depicted in the sitcom M*A*S*H, instead of a budding industrial giant, what happened next was perhaps a surprise.

The low-priced Hyundai swept through this country, setting a record for first-year sales by an imported car—168,882 sold in 1986—and quickly became a name to be reckoned with in the world auto industry.

The Hyundai sailed on winds of change that have drastically transformed the economic shape of the globe—establishing an entirely new relationship between the United States and the rest of the world, making it vastly more difficult for U.S. industries to compete in crucial global markets.

The changes have been so sweeping and have taken place with such astonishing speed—over just 15 years—that they are only partly understood by the American public and policy-makers in government.

RUDE AWAKENINGS
THE CHALLENGE OF THE GLOBAL ECONOMY

But virtually all the experts agree that the era of overwhelming U.S. dominance of the international economy—an era that began after World War II when much of the rest of the world was devastated—is over.

"We have come to a divide," said University of California political scientist John Zysman. "The economic changes we are watching will reshape the international security system. They are fundamental shifts of the power relations among nations."

In the United States, these changes have contributed to serious economic dislocation: the closing of steel mills and auto plants, the conversion of the industrial heartland into the Rust Belt, a loss of millions of manufacturing jobs.

They have raised questions, as C. Fred Bergsten, director of the Institute for International Economics, wrote recently in Foreign Affairs magazine, as to whether

See COMPETE, A18, Col. 1

U.S. Faces Up to Erosion Of Economic Supremacy

COMPETE, From A1

the United States can keep its mantle of world leadership.

At the same time, many experts believe that for all the pain caused in the United States by these changes, the world as a whole is a better place. "We have built a world system where we are now beginning to bring into membership at the highest levels countries which 25 years ago were in poverty," said Henry Nau, professor of political science and international relations at George Washington University.

The most visible symbol of America's loss of global economic supremacy is four years of towering trade deficits, which reached $170 billion last year, coupled with the transformation of the United States in the last year from a creditor nation into what Bergsten called "the largest debtor nation ever known to mankind." The United States now owes about $220 billion more abroad than foreign countries owe the United States.

By the end of this decade, he said, the United States will owe more than a half-trillion dollars and will be paying tens of billions of dollars a year in interest to foreign investors.

Many more signs illustrate how the United States is no longer the preeminent player in the world economy, and how other nations are coming up:

- In 1950, the United States produced 40 percent of the world's goods and services. By 1980, the U.S. share had dropped almost by half, to 22 percent. Meanwhile, Japan's share climbed from less than 2 percent to about 9 percent, and Europe's share rose from 21 percent to almost 30 percent.
- For the first time since World War II, the United States last year lost its position as the world's leading exporter, supplanted by West Germany, with Japan pressing on the United States in third place.
- Last year, again for the first time, the United States ran a trade deficit in high-technology products, considered the wave of the future for the U.S. economy and critical for U.S. national security.
- In 1974 the United States was responsible for the design of 70 percent of the advanced technology in the world. By 1984, this figure had dropped to 50 percent. According to estimates, it will slide further, to 30 percent by 1994.

The 'Four Tigers'

Most surprisingly, at least to Americans who were not paying attention, has been the emergence of a whole new phalanx of competitive nations—the "Four Tigers" of the Pacific Rim—Hong Kong, Singapore, Taiwan and South Korea.

These newly industrialized countries (NICs) join Japan, which a generation ago was considered a developing country, as the most vital growth forces in the world economy. Western Europe, meanwhile, is going through a period of sluggish growth, and most Third World nations have grown relatively poorer.

"The real stakes are the wealth and power of the United States," said Stephen S. Cohen, a Berkeley economist who is codirector with Zysman of the Berkeley Roundtable on the International Economy.

"We will have to get used to living in a world in which we are no longer No. 1 . . . , or at least not No. 1 by much," said Herbert Stein, chairman of the Council of Economic Advisers under Presidents Nixon and Ford who now is a senior fellow at the American Enterprise Institute.

The country, experts say, will also have to get used to a greater dependency on trade with the rest of the world than ever before. In 1960, sales abroad and U.S. purchases from foreign countries amounted to just 7 percent of gross national product. Twenty years later, trade accounted for 15 percent of U.S. GNP. Government officials estimate that 5.5 million jobs now depend on exports, and one in four farm acres produces crops for sale abroad.

The decline in both power and standard of living is difficult to accept in this country, which was born out of the limitless optimism of pioneers who saw the American dream as one of continued economic and social enrichment, said former deputy treasury secretary Richard Darman, a former specialist in public policy and management in Harvard University's department of government.

The American psyche, said Darman, is rooted in being No. 1, and most Americans alive today have never lived in a world in which they were not clearly the dominant force.

And, he added, "The day you accept being No. 2, psychologically you are on the way down."

This reordering of the world economomy generally is measured from 1971, when the United States registered its first merchandise trade deficit. But the seeds were planted much earlier, many of them by the United States itself.

There was, of course, the Marshall Plan, to reconstruct war-ravaged Europe.

In Japan, the U.S. occupation authorities set an artificially low exchange rate for the yen to boost Japanese competitiveness. The theory, expressed by then-Secretary of State John Foster Dulles, was that Japan made nothing that any other country wanted to buy.

The postwar institutions set up by the United States to mirror its view of the world also contributed. These included the World Bank and the International Monetary Fund, formed to finance a stable world, and the General Agreement on Tariffs and Trade, established to perpetuate free trade and make sure the world economy did not fall prey to protectionism as it did between the world wars.

"It's a remarkable story of postwar success," Nau said.

The dominance of the United States in world trade, many experts say they believe, was destined from the beginning to be temporary, because it stemmed from unique circumstances following the war, when the country "sat astride the world economy as the only large industrial power undamaged by war," said Commerce Undersecretary Bruce Smart.

Nevertheless, he continued, "we believed our national economic superiority was entirely of our own making, an inalienable right or entitlement, rather than a temporary phenomenon conferred upon us by a unique confluence of circumstances for which we could claim only limited responsibility."

This abnormal situation, some historians and economists believe, lulled the United States into complacency.

But if the United States thought it was entitled to economic preeminence, other countries refused to stand pat. In the new global environment, Japan, not the United States, is the model for other nations.

Korea and Taiwan, for instance, have achieved success following the Japanese model: a combination of free enterprise and competition among domestic producers; heavy protectionism to keep foreign goods out, and strong government guidance to develop the exports-oriented industries that fueled growth. Zysman and Cohen call this system of development "state-centered capitalism."

"Korea and Taiwan had the advantage of seeing Japan develop," said Lawrence Krause, a professor of international relations at the University of California at San Diego.

Singapore Ambassador Tommy T.B. Koh pointed out in a speech last February that the "Four Tigers" of Asia supplied 19 percent of U.S. imports of manufactured goods in 1980, compared with just 5 percent in 1962.

"The world is going to start looking like Japan, not the United States," Krause said. "The less-developed countries see that the way to succeed is through closed home markets and export-led growth," commented GWU's Nau.

Like anyone who has a good deal going, neither the Japanese nor the Asian NICs appear willing to modify their fast-growth economies for the greater good of the global system.

"Just as the U.S. citizen feels entitled to 1950-like preeminence in every field," observed Smart, "the Japanese citizen believes that the tilted playing field of the last 40 years is his by national right."

The current U.S.-Japan battle over semiconductor trade reflects the realization that retaliation may be the only way to force Japan to live up to its new global responsibilities.

The Reagan administration drew the line on semiconductors because they are the building blocks of all high technology. Without a strong semiconductor industry, a country loses the ability to develop more powerful computers and the supercomputers that are vital for national defense.

Underlying the trade dispute are fears within the administration that U.S. national security is at stake if American high-technology innovation is thwarted by Japanese protectionist policies at home and aggressive discount pricing in the United States—the heart of the semiconductor dispute.

A 'Diminished Giant'

The situation is painful for Americans, and the country may be suffering from what has been called the "diminished giant syndrome." But many experts believe that it is better for the world than what came before.

"I think the United States has got to recognize that if we can create a community of common political values and economic growth, it will be worth it even if it costs us a relative share of economic and political power," said Nau. "We may have less power today, but we live in a world that is more peaceful, more stable. We live in a better world than the 1930s."

"The rest of the world is coming of age," said William T. Archey, international vice president of the U.S. Chamber of Commerce.

How America responds to these changes is the subject of the competitiveness debate going on in academia, Congress and the executive branch of government; between business and labor as they try to define new sets of work rules to meet heightened competition from other countries, some of which have added technological advances and high degrees of education to lower wages and less opulent standards of living, and among industrialists seeking a niche in this new economic order of the world.

In Congress, much of the debate concerns changes in U.S. laws to stop what is seen as other countries' unfair trade practices. But the larger issues of competitiveness are being framed beneath the jockeying for trade legislation.

"It depends on how much we invest, how much research and development we do, how well we educate ourselves, how we use our capital," said C. Michael Aho, senior

The once unquestioned dynamism of the United States in the world marketplace is being tested as never before, forcing Americans to confront dramatic changes in standard of living, expectations and values. This is the fourth of sixth articles exploring these changes. Succeeding articles will address "competitiveness" as a political issue and the outlook for the future.

fellow of economics at the Council on Foreign Relations. "Those things never used to matter. Now that we are no longer predominant, they do matter."

The concerns stretch beyond economic vitality to the international security arena. "As we get less competitive, the burden of maintaining the U.S. policy of national security will get more onerous on the economy," said Cohen, the Berkeley economist.

National Security Concerns

Stephen Krasner, a specialist in international economics and politics at Stanford University, agreed. "You can't think of the United States as the dominant power as it was in the past," he said. "That has to have military implications. It doesn't make sense for the United States to maintain the defense commitment it has in a world in which it is not the hegemonic power in the West."

Does it pay, for instance, for the United States to increase its naval presence in the Persian Gulf, as it did this month, to protect the sea lanes so that Western Europe and Japan can get the oil their economies need? "It would be better if Japan and Europe were protecting interests that are much more vital to them than to the United States," Krasner said.

"Can the world's largest debtor nation remain the world's leading power?" asked Bergsten in his Foreign Affairs article.

"Can a small island nation [Japan] that is now militarily insignificant and far removed from the traditional power centers provide at least some of the needed global leadership? Can the United States continue to lead its alliance systems as it goes increasingly into debt to countries that are supposed to be its followers? Can it push those countries hard in pursuit of its economic imperatives while insisting on their allegiance on issues of global strategy? Can it hold its allies together in managing the security system?"

There is new pressure on the United States to change, to end what some see as a complacency and weakening of the human spirit and to begin to compete fully in the new world environment.

Now, Aho said, "we will see how much vibrancy this economy has."

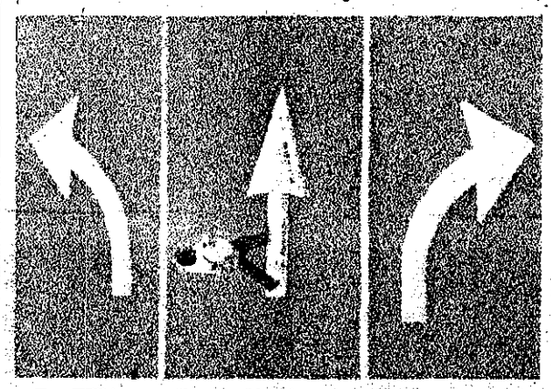
NEXT: Politics of "competitiveness"

RUDE AWAKENINGS



BY JAMES M. THRESHER—THE WASHINGTON POST

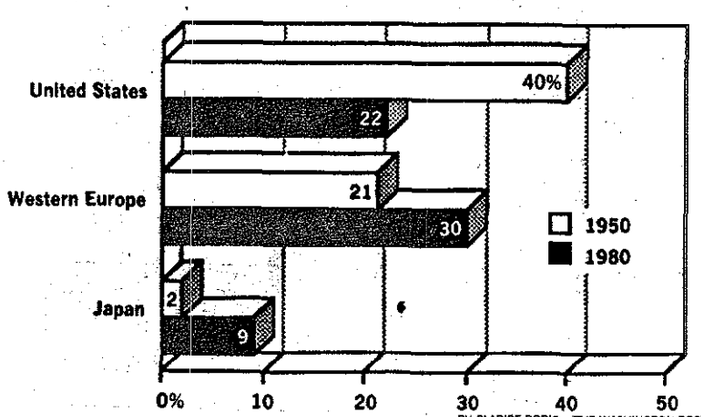
Korean workers prepare Hyundais for export to the United States and Canada. In the United States, the car set a first-year sales record for imports.



Virtually all the experts agree that the era of overwhelming U.S. dominance of the international economy, which began after World War II, is over.

A CHANGING BALANCE: THE U.S. SHARE OF WORLD GNP

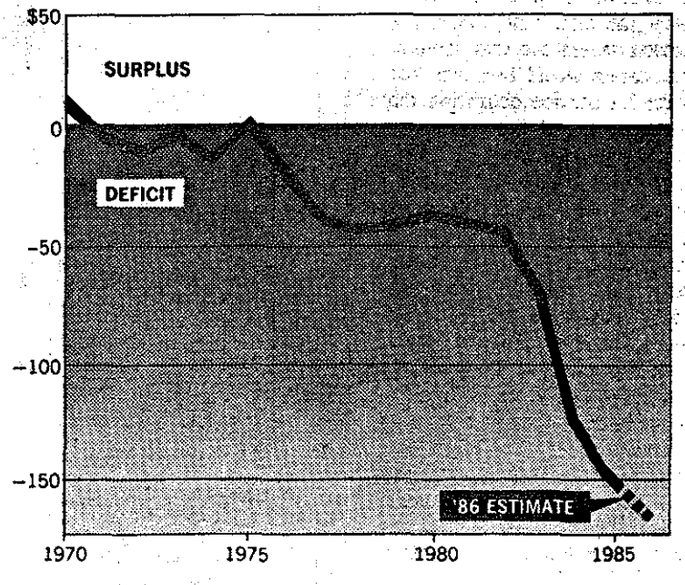
IN PERCENT



BY CLARICE BORIO—THE WASHINGTON POST

U.S. MERCHANDISE TRADE BALANCE

IN BILLIONS OF DOLLARS



SOURCE: U.S. Department of Commerce

BY JO ELLEN MURPHY—THE WASHINGTON POST

Lessons of the VCR Revolution

How U.S. Industry Failed to Make American Ingenuity Pay Off

Second of a series

By Boyce Rensberger
Washington Post Staff Writer

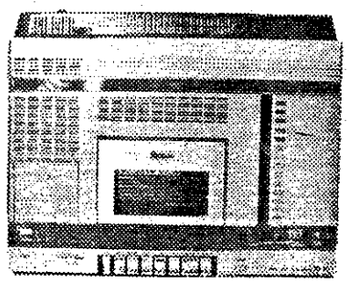
The videocassette recorder is an American invention, conceived in the 1960s by Ampex and RCA. The first VCR for home use to reach the U.S. market, in 1971, was the American-made Cartri-Vision.

By the mid-1970s, however, every American manufacturer had judged the VCR a flop and had left the business.

Today not one American company makes VCRs. All of the 13.2 million units sold in the United States last year—36,000 every day for a total of $5.9 billion—were made in Japan or Korea.

Even RCA, once a proud, patent-holding pioneer of the new technology, is now simply a middleman, buying Japanese VCRs and reselling them under its own label.

The story of the VCR, according to many experts, illustrates some of the reasons why American industry is losing its global competitiveness. It challenges the popular notion that a loss of innovative capacity lies at the heart of this country's eroding economic position. While there is evidence that American innovation may have lost some vigor and that other nations are gaining fast, many experts believe the United States is still the world leader in scientific and technological innovation.



RUDE AWAKENINGS
THE CHALLENGE OF THE GLOBAL ECONOMY

"The problem is not so much with American innovation," said Harvey Brooks, a specialist in technology and public policy at Harvard University. "Our scientists and engineers still lead the world in the origination of new ideas. The problem is what happens after that point. Where we're falling behind is in the ability to develop new ideas into products and to manufacture them to the high standards that we've come to expect from the Japanese."

The VCR is an example.

In the early '70s several companies in the United States, Holland and Japan unveiled VCR prototypes with great fanfare. Industrial-sized video recorders were already common in television studios, and the key to the home market seemed to be scaling down size, cost and complexity of operation. Most of the problems seemed near solution when the prototypes were demonstrated.

One hitch, it developed, was that the cassette would record only one hour of program. Market research showed that people wanted to get two hours on a tape, enough to record a movie. Cartri-Vision, named when cassettes were cartridges, was a one-hour machine that industry analysts say failed for that reason and because the recorder came built into a 25-inch TV set.

Despite the Japanese and Dutch activity in VCR development, the American firms did not think of

See COMPETE, A10, Col. 1

COMPLETE From A1

themselves as involved in an important global competition. It was an insular stance, common in many U.S. industries, that would later be seen as one of the causes of America's mounting trade deficit.

"Around 1974 RCA aborted its VCR project," said Frank McCann of the company's Consumer Electronics Division, now owned by General Electric. "It seemed clear the consumer just wouldn't buy it. What we didn't appreciate back then was that the Japanese would keep working on the VCR."

Within two years, both Sony and JVC (Japanese Victor Corp.) developed two-hour VCRs. Rising to beat the competition, Matsushita came out with a four-hour machine.

Pattern of U.S. Reluctance

What would come to be called the VCR revolution, accounting for an appreciable share of the U.S.-Japan trade imbalance, had been won by the Japanese. The United States lost, according to many analysts, not because American scientists and engineers had abandoned their heritage of Yankee ingenuity but because American industrial managers were unwilling to invest the resources to apply that ingenuity long enough to make a good idea pay off.

"It's not as if the United States is caught by surprise by what the Japanese or anybody else is doing," Brooks said. "Our people know what's possible. What we've been surprised by is the rapid commercialization of ideas in Japan."

Brooks said a common U.S. pattern is to avoid investing in new products that aren't fairly sure to return profits quickly and to withhold marketing a new advance in an existing product line as long as its predecessor is selling well. And, until recently, U.S. companies have not planned seriously to compete in international markets.

Japan, by contrast, holds global economic dominance to be a national goal, invests long and heavily in research and development and devotes far more of its best engineering expertise to sophisticated manufacturing methods.

Such factors have given Japan the advantage even though its scientific and technological innovativeness remain well behind that of the United States in all but a few narrow fields.

Although the United States spends more in total dollars on research and development (R&D) than Japan and the next two closest competitors, West Germany and France, combined, according to figures gathered by the National Science Foundation, those competitors have been increasing their spending dramatically in recent years.

In relation to the size of each country's economy, all four countries are now investing about the same in science and engineering research.

In 1986 the United States spent 2.8 percent of its gross national product on R&D, only a modest increase from the 2.6 percent spent in 1970.

Japan, by contrast, has increased its spending faster. In 1970 it invested 1.9 percent in R&D, but climbed steadily to match the United States' 2.8 percent by 1985, the last year for which figures are available. West Germany spent 2.1 percent in 1970 and grew to 2.6 by 1985. France went from 1.9 percent in 1970 to 2.4 percent in 1986.

Many analysts say, however, that the U.S. figures are misleadingly high because this country spends nearly one-third of its R&D money on military research, a far greater proportion than is spent by Japan or West Germany. If military spending is subtracted for the most current figures, the United States spends only 1.9 percent of its GNP on research and development, while Japan spends 2.6 percent and West Germany 2.5 percent.

Some experts note that it is not necessary to be the creator of a marketable idea to make money manufacturing the product. "Americans and especially members of the scientific community have exaggerated the purely economic benefits that flow from leadership at the scientific frontier," Stanford economist Nathan Rosenberg said.

As the costs of high-tech innovation rise, he said, the economic advantage goes to the imitator who can skip the costs of basic research, learn from the innovator's mistakes and come to market quickly with an improved version of the product.

Britain and the jet engine offer an older illustration. Although widely cited as an example of a major industrial power that has slid into global economic impotence and, in some ways, a declining standard of living, Britain continues to be one of the world's leading scientific innovators—second only to the United States as an originator of important fundamental technological advances.

"When a country falls behind in competitiveness, the last thing they fall behind in is innovation," Harvard's Brooks said. "The first thing is manufacturing and marketing."

Although Britain invented the jet engine, U.S. imitators—doing to Britain what Japan now does to the United States—reaped most of the economic benefits.

Britain's pioneer jet airliner, the Comet 1, turned out to be a financial disaster. Only when Boeing and Douglas picked up the idea, added some improvements and manufactured it to higher standards, did jet airliners sweep the world's aviation market.

What has slipped in the United States, Rosenberg contends along with many others, is the ability of industry to capitalize on "next generation" improvements in good ideas, regardless of where the idea originated.

"To a far greater degree than we once believed," Rosenberg said, "a first-rate, domestic scientific research capability is neither sufficient nor even necessary for economic growth." More critical is the sophistication of the nation's manufacturing ability.

Different Cultures at Work

Many observers attribute much of Japan's rise to what amounts to a cultural difference between the way U.S. and Japanese scientists and engineers work.

American engineers often prefer to work in research and development rather than in manufacturing. In the United States, the engineer who invents a product holds higher status and earns more money than the engineer who figures out how to manufacture it to high standards and keep it profitably low in cost.

One painfully obvious result, according to many, is that while the United States still spawns plenty of brilliant ideas, there are too few first-rate engineers to design good products based on the ideas. And when they are designed, those products often contain many times more defects than do Japanese counterparts.

"The relatively lower status and lower pay that have characterized careers in [U.S.] manufacturing represent an impediment to attracting first-rate people. Engineering departments in colleges and universities have largely ignored the field until very recently," a panel of the National Academy of Engineering concluded in a 1985 report. "In sharp contrasts, in both Europe and Japan the status of technical education and of careers in manufacturing is higher."

By having better brains in manufacturing, the Japanese and the Europeans are able to develop superior manufacturing methods and technology.

A related difference that yields poorer quality American products, according to a study of computer manufacturers done jointly by two experts in technology management, one an American and the other a Japanese, is that Japanese engineers move easily back and forth between R&D and manufacturing.

American R&D engineers, according to the study, not only come up with a new product idea, they produce the final specifications and simply turn them over to a separate manufacturing division. Japanese R&D engineers design only to a rough prototype stage, leaving the final specifications to manufacturing engineers.

Often a key R&D engineer will then move with the product to the manufacturing division, a step rare in the United States but part of the normal career ladder in many Japanese firms.

Under the Japanese system, experts in manufacturing technology

are free to complete the design in accordance with their knowledge of sophisticated manufacturing methods. They may modify the product design to ensure more reliable quality after manufacture. They may even invent new methods to make the product. As a result, the Japanese product can be made more easily, more cheaply and with much lower risk of defects.

The study was done by D. Eleanor Westney of the Massachusetts Institute of Technology's Sloan School of Management and Kiyonori Sakakibara of Hitotsubashi University in Tokyo.

Other key differences between the Japanese and American styles of managing engineering talent, according to Westney and Sakakibara, include:

- Japanese firms invest far more time and money in advanced training for their engineers than do American firms, partly because they have little fear that highly talented individuals will be hired away by rival firms. It is traditional for Japanese engineers to stay with an employer for life. One result is that hundreds are sent abroad to study for months or years—most often at American universities, which many Japanese regard as the best in high-technology fields. At MIT, for example, there are more than 100 Japanese engineers taking classes at any given time. Japan's much vaunted "fifth generation" computer project, in which the country hopes to leapfrog American computer technology, is based largely on innovations borrowed from U.S. computer scientists at MIT.
- While many Japanese engineers are soaking up the most advanced R&D skills and knowledge in U.S. universities, far fewer American engineers go to Japan, even to learn what Japan does best, advanced manufacturing technology.
- Although engineers everywhere often engage in "bootleg research," using company resources to pursue personal projects on the side, American firms try to discourage such activities because the engineers may then leave to exploit their ideas in new, spinoff entrepreneurial firms. Japanese companies encourage such sideline research, confident that the engineers will stay and turn the new ideas into valuable products for the company.

Another important difference, cited by many analysts and illustrated by the history of the VCR, is the greater willingness of Japanese firms to spend money over longer periods of time to bring a new product idea to fruition. U.S. firms are often run by professional business managers, untrained in engineering, who make decisions to maximize short-term profits.

In Japan, which has no business schools, high-technology firms are more likely to be run by engineers who showed management skills and who have advanced up the corporate ladder. They plan much further ahead and are willing to forgo short-term profits for a long-term advantage.

"American investors need earnings trends quarter to quarter. The Japanese are much more patient," said G. Stephen Burrill, head of a high-technology consulting group at Arthur Young, an accounting firm.

Next Battle: Biotechnology

Electronics has been one of Japan's oldest arenas of high-tech competition. One of the newest is biotechnology, another field pioneered chiefly in the United States and which promises a multibillion-dollar market supplying medicine with more effective drugs and diagnostic tools and supplying agriculture with various products to enhance crop yields. Japan's approach to biotechnology illustrates what many scientists see as another of that nation's advantages—Japan's method of creating government-supported consortiums of private corporations.

U.S. biologists invented gene splicing, also called recombinant DNA technology, and developed most of the methods of applying the technology. Although a swarm of new American entrepreneurial biotech firms has emerged, the Japanese are pushing hard to capture much of the market. Many leaders of U.S. biotech firms believe it will be hard, though not impossible, to stay ahead of Japan.

The once unquestioned dynamism of the United States in the world marketplace is being tested as never before, forcing Americans to confront dramatic changes in standard of living, expectations and values. This is the second of six articles exploring these changes and their causes.

As in many other fields, a key feature of Japan's drive is its unusual degree of cooperation among related industries and universities and the Japanese government's strong encouragement and financial support for a coherent national program in this area.

While antitrust laws prevent U.S. biotech firms from collaborating and while tradition leads many to pursue their goals apart from federal labs, Japan's Ministry of International Trade and Industry (MITI) has created a consortium of 14 major corporations to collaborate on biotech. Global domination in biotechnology is an official national goal under one of Japan's 10-year "Next Generation Projects."

Howard A. Schneiderman, vice president for R&D at Monsanto, a major biotech firm, sees his company as having to compete not just with other firms but with all of Japan.

"Monsanto, du Pont and Eli Lilly cannot cooperate in biotechnology," Schneiderman said. "We must be competitive, at arm's length. Yet Monsanto must be able to compete scientifically and commercially in biotechnology with MITI's consortium of 14 great companies in biotechnology and must compete with Japan's national commitment to biotechnology."

Monsanto's answer, and that of many other firms, is to seek collaboration with U.S. science-oriented universities.

"No MITI consortium in Japan, no industrial combine in the U.S. or elsewhere can duplicate or compete with the basic research capabilities of America's great research universities," Schneiderman said.

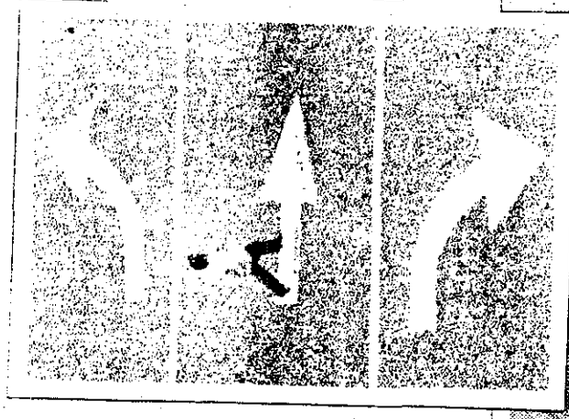
While such corporate-university collaborations are developing, there is controversy as to whether industry's need for proprietary secrecy conflicts with the traditional openness of university research.

Most university-based research in biotechnology is funded by federal grants and some industry leaders, such as Ronald E. Cape, chairman of Cetus Corp., a California biotech firm, worry that spending in this area has not grown significantly in several years. Because Japan's spending on basic biotech research is continuing to grow, Cape forecasts that Japan will take the world lead in biotechnology in the 1990s.

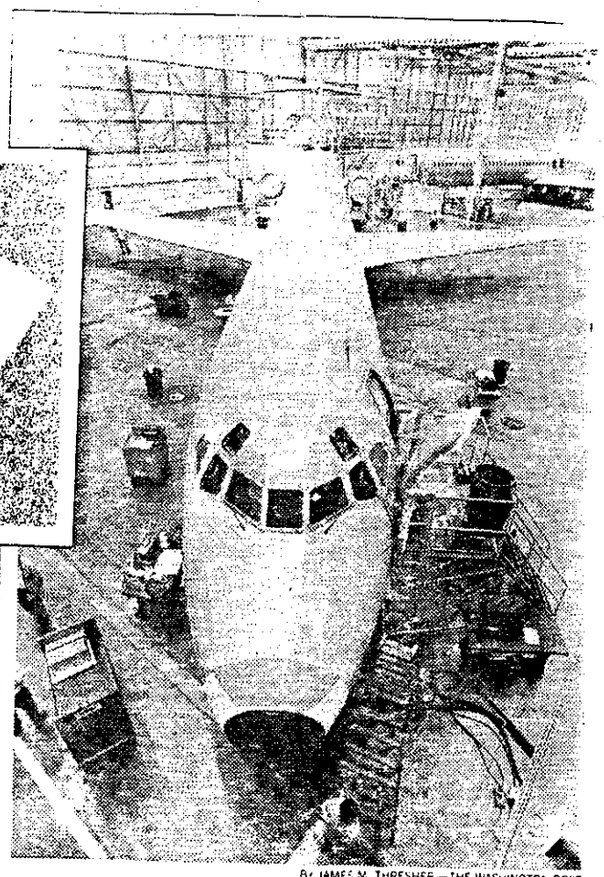
"In 10 years, if what I'm saying is correct," Cape says, "I bet we'll have hearings in Congress and a lot of American industrialists will bitch and moan about how the Japanese have done unfair things in trade. But that is not the case with biotechnology. The Japanese are doing the right thing."

NEXT: The role of education

RUDE AWAKENINGS



The United States may have lost the VCR revolution because industrial managers were unwilling to invest resources long enough to make a good idea pay off.

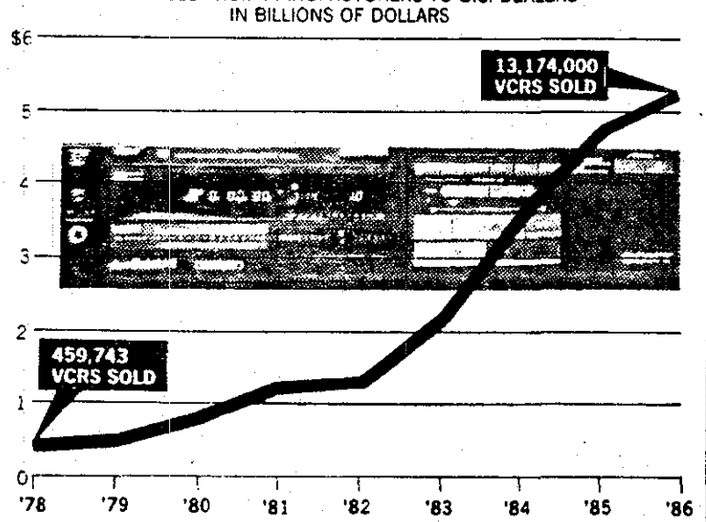


BY JAMES M. THRESHER—THE WASHINGTON POST

An MD80 jet nears completion at a McDonnell Douglas plant in Long Beach, Calif. Britain invented the jet engine, but U.S. imitators, including McDonnell Douglas, improved on the idea and reaped most of the economic benefits—doing to Britain what Japan now does to the United States.

MISSED OPPORTUNITY

VCR SALES FROM MANUFACTURERS TO U.S. DEALERS
IN BILLIONS OF DOLLARS

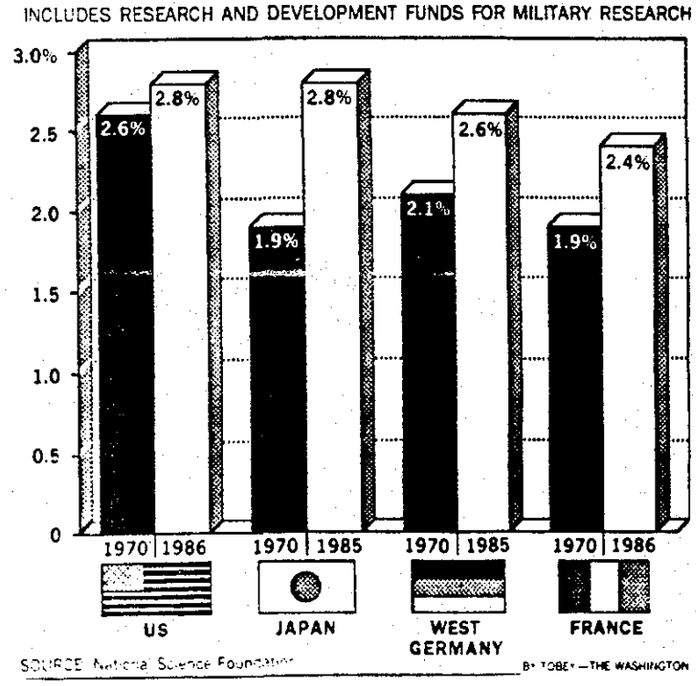


SOURCE Electronic Industries Association

BY JO ELLEN MURPHY—THE WASHINGTON POST

PERCENTAGE OF GNP SPENT ON RESEARCH AND DEVELOPMENT

INCLUDES RESEARCH AND DEVELOPMENT FUNDS FOR MILITARY RESEARCH



SOURCE National Science Foundation

BY TOBEY—THE WASHINGTON

Why We Need A Tough National Science Adviser

By Jerome B. Wiesner

FEW INSTITUTIONS of the Federal Government have had as rapid a rise to prominence and lapse into oblivion as the President's Science Advisory Committee (PSAC). Few institutions have been punished as thoroughly for doing a good job. And few institutions are needed more right now.

A flood of recent events and problems are directly traceable to the absence of a presidential advisory group: The Challenger disaster, the unproven and exaggerated claims about military inferiority and need for excessive amounts of new military technology and hardware, the exaggerated claims of Soviet cheating on arms agreements, the disregard by the responsible agencies of serious environmental and public-health problems and the loss of competitiveness of much of American industry.

Jerome Wiesner, science adviser to Presidents Kennedy and Johnson, is president emeritus of Massachusetts Institute of Technology.

It may be sheer coincidence but the disintegration of the U.S. space program, sliding from a position of world leadership to one of embarrassment, has paralleled the decline of presidential science advising. Last year American space scientists had to send their instruments on Soviet space probes to investigate Halley's Comet, and American companies wanting to launch communication satellites are looking to European companies for launchings.

Meanwhile, much of U.S. industry, both low and high tech, has gradually slipped out of competitive range of industries in other nations, most notably in price, but often in quality as well. And this turn of events has occurred despite U.S. research activities remaining among the world's best.

The demise of the President's Science Advisory Committee parallels a growing U.S. tendency to disregard inconvenient facts in arriving at decisions. This tendency is particularly strong on matters of defense. The fear of Soviet military might has long provided an excuse for exaggerating the threat in order to justify many unnecessary

See SCIENCE, D4, Col. 1

The Washington Post
Sunday, May 24, 1987

Military R&D Depletes Economic Might

By Frank R. Lichtenberg

The countries that lost World War II have been winning the battle for world markets in recent years. They have gained from not directing enormous amounts of capital to military uses.

Japan and West Germany are both experiencing substantial trade surpluses, in 1983 exporting 17% and 10% more, respectively, than they were importing. The U.S., the U.K. and France, which emerged victorious from the war, are now experiencing large trade deficits. In 1983 the U.K. and France exported about 10% less than they imported, while for the U.S. the deficit was an enormous 26%.

Differences among the industrialized nations with respect to trade performance probably are attributable to a variety of factors, but a potentially important, and perhaps not widely appreciated, factor is the difference in rates of investment in research and development.

Finding the True Share

An important determinant of the competitiveness of a country's products in international markets is the amount of R&D invested to develop and produce them. "Process" R&D enhances competitiveness by reducing cost, while "product" R&D does so by improving product quality and reliability. Now, the U.S. devotes almost exactly the same share—about 2.6%—of its gross national product to R&D investment as do Japan and Germany. (The U.K. and France have a somewhat lower R&D investment share, about 2.2%.) But a substantial fraction of the R&D investment of the U.S., the U.K. and France is military in orientation. According to official estimates, about 27% of U.S. and U.K. R&D investment, and 21% of French R&D investment, is military.

These estimates are based on the assumption that the government sponsors military R&D, which for the U.S., at least, is clearly false. Defense contractors devote a substantial fraction of their own R&D personnel and facilities to the preparation of technical proposals that are the basis on which the Pentagon awards competitive contracts for major weapons systems. The true share of (government plus private) military R&D in total U.S. R&D investment is probably about 35% to 40%. In contrast, less than 4% of Germany's, and 1% of Japan's, R&D investment is military. These low shares reflect the deliberate policy on the part of the victors of World War II that the reconstructed Japanese and German economies would exclude defense sectors. Military research and production would be the province of the wartime Allies.

Fewer than 1% of 8,000 patents produced by Navy-sponsored research and available for licensing are licensed; almost 13% of the Agriculture Department's patents are.

Military R&D no doubt enhances the competitiveness of U.S. military products: The U.S. (as well as the U.K. and France) is a net exporter of arms. But armaments represent a relatively small share of U.S. exports; perhaps 35% of its R&D investment is dedicated to products that account for only 5% of our exports.

Military R&D also may enhance, to some extent, the competitiveness of U.S. civilian products. The dominance of American producers in the world market for civilian aircraft, for example, is probably attributable in part to the technological advantage conferred on them by having performed government-sponsored research in military aviation. There is a question, though, of how extensive the civilian benefits, or "spinoffs," from military R&D generally are. Most of the military R&D budget is devoted to the advanced development of prototypes rather than to basic or even applied research, which are more likely to generate spinoffs. The atmosphere of secrecy in which much military R&D is conducted also tends to inhibit spinoffs.

Two pieces of evidence suggest that in most cases, few civilian benefits result from military R&D. First, companies performing defense R&D under contract for the government decline to exercise their right to claim title to about two-thirds of the innovations they produce. Second, fewer than 1% of the more than 8,000 patents produced by Navy-sponsored research and available for licensing are licensed; in contrast, almost 13% of the Agriculture Department's patents are licensed. These data are suggestive rather than conclusive; no one really knows how extensive the civilian spinoffs from military R&D generally are. But it is safe to say that a dollar spent on defense R&D does much less to enhance our international competitiveness than does a dollar spent on civilian R&D.

Because a country's total (civilian plus military) R&D investment, or its ratio to GNP, is not in any meaningful sense fixed, an increase in military R&D need not imply an equivalent reduction in civilian R&D. (The strong negative correlation across the five countries between military and civilian R&D expenditure—both divided by GNP—is, however, striking.) But increases in military R&D expenditure, particularly rapid increases such as those occurring in the U.S. earlier in this decade, tend, at least in the short run, to drive up the prices of scarce resources (such as scientists and engineers) required to perform both types of research. Starting salaries of engineers and technicians were increasing at an average annual rate of about 10% during the recent defense buildup; the rate of increase fell to about 3% after Congress and the administration agreed to end the buildup. The escalation in research costs presumably reduced real growth of civilian (if not of military) R&D investment.

Policy Implications

So we can posit that one factor contributing to the superior trade performance of Japan and Germany, relative to that of the U.S., the U.K. and France, is the former countries' significantly higher rate of civilian R&D investment relative to their GNPs. It is true that that these countries' relative rates of total (and civilian) R&D investment have remained fairly stable over time, whereas only recently have the trade performances of the U.S., the U.K. and France compared so unfavorably with those of the other two countries. But Japan and Germany began the postwar era at a substantial technological disadvantage. By maintaining a higher postwar rate of investment in civilian R&D than the countries that defeated them, they were able to reduce the gap and eventually to achieve technological parity or even superiority.

The policy implications of this analysis are clear. Advocates of large U.S. military R&D outlays argue that they are necessary to compete effectively with the Soviets. But how the U.S. fares in competition with the Soviet Union depends upon the relative economic strength of the two nations, as well as on their relative military strength. A high rate of military R&D spending perhaps contributes to our military strength, but it weakens our economy by reducing civilian R&D investment and thus our ability to compete in global markets.

Mr. Lichtenberg, an associate professor at the Columbia University Graduate School of Business, is affiliated with the National Bureau of Economic Research.

A Tough Science Adviser

SCIENCE, From D1

technical developments and military purchases. The same fear has been used to hide the damage being done to the U.S. science and technological enterprise by the Pentagon's control of employment for many technically trained persons and funding for much advanced research.

But 40 years of priorities tilted heavily towards the military, even taking into account the positive achievements, have brought U.S. civilian technology to its present position and ironically, have had the net effect of continuously increasing our real national danger.

Because of the dominance of federal funding, the ability of the United States to manage effectively the wide-ranging and complex issues raised by the rapid advance of technology rests on the government, and thus ultimately with the president. This situation has existed since the end of World War II. Before the war, science and technology were primarily private activities. Technological decisions were made by market forces and research decisions were dictated by intellectual curiosity.

Since the war, bureaucratic objectives and military profits have invaded a once benign scene. In addition, increased technical complexity and the imposition of military secrecy have shut out public understanding and participation from decision-making. Thus many technological choices—particularly the major ones—became the sole responsibility of the president.

It is my observation, based on personal experience with the scientific advisory apparatus used by four presidents, that scientific advisory groups always generate major anxieties among other groups in the government, as well as industrial firms looking for work.

Basically the question of who provides the advice boils down to a competition for control of presidential decisions. For a president, the task is to adjudicate the rivalries among many contenders who join together only to confront him. The challenge is to retain control of his information sources and thus his freedom of decision.

I watched at close range the game played by the Pentagon against all four presidents; for example, practically the only times the members of the Joint Chiefs agreed was when they were attempting to persuade the secretary of defense or the president to accept their proposals. Otherwise, in their advisory capacity, one could always predict their position on any subject by identifying the vested interest of their individual service. And because so many of the dominant issues of our times involved military technology, the perceived need for secrecy has been added to the obvious barrier of technical complexity.

President Truman faced the question of technical decision-making as soon as World War II ended. Troubled by inter-service battling over which of them should have the responsibility for the many new technologies that were evolving, and especially by the continuing controversies about nuclear weapons, Truman commissioned a study of how to get himself better information and advice. He persuaded William Golden, a prominent lawyer who had had considerable experience with the wartime Navy Department's research and development efforts to study the problem and make recommendations about what to do. In the fall of 1950, Golden filed a report that proposed a full-time scientific adviser to the president, to be assisted by a scientific advisory committee of highly qualified scientists. The opponents of Golden's plan succeeded in weakening it. The new committee, established in 1951 by Truman, was placed under the director of the Office of Defense Mobilization instead of reporting directly to the president.

It took the shock of the Soviet Sputnik in 1957 to realize the Golden proposals. Eisenhower was upset by how little he had been told about the difficulties of the American satellite, Vanguard.

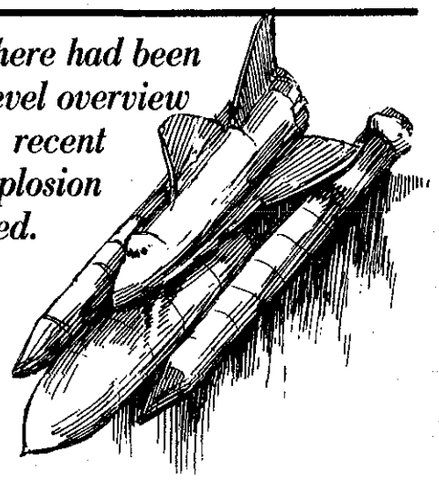
His solution, used soon after the launching of Sputnik in the fall of 1957, was to appoint Dr. James Killian as his special asssitant for science and technology and move the aavisory committee into the Executive Office of the President, where it could provide him with independent evaluation of the government's many scientific programs. Its members quickly developed a close rapport with the president, who turned to it frequently for help. President Eisenhower provided Killian with a letter of appointment spelling out, in great detail, his responsibilities and giving him wide-ranging authority. When George Kistiakowsky replaced Killian in 1960, he followed the operating procedure established by Killian.

When I became science adviser to President Kennedy in 1961, he used this same letter to define my responsibilities. This essentially gave me total oversight of all science and technology programs in the government and in related education programs.

In the Eisenhower-Kennedy period, a major role of PSAC and the president's special assistant for science and technology was to screen the avalanche of military and space projects confronting the president and attempt to provide sufficiency within a manageable budget. Such a task can be done only by a technically competent group totally without vested interest.

In 1958, as Eisenhower became increasingly dedicated to halting the arms race, he asked the Science Advisory Committee to help him. I vividly recall the drama of the moment. Referring to the 1957 Gaither Panel's report on the consequences of nuclear war, he pounded his desk and said, "You can't have that war. There aren't enough bulldozers in the country to scrape the bodies off the streets. Why don't you help me prevent it? Neither the Defense Departmentnor AEC will give me any help. They have other interests."

I am convinced that if there had been adequate presidential-level overview of technical programs in recent times, the Challenger explosion would not have happened.



With this challenge, many of us on the PSAC turned our attention to the technical questions of the test ban and other disarmament efforts. The PSAC was the President's main source of technical information on arms-control and also, which was important to its ultimate fate, the target of the weapons advocates' wrath, a situtation that continued as long as PSAC survived.

Without planning to do so, PSAC also became the ombudsman for federal science and technology programs. The staff became a group to whom workers on government programs, aware of faulty designs, poor manufacturing, inadequate perfomance, unnecessary programs, or other problems could appeal when their concerns were ignored within their own organization. Scientists and engineers realized that the PSAC staff provided a channel that they could use with the confidence that they were not risking the traditional fate of the whistle-blower. We made no effort to encourage this channel, but neither did we discourage it. Robert McNamara once asked me how it was that the few people in my office knew much more about Department of Defense R&D and procurement difficulties than he did with his large staff.

I said earlier that I am convinced that if there had been adequate presidential-level overview of technical programs in recent times, the Challenger explosion would not have happened.

Although the immediate cause of the Challenger disaster was the explosion of a solid-fueled rocket, the real reason for the failure was that President Reagan did not have his own technical-review team. All of the groups involved were under extreme pressure to maintain a launch schedule at all costs. They ignored numerous warning signals. In technical jargon, the president had no feedback. He received no independent information or advice to help him judge Challenger or any other technical program for which he was responsible, or for that matter the soundness or need for any of the proposed new programs that flow into the White House continuously, such as most notably, the Strategic Defense Initiative.

Reagan did not create this situation; he inherited it. It was President Nixon who abolished the Science Advisory Committee and the post of Special Assistant to the President for Science and Technology. He got rid of them because he did not like the advice that they were providing on issues ranging from the controversial anti-ballistic-missle system and the proposed supersonic transport aircraft to the performance of military equipment in Vietnam. Their evaluatons were negative, while he was getting more optimistic information from other sources. He finally abolished PSAC and the post of science adviser after a few frustrated members of PSAC—wrongly, I believe—publicly opposed the ABM and supersonic transport. In doing this, they violated the long-standing and proud tradition of confidentiality of the Science Advisory Committee.

Nixon did not want to hear the facts. In a sense, he chose to kill the messenger. In later years Presidents Ford and Carter made arrangements to get their own assistance on technical questions. Ford faced an anti-PSAC bias that lingered on after Nixon and so never was able to create an adequate advisory system. Carter appointed a special assistant for science but didn't reestablish a Presidential Science Advisory Committee with anything like the extensive capabilities of the original committee.

Reagan's operating style dictates altogether different ways of making technical decisions. He uses the buddy system, which in the end, proved disastrous. Reagan has made no effort to get independent advice about technical questions such as the shuttle, or SDI, perhaps because he did not know that he needed it. He trusted the advocates who had surrounded him during his campaign for the presidency, and he heeded their advice.

It is true that a number of very good scientists refused Reagan's offer of appointment to the position of science adviser when they learned about the limited role they were going to have, and especially that their information and advice would flow to the president mainly through his chief of staff; that in fact they were being asked to be an adviser to a presidential aide. They might have made a difference. George Keyworth accepted the position despite the limitations and thus served the president and the country poorly.

What can be done to reverse the decline in the U.S. technological well-being? We are faced with two separate challenges. First, the president must resume control of the federal scientific enterprise. He must take back control and oversight of these vast resources from the military/industrial complex. Second, we must simultaneously revitalize the civilian science and technology enterprise, all of it—education, basic research and civilian application of technology. We should buy only the few military systems needed to insure national security and direct the rest of our vast technical resources to rebuilding the nation's civilian industrial base.

An essential part of this task is to build the presidential science advisory mechanism back up in a way that would regain the confidence of the Congress and general public in the government's decision-making process. This will not be easy, given the recent history. But it must be done.

THE WALL STREET JOURNAL THURSDAY, AUGUST 21, 1986

Military R&D Depletes Economic Might

By Frank R. Lichtenberg

The countries that lost World War II have been winning the battle for world markets in recent years. They have gained from not directing enormous amounts of capital to military uses.

Japan and West Germany are both experiencing substantial trade surpluses, in 1983 exporting 17% and 10% more, respectively, than they were importing. The U.S., the U.K. and France, which emerged victorious from the war, are now experiencing large trade deficits. In 1983 the U.K. and France exported about 10% less than they imported, while for the U.S. the deficit was an enormous 26%.

Differences among the industrialized nations with respect to trade performance probably are attributable to a variety of factors, but a potentially important, and perhaps not widely appreciated, factor is the difference in rates of investment in research and development.

Finding the True Share

An important determinant of the competitiveness of a country's products in international markets is the amount of R&D invested to develop and produce them. "Process" R&D enhances competitiveness by reducing cost, while "product" R&D does so by improving product quality and reliability. Now, the U.S. devotes almost exactly the same share—about 2.6%—of its gross national product to R&D investment as do Japan and Germany. (The U.K. and France have a somewhat lower R&D investment share, about 2.2%.) But a substantial fraction of the R&D investment of the U.S., the U.K. and France is military in orientation. According to official estimates, about 27% of U.S. and U.K. R&D investment, and 21% of French R&D investment, is military.

These estimates are based on the assumption that the government sponsors military R&D, which for the U.S., at least, is clearly false. Defense contractors devote a substantial fraction of their own R&D personnel and facilities to the preparation of technical proposals that are the basis on which the Pentagon awards competitive contracts for major weapons systems. The true share of (government plus private) military R&D in total U.S. R&D investment is probably about 35% to 40%. In contrast, less than 4% of Germany's, and 1% of Japan's, R&D investment is military. These low shares reflect the deliberate policy on the part of the victors of World War II that the reconstructed Japanese and German economies would exclude defense sectors. Military research and production would be the province of the wartime Allies.

Fewer than 1% of 8,000 patents produced by Navy-sponsored research and available for licensing are licensed; almost 13% of the Agriculture Department's patents are.

Military R&D no doubt enhances the competitiveness of U.S. military products: The U.S. (as well as the U.K. and France) is a net exporter of arms. But armaments represent a relatively small share of U.S. exports; perhaps 35% of its R&D investment is dedicated to products that account for only 5% of our exports.

Military R&D also may enhance, to some extent, the competitiveness of U.S. civilian products. The dominance of American producers in the world market for civilian aircraft, for example, is probably attributable in part to the technological advantage conferred on them by having performed government-sponsored research in military aviation. There is a question, though, of how extensive the civilian benefits, or "spinoffs," from military R&D generally are. Most of the military R&D budget is devoted to the advanced development of prototypes rather than to basic or even applied research, which are more likely to generate spinoffs. The atmosphere of secrecy in which much military R&D is conducted also tends to inhibit spinoffs.

Two pieces of evidence suggest that in most cases, few civilian benefits result from military R&D. First, companies performing defense R&D under contract for the government decline to exercise their right to claim title to about two-thirds of the innovations they produce. Second, fewer than 1% of the more than 8,000 patents produced by Navy-sponsored research and available for licensing are licensed; in contrast, almost 13% of the Agriculture Department's patents are licensed. These data are suggestive rather than conclusive; no one really knows how extensive the civilian spinoffs from military R&D generally are. But it is safe to say that a dollar spent on defense R&D does much less to enhance our international competitiveness than does a dollar spent on civilian R&D.

Because a country's total (civilian plus military) R&D investment, or its ratio to GNP, is not in any meaningful sense fixed, an increase in military R&D need not imply an equivalent reduction in civilian R&D. (The strong negative correlation across the five countries between military and civilian R&D expenditure—both divided by GNP—is, however, striking.) But increases in military R&D expenditure, particularly rapid increases such as those occurring in the U.S. earlier in this decade, tend, at least in the short run, to drive up the prices of scarce resources (such as scientists and engineers) required to perform both types of research. Starting salaries of engineers and technicians were increasing at an average annual rate of about 10% during the recent defense buildup; the rate of increase fell to about 3% after Congress and the administration agreed to end the buildup. The escalation in research costs presumably reduced real growth of civilian (if not of military) R&D investment.

Policy Implications

So we can posit that one factor contributing to the superior trade performance of Japan and Germany, relative to that of the U.S., the U.K. and France, is the former countries' significantly higher rate of civilian R&D investment relative to their GNPs. It is true that that these countries' relative rates of total (and civilian) R&D investment have remained fairly stable over time, whereas only recently have the trade performances of the U.S., the U.K. and France compared so unfavorably with those of the other two countries. But Japan and Germany began the postwar era at a substantial technological disadvantage. By maintaining a higher postwar rate of investment in civilian R&D than the countries that defeated them, they were able to reduce the gap and eventually to achieve technological parity or even superiority.

The policy implications of this analysis are clear. Advocates of large U.S. military R&D outlays argue that they are necessary to compete effectively with the Soviets. But how the U.S. fares in competition with the Soviet Union depends upon the relative economic strength of the two nations, as well as on their relative military strength. A high rate of military R&D spending perhaps contributes to our military strength, but it weakens our economy by reducing civilian R&D investment and thus our ability to compete in global markets.

Mr. Lichtenberg, an associate professor at the Columbia University Graduate School of Business, is affiliated with the National Bureau of Economic Research.

Defense Research Aids U.S. Industry

Scientific Spinoffs From Federal Laboratories Find Wide Usage

By Sue Major Holmes
Associated Press

ALBUQUERQUE—When drill bits chew through layers of hard rock seeking oil, it's a punishing procedure that becomes more expensive as the rock loosens the diamonds on the bit and eventually causes them to drop off.

But now there is a new type of bond to keep the diamonds on.

Similarly, insulated tubing can carry steam down a bored well to loosen hard-to-get oil deposits, but the benefits of the insulation are nearly lost because heat escapes through the uninsulated couplings.

Now there is an inexpensive way to insulate the couplings.

These, according to Glenn Kuswa of Sandia National Laboratories here, are just two examples of the hundreds of instances of technology being transferred from the government laboratories to business.

In the past few years, innovations increasingly have been moved from the federal laboratories where they were engineered to the private sector where they could be developed and marketed.

A large share of the nation's research funds have been invested in the laboratories, and Congress and the public are demanding more from their dollars, Kuswa said. While much of the money goes into weapons, even defense science can be spun off into other areas, he said.

And technology transfer benefits the government, as well.

"In working with industry, there's a lot of passing back of information that is very valuable," he said. "We may develop information; they may make improvements."

In 1980, Congress passed the Stevenson-Wydler Act, which promotes private sector use of federally developed technology.

The national laboratories have some advantages in developing technology, Kuswa said. Government research and development can take on projects that involve expense and high risk over a long time or can do research that smaller business cannot afford, he said.

The laboratories have built up "a technical base that's second to none," Kuswa said. "Academically oriented people work in a field their whole careers without dislocation. Only large industry can afford similar research labs."

But, he said, developments from the national laboratories have to get out to industry before they can help the nation's economy.

Sandia and one of its lab employees, Richard Braash, received the American Wind Energy Association's technology transfer award in 1984 for a verticle-axis wind turbine that is manufactured by several U.S. companies. The same year, Industrial Research magazine cited a corrosion-resistant glass that Sandia developed to extend the life of batteries for weapons. The glass is being used commercially to add to the life of special-use batteries, such as those in heart pacemakers.

Sandia also took computer microchips designed by industry, developed ways to harden, or shield, those chips from radiation, then turned that technology back to companies to market, Kuswa said.

He emphasized that Sandia exists to work on national defense, and innovations or aid to industry are made in that context.

"For example, Sandia does not do any biology, but that doesn't mean we couldn't help in biology," he said.

He pointed out that so-called "smart weapons" are programmed to detect a target and hone in only on that target—image recognition computer technology that someday might help biologists in spotting certain chromosomes he said.

And the scientists who design the weapons must use extremely accurate mathematical calculations. The algorithms, or repetitive calculations, developed from that work have been turned over to industry, providing speed and accuracy not possible with traditional math tables of values, Kuswa said.

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Inman Quitting Top Position at High-Tech Firm

WPost 9/5

By Michael Schrage
Washington Post Staff Writer

Retired admiral Bobby Ray Inman, a former National Security Agency director and CIA deputy director, is resigning as chief of Microelectronics and Computer Technology Corp., the Texas-based high-technology consortium formed in response to Japan's advanced computer successes.

Inman, 55, who recently served on a government commission examining the security of U.S. embassies, chose not to renew his contract and said he will leave after four years as head of the 21-company consortium exploring new computer designs and semiconductor technologies.

Inman announced his resignation at MCC's board meeting in Austin, Tex., Wednesday.

"It came as a surprise to all of us," said Samuel H. Fuller, Digital Equipment Corp.'s representative on the board. "My reaction is that he did an outstanding and unique job moving MCC from dream to reality."

Inman, recruited as MCC's first chief executive officer in 1983 after leaving the CIA, used his high Washington profile to lobby against antitrust rules that had prevented companies such as Advanced Micro Devices, RCA Corp. and Control Data Corp. from performing joint research.

Fuller and other MCC board members reported that Inman said he had no firm plans. Inman was unavailable for comment.

In a statement, he said he is concerned about the speed at which U.S. companies apply technology and that future activities are likely to "center around this very critical element in the U.S. ability to compete in the international marketplace."

Changing Role of Federal Labs

Inhibitions limiting use of federal laboratories by industry disappearing; collaboration increasing

BY H. DANA MORAN*

About one-sixth of all national research and development in the United States is conducted in Federal laboratories. Federal laboratories account for a significant fraction of America's science and technology enterprise. Yet, historically only a small proportion of the new technology developed in these laboratories has been brought to the private sector. The reasons have been many: classification of information; apprehension of dealing with the United States Government; controls on access to publicly-owned inventions; delays in publications; lack of publicity. But whatever the reasons, national laboratories have represented a substantially underutilized resource for private industry.

Recent developments in Congress, the administration, and in the federal agencies are changing this picture. Beginning in 1980, Congress initiated a series of changes in patent law and in policies governing the management of intellectual properties resulting from publicly-funded research and development. The present administration has endorsed and supported these changes. Federal agencies have implemented them, resulting in significantly improved access by private industry and a forthright commitment to facilitate commercialization of developments emerging from the laboratories.

As executives responsible for the acquisition and disposition of rights in new technologies, these developments can be important to you and your companies. I'll discuss the significant actions which have brought about this enlightened environment for technology transfer and highlight some results.

FEDERAL LABORATORIES

First, let me define my terms. By "federal laboratories" I mean those institutions chartered by U.S. government agencies to conduct research, development, testing and related activities. The Government Accounting Office has identified 755 such facilities, ranging in size from 8,000 employees to less than five staff members. Of those, 388 have a specific and continuing research mission. These laboratories account for about one-third of the federal research and development budget — $20 billion in 1986. Most are government-owned and government-operated facilities — GOCO's in bureaucratic jargon. Fourteen agencies support these laboratories (Table 1).

FEDERAL LABORATORIES BY AGENCY

Agency	Number of Labs	Total* Staff	Average Lab. Staff
DOD	92	89016	968
DOE	39	64544	1655
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DOI	24	13482	562
HHS	21	8540	407
USDA	67	7786	116
DOC	36	5077	141
DOT	7	2625	375
NSF	6	1641	274
EPA	14	1565	112
TVA	4	1404	351
VA	60	600+	10+
DOJ	1	429	429
Smithsonian	6	291	48
	388	221,885	572

*Estimate

Table 1

An important class of federal laboratory is the FFRDC — Federally-Funded Research and Development Centers. These are contractor-owned/contractor-operated or government-owned/contractor-operated (GOCO) facilities supporting the missions of federal agencies through conduct of basic research, applied research and/or development. The Office of Management and Budget has defined 34 such FFRDC's, sponsored by the Department of Energy, Defense, Health and Human Services, and by the National Aeronautics and Space Administration, and the National Science Foundation. (See Table 2). Funding for these 34 laboratories exceeds $4 billion a year.

Twenty of these laboratories are operated for the Department of Energy; all are GOCO's. In size—and in funding— these DOE laboratories are substantially the largest. Combined, the DOE laboratories file an average of 400 patent applications each year. Federal laboratories, collectively, employ 200,000 scientists and engineers. Thus, by all measures, the Federal Laboratories are a major national research and development resource.[1]

TRADITIONAL POLICIES

Most federal laboratories were created to pursue developments for the purposes of government: defense, public health, regulation, and the use of public resources. Their focus was not on technology for the private sector and when commercial applications occurred, they were

Manager, Industry Affairs, Solar Research Institute, Golden, CO; paper presented at LES U.S.A./Canada Annual Meeting, October 1985.

among laboratories but has not been strong traditionally. National interest demands that this collaboration be stronger to ensure continued advances in scientific knowledge and its translation into useful technology."

The panel specifically urged improved access to the facilities of the laboratories by universities and industry, greatly increased R&D interactions and collaborations with industry, and simplified contracting procedures. In its "bottom line," the panel stated, "The federal laboratories must be more responsive to national needs."

The administration, through OSTP and OMB, directed the agencies to respond to the Packard Panel's recommendations. While that response has varied,[3] in general the agencies have adopted these proposals and are making a sincere effort to both improve the management and productivity of the laboratories.

PUBLIC LAW 98-620

The experienced of the first two years under P.L. 96-517 demonstrated to Congress and the administration the value of liberalized rights to intellectual properties and allayed some reservations with regard to possible misuse of such rights.

The benefits led President Reagan, by Executive order on February 18, 1983, to expand the scope of P.L. 96-517, to authorize all contractors to receive invention rights derived from federally-funded research. However, implementation of this Executive Order was limited, both by bureaucratic inertia in some agencies, and by the fact that more than 20 patent statutes and provisions governed the patent policies of different agencies.

In 1982, Senator Schmitt reintroduced his proposed "Uniform Science and Technology Research and Development Utilization Act" as S.1657. A companion bill, H.R. 4564 was introduced in the House by Congressman Ertel. During the remainder of the 97th Congress, these bills went through a variety of committee reviews and hearings. Although the sympathy of Congress seemed clearly with the intent of the legislation, the progress was slow.

With minimal changes, these bills, under the same title, were reintroduced in the 98th Congress by Senator Dole (S.2171) and Congressman Fuqua (H.R. 5003). With further evidence demonstrating the value of P.L. 96-517, and support from the administration, the bills were favorably reported out of committees. In the end, however, they were incorporated in a larger Bill, as Title V of the "Trademark Clarification Act of 1984," which became P.L. 98-620. In doing so, Congress narrowed the scope, setting aside the general conveyance of rights to all contractors, but extending to nonprofit government-owned/contractor-operated federal laboratories the rights granted under P.L. 96-517. This most notably affects most of the 39 laboratories chartered by the Department of Energy, including 16 of the FFRDCs listed above. Under 98-620, the rights to inventions, if retained by the laboratory, may be licensed by that laboratory. Royalty income, up to a specified limit, may be retained by the laboratory to support further R&D, and to provide invention awards to staff members.

P.L. 98-620 has significant implications for industry. Access to new technologies developed in the contractor-operated laboratories will be more readily available. The laboratories may convey exclusive rights, and may enter into license agreements which provide for shared rights in future developments. The laboratories can cooperate in such further developments, providing access to facilities and staff as appropriate. Several hundred new inventions will be available for license each year, and, with approval of the sponsoring agency, such access through the laboratory may be retroactive, including patents applied for in previous years.

It should be noted that the implementation of policies such as this depend on the issuance of "implementing regulations." The Department of Commerce was assigned the task of preparing those regulations. Draft regulations were published in April 1985, with comments due by June 3. Such comments have been compiled, and it is expected that the implementing regulations will be issued soon.

FURTHER DEVELOPMENTS

The saga of legislative development with respect to the federal laboratories does not end here. Congress presently has under consideration additional proposals for relaxing federal controls over inventions made with government funding. Senator dole has introduced two bills, S. 64, the "Uniform Patent Procedures Act of 1985," and S. 65, the "Federal Laboratory Technology Utilization Act of 1985." S. 64 would complete the initiatives of P.L. 98-517 and P.L. 98-620, extending to *all* contractors, regardless of size or profit status, primary rights in inventions made under government contract. In effect, S. 64 would formalize the provisions of the Executive Order of February 1983.

Senate bill S. 65 — the companion bill is HR 695 (Congressman Michel) — would complete the process by applying the principles of P.L. 98-620 to the government-operated laboratories (GOGOs). If approved, this legislation will permit government-operated laboratories to retain rights in inventions, enter into agreements with industry for cooperative R&D, negotiate and issue patent licenses, and reward staff inventors with at least 15% of any ensuing royalties.

It is the royalty provision, which has made these proposals controversial. Industry views the plan to reward government employee inventors as a possible threat, because it could encourage legislation requiring similar compensation to private inventors. There is also expressed concern that commercial interests could distract government employees from their primary missions.

A similar bill in the House, H.R. 1572, is sponsored by five members of the subcommittee on Science and Technology. It adds provisions establishing the Federal Laboratory Consortium as a responsibility of the National Science Foundation. A separate bill, updating the Stevenson-Wydler Act and containing similar conditions formalizing the FLC, is expected to be introduced by Congressman Lundine.

In this context, two other pieces of recent legislation should be mentioned; Public Law 98-525, the "Defense Authorization Act of 1985," and Public Law 98-577, the Small Business and Federal Procurement Competition Act of 1984. Both contain provisions with regard to contractor rights to "technical data," which is defined as including computer software. Since computer software is a licensable product, those rights can be valuable assets in technology transfer. For a more complete discussion of the implications of these new laws, I refer to an article by

SUMMARY

Federal laboratories play a major role in the national research and development program; they are a vast resource of new technology which can lead to improved — and profitable — products, processes and services for industry. But a variety of institutional inhibitions have limited the use of this resource by industry. That picture is changing, rapidly. Congress is providing the legislative tools, the administration is providing the policies, and the agencies are providing the processes, to allow and encourage industry to work in close harmony with the federal laboratories. The laboratories now can meet with industry on common turf, sharing their skills, facilities and intellectual developments with industry partners.

These developments have created a whole new ballgame in the "government-industry partnership." Technology transfer is not only the name of the game; it also is the prize for the players.

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Center For the Utilization of Federal Technology
5285 Port Royal Road
Springfield, Virginia 22161

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Changing Role of Federal Labs

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The administration, through OSTP and OMB, directed the agencies to respond to the Packard Panel's recommendations. While that response has varied,[3] in general the agencies have adopted these proposals and are making a sincere effort to both improve the management and productivity of the laboratories.

PUBLIC LAW 98-620

The experienced of the first two years under P.L. 96-517 demonstrated to Congress and the administration the value of liberalized rights to intellectual properties and allayed some reservations with regard to possible misuse of such rights.

The benefits led President Reagan, by Executive order on February 18, 1983, to expand the scope of P.L. 96-517, to authorize all contractors to receive invention rights derived from federally-funded research. However, implementation of this Executive Order was limited, both by bureaucratic inertia in some agencies, and by the fact that more than 20 patent statutes and provisions governed the patent policies of different agencies.

In 1982, Senator Schmitt reintroduced his proposed "Uniform Science and Technology Research and Development Utilization Act" as S.1657. A companion bill, H.R. 4564 was introduced in the House by Congressman Ertel. During the remainder of the 97th Congress, these bills went through a variety of committee reviews and hearings. Although the sympathy of Congress seemed clearly with the intent of the legislation, the progress was slow.

With minimal changes, these bills, under the same title, were reintroduced in the 98th Congress by Senator Dole (S.2171) and Congressman Fuqua (H.R. 5003). With further evidence demonstrating the value of P.L. 96-517, and support from the administration, the bills were favorably reported out of committees. In the end, however, they were incorporated in a larger Bill, as Title V of the "Trademark Clarification Act of 1984," which became P.L. 98-620. In doing so, Congress narrowed the scope, setting aside the general conveyance of rights to all contractors, but extending to nonprofit government-owned/contractor-operated federal laboratories the rights granted under P.L. 96-517. This most notably affects most of the 39 laboratories chartered by the Department of Energy, including 16 of the FFRDCs listed above. Under 98-620, the rights to inventions, if retained by the laboratory, may be licensed by that laboratory. Royalty income, up to a specified limit, may be retained by the laboratory to support further R&D, and to provide invention awards to staff members.

P.L. 98-620 has significant implications for industry. Access to new technologies developed in the contractor-operated laboratories will be more readily available. The laboratories may convey exclusive rights, and may enter into license agreements which provide for shared rights in future developments. The laboratories can cooperate in such further developments, providing access to facilities and staff as appropriate. Several hundred new inventions will be available for license each year, and, with approval of the sponsoring agency, such access through the laboratory may be retroactive, including patents applied for in previous years.

It should be noted that the implementation of policies such as this depend on the issuance of "implementing regulations." The Department of Commerce was assigned the task of preparing those regulations. Draft regulations were published in April 1985, with comments due by June 3. Such comments have been compiled, and it is expected that the implementing regulations will be issued soon.

FURTHER DEVELOPMENTS

The saga of legislative development with respect to the federal laboratories does not end here. Congress presently has under consideration additional proposals for relaxing federal controls over inventions made with government funding. Senator dole has introduced two bills, S. 64, the "Uniform Patent Procedures Act of 1985," and S. 65, the "Federal Laboratory Technology Utilization Act of 1985." S. 64 would complete the initiatives of P.L. 98-517 and P.L. 98-620, extending to *all* contractors, regardless of size or profit status, primary rights in inventions made under government contract. In effect, S. 64 would formalize the provisions of the Executive Order of February 1983.

Senate bill S. 65 — the companion bill is HR 695 (Congressman Michel) — would complete the process by applying the principles of P.L. 98-620 to the government-operated laboratories (GOGOs). If approved, this legislation will permit government-operated laboratories to retain rights in inventions, enter into agreements with industry for cooperative R&D, negotiate and issue patent licenses, and reward staff inventors with at least 15% of any ensuing royalties.

It is the royalty provision, which has made these proposals controversial. Industry views the plan to reward government employee inventors as a possible threat, because it could encourage legislation requiring similar compensation to private inventors. There is also expressed concern that commercial interests could distract government employees from their primary missions.

A similar bill in the House, H.R. 1572, is sponsored by five members of the subcommittee on Science and Technology. It adds provisions establishing the Federal Laboratory Consortium as a responsibility of the National Science Foundation. A separate bill, updating the Stevenson-Wydler Act and containing similar conditions formalizing the FLC, is expected to be introduced by Congressman Lundine.

In this context, two other pieces of recent legislation should be mentioned; Public Law 98-525, the "Defense Authorization Act of 1985," and Public Law 98-577, the Small Business and Federal Procurement Competition Act of 1984. Both contain provisions with regard to contractor rights to "technical data," which is defined as including computer software. Since computer software is a licensable product, those rights can be valuable assets in technology transfer. For a more complete discussion of the implications of these new laws, I refer to an article by

SUMMARY

Federal laboratories play a major role in the national research and development program; they are a vast resource of new technology which can lead to improved — and profitable — products, processes and services for industry. But a variety of institutional inhibitions have limited the use of this resource by industry. That picture is changing, rapidly. Congress is providing the legislative tools, the administration is providing the policies, and the agencies are providing the processes, to allow and encourage industry to work in close harmony with the federal laboratories. The laboratories now can meet with industry on common turf, sharing their skills, facilities and intellectual developments with industry partners.

These developments have created a whole new ballgame in the "government-industry partnership." Technology transfer is not only the name of the game; it also is the prize for the players.

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CAN ROGER SMITH CHANGE GENERAL MOTORS' CULTURE? PAGE 84

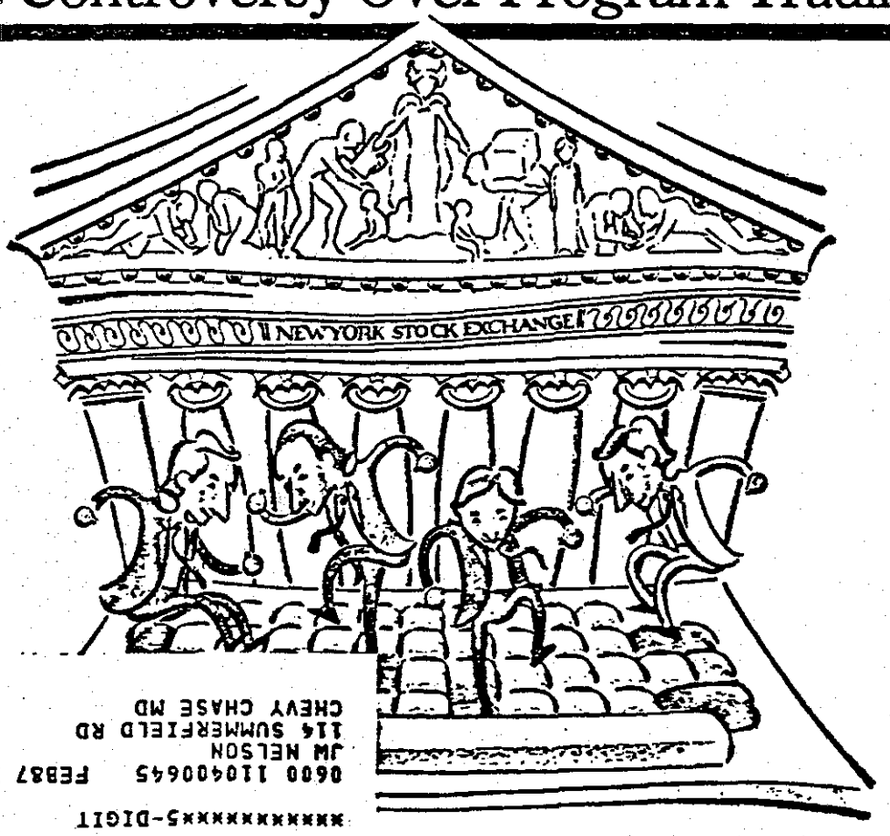
BANKS' HOW POWER IS SHIFTING PAGE 56

BusinessWeek

APRIL 7, 1986 A McGRAW-HILL PUBLICATION $2.00

THOSE BIG SWINGS ON WALL ST.

The Controversy Over Program Trading PAGE 32



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JW NELSON
114 SUMMERFIELD RD
CHEVY CHASE MD 20815

AMERICA CAN BEAT ANYONE IN HIGH TECH. JUST ASK BRUCE MERRIFIELD

BUT THE COMMERCE DEPT. CRUSADER FOR A NEW ERA OF R&D MAY SOON BE OUT OF A JOB



MERRIFIELD'S BRASH EFFORTS TO AID THE HIGH-TECH INDUSTRY ALIENATED THE REAGANITES

"If you believe in astrology, Geminis are manipulative, pretty damn clever, and very success-oriented," observes a Commerce Dept. official. D. Bruce Merrifield is a Gemini, and those characteristics contributed mightly to his success as the Reagan Administration's most effective advocate of U.S. technological competitiveness. As Assistant Commerce Secretary for productivity, technology, and innovation during the past four years, Merrifield led the fight to modify antitrust law to permit cooperative research among competing companies, stimulate the growth of research and development limited partnerships, and launch discussions with 38 countries on cooperative agreements for developing technology.

So why has the Administration marked his office for extinction next year? The official answer is that it has accomplished what it was set up to do. Insiders see it differently. They say Merrifield has been so manipulative, clever, and successful that he made enemies in his own department, at the White House science policy office, and—most important—in the Office of Management & Budget. Merrifield, says one industry research director, "never learned to live in the Washington climate; he didn't smooth the feathers he needed to."

Yet Merrifield's zeal has made him a hit on Wall Street and a hero to CEOs of both major corporations and tiny, high-tech startups. "He has a real vision, you know," says one colleague. "He's really sort of the prophet of high technology." Indeed, 64-year-old Merrifield preaches his sermon to all who will listen and to some who would rather not. "There is no excuse for us to lose the leading edge in technology," he says. "The U.S. can outrun anybody, any place, any time if we just get our act together." All that's needed, he believes, is to tap the innovative technology created by startups and remove roadblocks to intercompany cooperation on important R&D projects.

The chance to help the U.S. do just that induced Merrifield in 1982 to leave Continental Group, where he was vice-president for technology and venture management, and resign as president-elect of the Industrial Research Institute, a group of corporate-research managers. He took charge of a tiny corner of the Commerce Dept. known as the Office of Productivity, Technology & Innovation (OPTI), with only two dozen employees and a budget of about $2 million.

Although Merrifield holds master's and doctoral degrees in physical organic chemistry from the University of Chicago, his message is laced with economics. He insists that while many of the top industrial corporations are "going down the tubes," thousands of high-tech start-ups are ready to take up the slack. "The climate for entrepreneurship and productivity is bringing about a total restructuring of the economy," he says.

The problem, according to Merrifield, is that this growth is "pretty much invisible." Even though the U.S. is creating almost 700,000 new companies a year, 80% of them go unnoticed because the Census Bureau does not count companies with fewer than 20 employees. Merrifield also argues that the OMB's Standard Industrial Classification codes are hopelessly outmoded. "Silicon chips and computer software are listed in a category of stone, glass, and clay, and there is no code for biotechnology," he says. "The bureaucrats are turning a crank that's 30 years old."

A TRICK OR TWO. Cracks like that have earned Merrifield few friends in the warrens of Washington. Moreover, his proposed solutions sound suspiciously like "industrial policy" to Reaganites opposed to government intervention in the marketplace. Even so, he has won some important battles. The most significant: He engineered changes in U.S. antitrust laws to allow rival companies faced with foreign competition to undertake joint R&D projects. "Everyone thought I was crazy," Merrifield says.

That victory required more than a year of battling to convince William F. Baxter, then head of the Justice Dept.'s antitrust division, that change was needed. Merrifield was not above a trick or two to get the job done. He once planted retired Admiral Bobby R. Inman, who heads a research consortium of major electronics and computer companies called Microelectronics & Computer Technology Corp. (MCC), in the audience during a Baxter speech. When Baxter commented that it was only a perception that antitrust law was a barrier to such research co-ops, Inman "jumped up and

said, 'When are you stupid people going to get your heads screwed on right?' " Merrifield recalls. "For the first time, Baxter admitted there might be something to what I had been saying."

Merrifield's next stop was Capitol Hill, where House Judiciary Committee Chairman Peter W. Rodino Jr. (D-N.J.) said he was not interested in altering antitrust law. So, says Merrifield, "I cited six horrendous cases of Justice Dept. intervention in attempts to do cooperative research." And when Senator Howard M. Metzenbaum (D-Ohio) threatened a filibuster, Merrifield got 77 senators to co-sponsor the bill and made impassioned speeches in Cleveland and Akron. That, says Merrifield, caused the senator to change his mind.

'ZEROED OUT' Whether Merrifield has embellished his account or not (Metzenbaum's office disputes his version), the National Cooperative Research Act of 1984 passed. Since it became law about a year ago, some 40 research consortiums, including Inman's MCC, have registered with Justice and the Securities & Exchange Commission. Some are using another Merrifield idea—financing their efforts with R&D limited partnerships. Wall Street likes the idea. PaineWebber Inc., for one, is raising $100 million to finance such partnerships.

The OPTI chief has also lobbied hard for laws that will allow the private sector to own patents on inventions developed with government money and he has sought retraining for workers laid off by dying industries. Merrifield wants the National Technical Information Service, which he oversees, to create a "one-stop, world-scan data base" to let U. S. companies tap foreign technology. "A decade ago we created 75% of the world's technology," he says. "That's now down to 50%, and soon it will be one-third."

When Merrifield is not riding circuit with his sermon, he continues to ruffle feathers in Washington. He recently warned the Agriculture Dept. that while it is worrying about plummeting farm exports, it is ignoring the need for new agricultural technology. Such incursions into others' bureaucratic turf may have cost him critical points. Merrifield's office "really did play hardball up here," grouses one congressional aide. "They burned some people and may well get burned in return." His meaning was clear: If the budget office "zeroes out" OPTI as it did last year, Congress this time may not restore the funding.

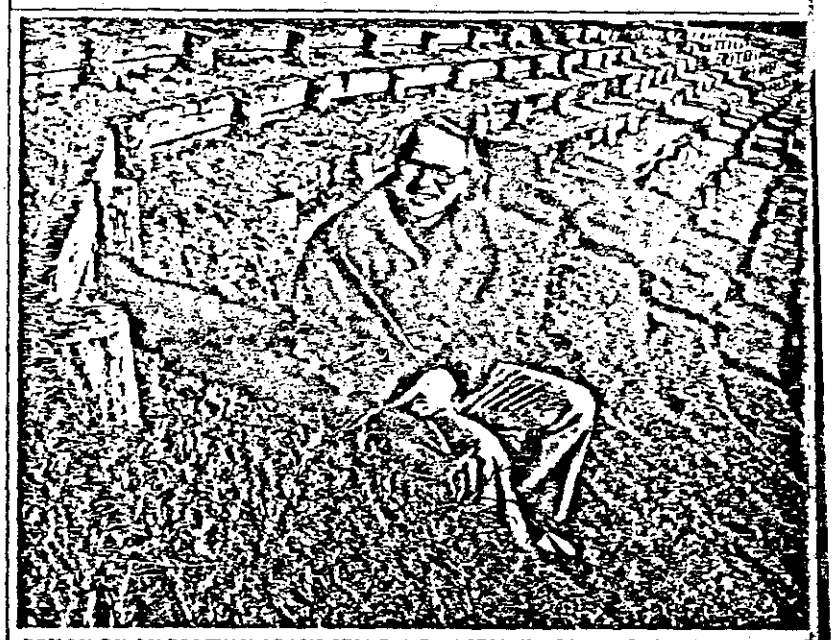
Merrifield seems unperturbed. Echoing the OMB's rationale for shutting down his office, he says: "No problem. There are times when I think maybe I've done what I can here." But, adds a colleague: "It's amazing that he has run loose this long."

By Evert Clark in Washington

JOHN HANSEN

HOW THE PGA IS STAYING OUT OF THE ROUGH

FEARING A DEPENDENCE ON TV, COMMISSIONER BE EXPANDED INTO MARKETING AND EVEN INTO REAL E



BEMAN ON AN EARTHEN GRANDSTAND: NEW "STADIUM COURSES" DRAW CROWDS

Golf has one feature that's unique among major professional sports: Its spectators have a hard time seeing what's going on. The trouble is that golf courses—until recently—were designed to accommodate the players, not the watchers. But when Deane R. Beman, a top-ranked touring professional, was named golf commissioner 12 years ago, he made it one of his goals to change that.

Has he ever. He invented the stadium golf course. The earth that's bulldozed out for water hazards and other features is used to build spectator mounds along the course and earthen grandstands at the first tee and 18th green. Beman hopes this perfectly simple idea will go a long way toward ensuring that professional golf has a golden future.

RENT A TENT. Today there are 12 such courses, all operated by the entity Beman heads, PGA Tour Inc., and 12 more are planned. The record shows that the new courses attract bigger crowds: Some 50,000 people a day are expected at the last two days of the Tournament Players Championship at the PGA's prototype stadium course in Ponte Vedra, Fla., the last weekend in March. Bigger crowds mean greater ticke and concession revenues. tournaments also attract cor rent tents in which they sell from golf gear to life insu larger the crowds, the greate tive to rent a tent.

It all means more money, the name of the game f though the tour is a nonprof tion. When he took over the had assets of $730,000 and income of $3.9 million, virtua the sale of television rights. commissioner, then 35, that ening. It meant that the gam was in the hands of the netv

He was determined to b revenue base—and he's gone toward that goal. The tour is in marketing and merchandis tate development, golf-cou tions, and TV production. It h ated a new product, the Senio pro golfers over 50. Last ye Tour, with assets of $41.6 m total revenues of $48.3 millio $16.4 million came from tele

PGA Tour, as distinct from sional Golfers' Association o

Inside U.S. Trade

An Inside Washington Publication

An exclusive weekly report on major government and industry trade action

Vol. 4 No. 7 February 14, 1986

SPECIAL SUPPLEMENT

WHITE HOUSE EVALUATING R&D PLAN TO RETAIN EDGE OVER FOREIGN TECHNOLOGY

The Administration is evaluating a comprehensive set of recommendations to increase research and development in order to preserve a U.S. lead over foreign technology, informed sources said. Without these incentives, the White House fears the U.S. will lose its competitive edge to countries that target industries for development. The plan includes changes for the research & development tax credit and a uniform federal copyright policy that would give all government contractors ownership of technical data in exchange for royalty-free use by the government, according to a copy of the plan made available to *Inside U.S. Trade* and reprinted below. The r&d recommendations were reviewed by the cabinet-level Economic Policy Council, which sent them back to the Treasury's Office of Tax Policy to evaluate their effect on revenue, one informed source said. The recommendations were drawn up by the Working Group on Research and Development, which was chaired by Manuel Johnson, the assistant secretary for economic policy at the Treasury Dept. The document was initially drawn up for a Dec. 19 EPC meeting.

The working group made four recommendations, emphasizing that it is important for the U.S. to increase its efforts in all phases of r&d. The recommendations say this will strengthen the competitiveness of U.S. goods and services, increase productivity and economic growth, reduce the rate of inflation and create new jobs. The group recommended: 1. a fixed base for the r&d tax credit, adjusting its rate to maintain revenue neutrality; 2. a uniform federal copyright policy that gives federal contractors ownership of technical data; 3. an increase in the incentive for researchers in government laboratories to transfer technology to the private sector for commercialization; and 4. a directive for all major r&d agencies to build up university-based scientific and engineering research that bears on technology and industrial competitiveness. It also proposed that the Administration explore whether it should use a competitive bidding process to fund federal r&d projects, according to the document.

Incentives for r&d are necessary to keep the U.S. competitive with other countries, the working group pointed out. Generally, the private market provides enough incentives for firms to fund r&d to sustain rapid rates of innovation, the group said. However, this is not true for basic research, where there may be significant underinvestment. In that case, government should provide incentives to stimulate investment in r&d, the group said. Antitrust, patent and copyright policies also can help lower some of the barriers to private innovation and r&d, enabling U.S. firms to compete more effectively in domestic and international product markets, the paper said. "Government procurement activity can provide a large market for private output and in the process influence the development of new technologies and encourage the investment necessary to apply it," the group said.

The r&d tax credit, which expired in December, should be based on a fixed annual base adjusted for inflation, the working group recommended. The current tax credit contained in the House tax bill provides a 25% credit on the part of a corporation's r&d that exceeds the average r&d expenditures for the three preceding years. Figuring the credit over such a constantly increasing three-year base may provide less incentive for increases in r&d than alternative arrangements, the working group said. Advocating this change may prove politically awkward, the group said, because Treasury late last year negotiated with the House Ways & Means committee about an extension of the credit and agreed to a constantly increasing base. "However, it is appropriate to consider changes in the incremental structure that could increase considerably the marginal incentive while maintaining revenue neutrality," the group said.

Following is the text of the recommendations sent to the EPC by the working group on r&d:

existing ones. Industrial innovation — the development and commercialization of R&D — accounts for a significant part of our increased productivity, which helps to reduce the costs of producing goods and services and is responsible for a sizable share of the Nation's economic growth. It is critical that the United States continue to increase its efforts at all phases of R&D in order to increase productivity and economic growth, reduce the rate of inflation, create new jobs, and strengthen the competitiveness of U.S. goods and services.

R&D is itself an important component of the U.S. economy, accounting for an estimated $106.6 billion or 2.7 percent of the Gross National Product (GNP) in 1985.

Twenty years ago the U.S. clearly had a lead over other countries in the share of the GNP allocated to total R&D spending. Over the past 20 years, however, there has been a convergence between the U.S. R&D/GNP ratio and the ratio in other countries.

A relatively high degree of risk is generally associated with many aspects of R&D. In addition, all of the benefits from some types of R&D, particularly basic research, may not accrue to private investors although they would be available to society as a whole. In such cases, there may be significant underinvestment of private resources in R&D, and society is the loser. The presence of externalities — the availability of benefits to a broader group than the private investor undertaking the R&D — has long been viewed as justifying government intervention in the R&D process, particularly basic research.

Government policies can have a significant influence on R&D and innovation. Tax incentives, for example, can be used to reduce the cost of R&D activities to firms, thereby making such activities more attractive. In addition, antitrust and patent and copyright policies can help lower some of the barriers to private innovation and R&D and enable firms to compete more effectively in domestic and international product markets. Government procurement activity can provide a large market for private output and in the process influence the development of new technologies and encourage the investment necessary to apply it.

Other factors are thought to also have a significant impact — both positive and negative — on R&D and innovation. Expectations about macroeconomic conditions and the intensity of competition, both domestic and international, are particularly important. A strong, robust economy encourages investment and innovation; it generates increased business cash flow to help finance R&D internally, rather than by borrowing, and makes it easier to market new products.

In a strong economy innovations are diffused more rapidly throughout the economy because new capital equipment and new processes are likely to embody improved technology. Also, increased investment tends to encourage innovation in the capital goods industries by increasing the demand for business investments. Alternatively, a robust economy may lessen the urgency to pursue new products and processes, while slack economic conditions can provide an incentive for businesses to seek out new technologies and processes to help reduce costs of production. On balance, the evidence suggests that R&D spending is positively correlated with economic growth.

The Administration has been very supportive of R&D, particularly basic research where, because of significant externalities, the private sector may be underinvesting. Between 1981 and 1985, Federal investment in basic research will have increased by almost 30 percent in real terms. The Administration also worked with the Congress to enact the National Cooperative Research Act of 1984, which permits two or more persons to undertake joint research and development ventures with less concern that such cooperative efforts will be found to be in violation of our antitrust laws.

The current budgetary situation may require that R&D, like most other government programs, share in the need to scale back the growth of spending. Nevertheless, a reallocation of the government's R&D resources toward multidisciplinary long-term research on basic technologies would increase the effectiveness of the U.S. research effort. At the same time there are ways in which the Federal Government can encourage increased R&D efforts by the private sector without adding to the budget deficit, and in fact would help reduce the deficit through increased economic growth, job creation and lower inflation.

The Working Group on R&D reviewed a number of proposals for encouraging R&D. These proposals involved issues concerning the cost of R&D capital, regulatory and legal barriers to R&D and public/private R&D relationships.

The Working Group reviewed the possibility of further [including] the capital gains tax but did not include it in the Group's recommendations because of the current status of consideration [of] the President's proposal for tax reform. However, this change should be considered at a later time.

The following are four unanimous recommendations and one exploratory proposal of the R&D Working Group for encouraging industrial investment in research and development and improving the effectiveness of our overall R&D effort.

Recommendation 1. Improve the Structure of the R&D Tax Credit

Problem/Issue

The existing tax credit for research and experimentation is intended to provide a real incentive for additional (incremental) R&D. The Treasury Department has just negotiated with the House Ways and Means Committee an extension of the R&D credit. This could make it awkward to initiate a major revision in the credit at this time. However, it is appropriate to consider changes in the incremental structure that could increase considerably the marginal incentive while maintaining revenue neutrality.

Background/Analysis

The R&D tax credit is intended to give companies incentive to increase their R&D efforts. Otherwise firms are likely to underinvest in R&D because of its potential externalities and delayed return on investment. The current credit establishes such an incentive by providing a 25% credit on the increment of a corporation's R&D for the taxable year over the average of its R&D for the three preceding years. In other words, the credit is 25% of the increment over a "creeping" three-year R&D base.

This "creeping-base" structure may provide less incentive for increases in R&D than alternative structures. The basic reason for this is that the additional R&D performed in the current year will increase the base in each of the three succeeding years, thus reducing the credit the company could claim in subsequent years for maintaining that level of R&D.

This incentive effect of the credit could be increased by a shift to an "indexed base" structure. The credit would continue to be allowed on the increment over a base. Instead of a moving base consisting of R&D for the three years immediately preceding the taxable year, however, the base would be R&D for a fixed three-year period, indexed annually for inflation or some other indexing factor different from the company's own R&D record. Research indicates that with appropriate accompanying adjustments such a structure could provide several times the marginal incentive for extra R&D without increasing the revenue loss.

This alternative structure should be examined carefully by tax and R&D experts and, if it proves practicable and administrable, implemented.

Recommendation

Treasury, in collaboration with other interested agencies, should consider an amendment that:

- **incorporates the "indexed fixed period base" structure;**
- **maximizes its incentive effect;**
- **minimizes any associated problems;**
- **adjusts the credit rate to maintain revenue neutrality equivalent to present law.**

on whether such an amendment would have policy or political drawbacks.

Recommendation 2. Ownership of software and other Technical Data Produced Under Contract to the Federal Government

Problem/Issue

Many types of commercially valuable information such as computer software, engineering drawings, etc. are generated under Federal grants and contracts or in conjunction with them. Agencies now have a multiplicity of policies governing copyright ownership of this information. Such information often has great commercial importance to the private sector. However, the threat that the Government will hold all copyrights that derive in any way from work produced under contract can have a chilling effect on private sector participation in Government funded research projects. Copyrightable information developed in Government funded research projects does not receive the same protection afforded patentable products or processes developed under the same circumstances. This threat is especially great to researchers seeking to commercialize valuable copyrights such as software programs.

Background/Analysis

Passage of the Bayh-Dole Act (Public Law 96-517) in 1980 marked a turning point in Federal policy on patent rights to inventions. Congress sought to increase technology transfer from Federal research and development to the private sector by allowing universities and small business contractors to manage patentable inventions they made under Government grants and contracts. Subsequently, a number of university and private contractors have established technology licensing programs. The President's Memorandum on Government Patent Policy, February 18, 1983, extended the principles of the 1980 Bayh-Dole Act to all businesses, consistent with existing law; some medium and large business contractors still do not receive the benefits of this policy because of preexisting laws that were not affected by the 1980 Act. In 1984, PL 98-620 extended the 1980 Act to include most contractors who operated Federal laboratories. However, the [illegible] protection afforded to these contractors and grantees does not extend to copyrightable software and other technical information. The absence of a uniform Federal policy allowing contractor ownership of copyrights that may be generated under grants and contracts in exchange for royalty-free use by the Government inhibits contractors working in fields where such protection is needed for commercialization. This slows the transfer of new ideas to the commercial sector.

Recommendation

A uniform Federal copyright policy should be developed by OMB allowing all contractors (including medium and large size businesses) ownership of software, engineering drawings and other technical data in exchange for royalty-free use by the Government; it could be modeled on the President's memorandum of February 18, 1983. Such a policy would be consistent with the Administration's technology transfer goals by encouraging commercialization of copyrightable products by the private sector. This policy would also encourage the most innovative small, medium and large companies and universities to participate in Federally sponsored R&D projects, thereby benefiting the Federal agencies and the public.

Recommendation 3. Greater U.S. Competitiveness Through Federal Laboratory Cooperation with Industry

Problem/Issue

Federal laboratories perform more than $17 billion in R&D annually and employ about one-sixth of our research scientists and engineers. They represent a substantial yet insufficiently utilized resource for U.S. industrial competitiveness. Furthermore, present Federal pay and incentive systems for [illegible] required for laboratory missions nor stimulate technology transfer to the private sector.

Background/Analysis

About two-thirds of funding for Federal laboratories goes to government-operated institutions. The rest goes to contractor-operated institutions. At present, both kinds of laboratories have authority to grant exclusive licenses for their inventions to the private sector. However, only contractor-operated laboratories and their employees may receive a share of the royalties. There is little or no incentive for researchers in government-operated laboratories to transfer technology and contribute to U.S. industrial competitiveness. All Federal laboratories share the problem of removing barriers to increased collaborative research with U.S. industry. Issues such as protection of proprietary information and definition of government rights to products of collaborative research have not been fully resolved.

The 1983 White House Science Council's report on Federal laboratories (Packard Report) recommended that: R&D interactions between Federal laboratories and industry should be greatly increased by more exchange of knowledge and personnel, collective projects, and industry funding of laboratory work; provided an oversight mechanism is established to prevent unfair competitive practices.

Legislation is now being considered in Congress to enhance Federal laboratory collaboration with the private sector by giving government operated laboratories the same incentives as are available to contractor operated facilities.

Recommendation

The Administration should take administrative action or propose or endorse legislation that would:

incorporate contribution to U.S. industrial competitiveness as an explicit laboratory mission wherever that has not already been done and is not inconsistent with the primary laboratory mission;

allow agencies to delegate significant authorities to their laboratories for managing the technologies they produce, including licensing inventions made by laboratory employees;

allow the laboratories to further their research objectives by entering into cooperative research agreements with universities and industry that specify what rights the Government and the other collaborators have to any inventions that may result;

allow inventors and their laboratories to share the royalties their inventions produce as an incentive to move new technologies out of the laboratories and into the marketplace and to do so without reducing incentives to work on mission projects with little or no commercial use.

Recommendation 4. Increase Federal Investment in University Research on Basic Technologies

Problem/Issue

The U.S. has insufficiently tied together our great strength in university research with R&D in industry, and it has underinvested in long-term research on basic technologies.

Background/Analysis

R&D to develop specific products and processes for the market is the job of industry. But industrial firms cannot be expected to fund more than a small share of the type of research that provides the knowledge base for work across whole technologies, particularly those that are new and rapidly developing.

United States research universities lead the world in research and training in the traditional science and engineering disciplines—physics, chemistry, biology, mechanical engineering, etc. However, university basic research has inadequately nurtured research on basic technologies, which is typically multidisciplinary and differently focused from the traditional disciplines. As a result, the U.S. has underinvested in university research on basic technologies. In addition, scientists and engineers trained in a single discipline have been poorly prepared to collaborate in multidisciplinary work that

characterizes corporate R&D. Also, movement of people, and therefore of ideas and know-how, between universities and industry where multidisciplinary research is needed, has been too limited.

The Administration has taken important first steps in addressing this in the University Research Initiative of the Department of Defense and the Engineering Research Centers of the National Science Foundation (NSF) and other agencies. These are helping universities address the needs of the country for more multidisciplinary basic research, and encouraging greatly enhanced collaboration and interaction between universities and industry.

The initial NSF solicitation for multidisciplinary, university-industry engineering research centers, despite relatively short notice, evoked 142 proposals for investing $2.2 billion of Federal funds. The NSF actually had funds enough to establish only 6 centers for $10 million. The universities remain painfully short of resources with which to make the necessary transition.

Recommendation

Within the constraints of the President's budget, all major R&D agencies should be directed to make a stronger commitment to build up university-based scientific and engineering research that bears on technology and industrial competitiveness, especially through multidisciplinary basic science and technology centers.

This would accelerate Administration initiatives already started on a small scale to encourage university fundamental research that is (1) focused more on current or potential technologies than on traditional disciplines, (2) able to attract support from industry as well as Government, and (3) effective in encouraging university-industry collaboration in research and in the movement of people between university and industry.

Heads of agencies with major research and development programs should be directed to report to the President on their specific plans to implement this recommendation.

Proposal: Competitiveness of Federal Applied Research

Issue

Should the Administration explore applying on a demonstration basis to a specific program a bidding process for selecting Federally-funded applied R&D projects close to commercialization?

Background

Clearly, the best approach for financing applied R&D projects close to commercialization is to turn the responsibility for such financing to the private sector. However, the Congress often requires the Administration to finance such projects. Although private firms now share the costs with government in many applied R&D projects and the government consults with industry and academia on the technical and economic feasibility of projects, the government ultimately determines which applied R&D projects will be pursued.

Proposal

A better approach to financing these projects is to assure that the government finances only those applied R&D projects the market believes hold the most promise. Rather than having the Congress or a Federal department determine which specific technologies should be financed and then soliciting private support, the government would solicit bids from private firms on the amount of Federal funds they need to produce a given amount of coal, for example, that would meet certain environmental standards. The government would thus allow the market to choose the specific technologies on which research should be conducted. The firm offering the lowest bid, i.e., asking the government for the least funds, must believe that it has the most promising technology for producing the good. A firm might offer the lowest bid because it has a low-cost technology or it foresees benefits to itself from developing the technology.

The key feature of this system is that the government would award the funds only after the firm demonstrated it could produce the good. With this government guarantee of future payment, the firm could obtain financing by convincing the market that its technology was most feasible. The firm would have to persuade banks, venture capitalists, and individuals that it could produce the good. This system shifts from the government to the market the burden of determining a technology's economic feasibility.

In this system, there would be no immediate budget outlays since the government would not provide the firm funds until it can demonstrate the production of that good. In fact, if the firm fails to produce the good, the government need not provide the funds at all. The government would thus only finance research on those technologies that actually work. If no firm offered a bid to produce the good or if the bids require enormous Federal support, the government would have a signal that the market believes the technologies for producing the good are currently economically infeasible. The government should then either conduct basic research in this field or not conduct research at all.

Advantages

The government finances only those applied R&D projects the market believes are most economically feasible. The private sector is more capable than the government of determining the economic feasibility of projects.

Immediate budget outlays are reduced since the government would award funds for projects only after a firm demonstrates it can produce the good meeting the standards.

Future budget outlays may decline as well since if the firm cannot produce the good meeting the standards, the government does not have to award funds for the project.

Disadvantages

This approach would radically change the system of government selection of applied R&D projects close to commercialization. It would take much time to show the Congress how and why this approach would work.

This approach would likely face strong opposition from Federal departments conducting such research because it would obviate the need for government personnel who now decide which applied R&D projects should be financed.

BUSINESS INTELLIGENCE PROGRAM

DATALOG

March 1986 • No. 120

REPORT

GLOBAL STRATEGIES IN MANUFACTURING INDUSTRIES



Global strategies that build cross-country and cross-regional links are significantly altering the nature of international competition. Multinational companies with separate and largely independent operations in various countries and many large domestic manufacturers are threatened by manufacturers pursuing global strategies. The forces stimulating these global strategies include an international convergence in consumer tastes, an increase in technology innovation and expertise worldwide, and growing new product development risks. Better and cheaper transportation and communications, more flexible mass-production manufacturing, and lower tariffs are facilitating the implementation of global strategies. Movement toward global strategies will foster significant changes in the structure and nature of international competition in some industries, as well as in the management, organization, and operation of multinational companies (MNCs). Manufacturers face difficult challenges in developing and implementing global strategies; obtaining a global perspective—in part by finding executives with global views and experience—is often difficult. *Report* No. 727, **Global Strategies in Manufacturing Industries,** by G. Thomas Wachter, senior consultant in SRI International's Materials and Mechanical Industries Center, describes the forces behind this transition and examines the operational issues that manufacturing firms pursuing global strategies must address. It assesses the implications for and options available to not only the MNCs and their suppliers, but also their domestic competitors, consumers, the labor force, and national governments. Viable strategic options for manufacturers include focusing on markets where customer preferences are likely to retain distinct national characteristics, seeking an accommodation with a major global competitor, seeking defensive trade barriers, and using offshore sourcing and other methods to become competitive.

The reports described on this page will be mailed and will be available to B-I-P members through their companies' B-I-P Executive Contact.

SCAN

NEW PARAMETERS OF LIABILITY

Product liability concepts have undergone significant change over the past ten years, and *Scan* No. 2039 explores the parameters of this new liability doctrine. For one thing, contributory negligence on the part of a plaintiff no longer keeps him or her from winning the suit. Furthermore, product liability has been extended to cover parties other than those directly involved. Professional liability has also spread. Professionals in many areas besides medicine—lawyers, architects, engineers, actuaries, consultants, and even the clergy—are increasingly being held accountable in the courts for undesirable consequences resulting from the practice of their respective professions. Courts attempt to clarify the line of demarcation between individual and organizational responsibility, but the result often appears to

(Continued on page 4.)

This issue: • *Computer-Integrated Manufacturing* • *Aging Work Force* • *New Parameters of Liability* • *Industrial Inspection* • *Global Strategies in Manufacturing Industries*

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BUSINESS INTELLIGENCE PROGRAM

scan

ALERTING BUSINESS TO EARLY SIGNS OF CHANGE

• 2039
January/February
1986

THE NEW PARAMETERS OF LIABILITY

CORPORATE OFFICIALS all over the United States are increasingly facing prosecution, and the murder conviction last summer of three executives of Film Recovery Systems Inc. in Elk Grove Village, Illinois, accelerated the trend. Each executive was sentenced to 25 years in jail for causing the death of an employee who inhaled cyanide fumes at work. They are appealing (*Business Week,* 10 February 1986, page 73).

ARE ACTUARIES NEXT on the malpractice hit list? Recently, the Pension Benefit Guaranty Corporation (PBGC) sued the George D. Buck actuarial consulting firm, charging that Buck was unreasonably optimistic in calculating the probability of shutdowns at Mesta Machine Company. The PBGC had to cover the pension shortfall when shutdowns occurred (*Forbes,* 21 October 1985, page 102).

JOB-STRESS CLAIMS have substantially expanded the liability of the workers compensation system. In California, for example, the number of mental-stress claims more than tripled between 1980 and 1984. Insurers are worried that the relative youth of the claimants indicates that the new generation of workers is, at the very least, inclined to view its emotional problems as compensable. "Techno-stress" has already resulted in some claims—and some awards. A New Jersey word processor operator collected $7500 after blaming her job for her nervous breakdown (*Business Week,* 14 October 1985, page 152).

AN OHIO LAWYER placed an ad asking women if they had used the Dalkon Shield intrauterine device (IUD) for contraception. He used responses from the ad to file 95 suits against the A.M. Robins Company. The Ohio Supreme Court then reprimanded him for violating a state rule prohibiting lawyers from making specific product or company-oriented pitches to solicit new clients. However, the U.S. Supreme Court reversed that decision on free speech grounds. Many consider this decision to be a go-ahead for lawyers to do more target marketing (*Business Week,* 10 June 1985, page 70).

A JAPANESE STUDY reports that more than one-third of pregnant women working at video display terminals (VDTs) have problems during pregnancy or at birth. Of those who worked with VDTs six hours or more a day, two-thirds had problems (*New Scientist,* 23 May 1985, page 7).

MARYLAND'S COURT OF APPEALS ruled unanimously that makers and retailers of "Saturday night specials"—cheap, easily concealed handguns—can be sued by victims of criminal use of their products. The ruling appears to establish a new area of product liability. It states that makers and sellers of such weapons "know or should know that the guns are virtually useless except for criminal activities" (*The Wall Street Journal,* 4 October 1985, page 27).

PROPERTY AND CASUALTY INSURANCE premiums for business are up as much as 1000%, and the availability of insurance has decreased dramatically. Companies are finding themselves with insufficient insurance—or none at all. Yet most businesses want more insurance because litigiousness is increasing and so is the tendency to reinterpret legal doctrines of negligence and fault. In reaction, 33 major U.S. corporations have gathered nearly $300 million to set up their own A.C.E. Insurance Co. in the Cayman Islands. A.C.E., which recently began operations, provides as much as $150 million in liability coverage for each participating corporation; it offers similar coverage to other major companies, which must also buy stock in the insurer (*Fortune,* 10 May 1985, page 67).

Scan's purpose is to provide an early warning of possible changes that, if they occur, could present important threats or opportunities to B-I-P clients. Since our assessments are based on faint signals, B-I-P does not claim that the changes will occur, nor that our assessments are complete or correct. Instead, we hope *Scan* will alert B-I-P clients to possible changes they may not be aware of and stimulate them to explore further those changes whose implications are potentially important to their companies.

On this page *Scan* presents a cluster of faint signals of change identified by SRI International's business environment scanning system. On the following pages, we analyze the cluster and present some implications of the potential change it describes.

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AN ANALYSIS

In the decades since World War II, courts have emerged as one of the most significant engineers of change in U.S. society. Court decisions have brought about extraordinary alterations in political structures, civil rights, criminal justice, and many other social and political arenas. Recent court activity in the definition and determination of liability promises to result in as much change in business as other decisions have created in other sectors of society. (For additional discussion, see "Management and the Law," in *Scan* No. 2029, May/June 1984.)

The past ten years have seen concepts of product liability undergo considerable change. For one, contributory negligence on the part of a plaintiff no longer keeps him or her from winning the suit. In addition, product liability has been extended to cover parties other than those directly involved.

Professional liability has also spread. Malpractice has gone far afield from medicine. Lawyers, architects, engineers, actuaries, consultants—even the clergy—all are increasingly being held accountable in the courts for undesirable consequences resulting from the practice of their respective professions. It is particularly significant that professionals are being successfully sued even when their competence is not in question. Perhaps even more troublesome, however, are decisions wherein determinations of liability are setting new precedents or radically changing old ones—and thereby fundamentally altering the nature of relationships and the structure of organizations.

One such area is personnel. For example, in 1985, decisions in states from California to New Jersey held that statements in a company's employment manual or job offer letter that may reflect on termination policies were the equivalent of contractual provisions and thus were binding on the company. Other decisions have set new restrictions on the rights of management to fire employees. Indeed, the common-law "fire at will" doctrine seems to have gone by the boards altogether. All such changes are forcing companies to think very carefully not only about how and when to fire, but also about how and who to hire. A further complication is the application of the Racketeer Influenced and Corrupt Organizations Act (RICO) to personnel disputes. Under RICO, for example, a pattern is two similar occurrences of wrongful discharge involving the mails over ten years, so a second ruling against an employer can result in treble damages.

The courts are also attempting to clarify the line of demarcation between individual and organizational responsibility, although the result thus far appears to be more questions than answers. In the area of health, particularly, the implications are hard to read. The current concern about stress, for example, has not yet had much clarification. A recent study on stress for the National Institute of Occupational Safety and Health (NIOSH) concluded that stress costs business as much as $150 billion annually. Workers compensation awards for stress-related problems are increasing geometrically. Companies by the hundreds are rushing to institute stress reduction programs. Unanswered yet is the question of how to allocate responsibility for stress, although the courts are clearly leaning toward putting the onus on the employer and discounting the variations among individuals in susceptibility to stress and self-inducement of stress.

Underlying much of the current activity in labor relations liability is the application to the office of an industrial mind-set. Safety and health, which were dominant labor issues in the factory, are now assuming similar importance in the office. The shift to a service economy has apparently left some issues unchanged.

Perhaps the most profound change has yet to receive much attention. Some court decisions are changing the nature of the corporation itself in fundamental ways. The 1985 decision convicting executives of a Michigan corporation of murder in the death of an employee working with a toxic substance was a landmark. Originally, the corporation was a mechanism for limiting personal risk—and not only financial risk. Courts now seem to say that the corporation is not a shield. Individual responsibility of managers and directors is increasing—and, ironically, it is increasing at a time when the responsibility of individual employees is decreasing. Courts are holding corporations more liable in areas where they used to consider the employee responsible (for example, individual health). ■

POSSIBLE IMPLICATIONS

IN THE WORKPLACE

According to the American Institute of Stress, stress reduction programs are already among the top employee assistance activities in most major corporations. This development has occurred practically overnight, and whether the possible consequences have had sufficient study is uncertain. Does the introduction of a stress reduction program imply acknowledgment of employer responsibility for stress, for example? What is the relationship, if any, between stress and productivity? Is stress reduction an integrated part of a coherent human resources strategy so

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POSSIBLE IMPLICATIONS (Continued)

that mistakes—such as following the announcement of a stress reduction program with an announcement of layoffs—are avoidable?

Some employers are looking to strategies that reduce the possibilities of liability. These attempts go beyond merely rewriting recruiting literature. For example, companies are using more contract, leased, and part-time workers. Other companies are taking the opposite tack: introducing expanded benefit programs—exercise and diet, substance abuse counseling, day care, biofeedback, and so on—as an effort to create a caring environment. Some are instituting what approaches guaranteed lifetime employment. And some are even reexamining opposition to unionization because the alternatives (especially lawsuits) have proved worse.

Health and safety in the office are almost certainly expanding issues. Even though a recent U.S. Congress Office of Technology study concluded that we know little about reproductive risks in the workplace, evidence suggests that debate about this topic will receive greater focus in the near future. The large group of educated, articulate, employed baby-boom women now having or contemplating having babies brings the weight of numbers to bear. Birth defects allegedly resulting from indoor pollution and the growing use of electronic equipment seem most likely to generate a substantial amount of litigation.

Given the above, managers may need to evaluate the extent to which their employees' health can be linked to their management style or the environment in which their employees work. For example, a management attitude that says stress is part of any job and that employees are paid for accepting stress may appeal to hard-line, bottom-line management, but it may not to a jury considering an employee's stress-related suit.

To monitor developments affecting health in the workplace, human resource managers may need to increase their surveillance of literature reporting such advances or to strengthen contact with researchers investigating stress, video display terminals, and other dimensions of workplace health. Human resource managers may need to improve channels of communication to senior management and those responsible for the company's legal affairs so that new developments affecting health in the workplace can be considered for their impact on human resource policies, management style, and potential liability.

Selection and training of personnel, including managers, will increase in importance as sensitivity to liability increases within the company and in society in general. Given the "deep pocket" approach to claims settlement, companies may need to be concerned about the selection and training of personnel in companies that they influence strongly. For example, given growing public awareness and concern about charges of child abuse in day-care centers, companies sponsoring such centers may need to take a more active role in the selection and supervision of their personnel.

IN THE MARKETPLACE

The insurance crisis is already having a serious effect—especially on small businesses. Large companies can self-insure to some extent or, as some have recently done, combine to create their own insurance carriers. But small companies are out in the cold. A movement to require insurance companies to provide property and casualty insurance appears to be growing. Proponents argue that insurance has a quasi-utility status and that its unavailability adversely affects business people's opportunity to earn a livelihood. If insurers are required to offer liability coverage, they may demand the right to intervene more directly in the setting and observance of safety conditions and work rules—much as they have done in fire prevention and, of late, in toxic waste handling.

The combined efforts of the courts and public interest groups have set in motion a trend toward broadening liability that seems at the moment irreversible without the intervention of Congress and state legislatures. The hoped-for remedies range from limitations on product liability and class action suits to modification of RICO. If business hopes to overcome the strength of the liability advocates (including, of course, the politically powerful trial lawyers), it will need a carefully developed strategy that will recognize both the requirements of business and the legitimate demands for equity and fair compensation.

The Saturday-night-special case troubles many observers. While it may be hard to defend the manufacturers of such weapons, is it just to decide a manufacturer's intentions on the basis of how some customers use the product? For example, could the manufacturer of a device that alerts drivers to radar used by the highway patrol to spot speeders be held liable for an auto accident? Some people may argue that the device encourages drivers to speed because it reduces their fear of being caught.

AMONG PROFESSIONALS

The trend toward holding people accountable for undesired consequences of their actions—thus toward more charges of malpractice—shows no sign of abatement, despite strenuous efforts by doctors and other adversely affected professionals. It would seem prudent for businesses to do a form of vulnerability analysis of potential trouble areas. For example, what implied promises exist in advertising or promotion materials that might later come

POSSIBLE IMPLICATIONS (Concluded)

back to haunt a company? If a company needs to exercise greater care in marketing, how can it do so without inhibiting creativity? (For a description of vulnerability analysis, see B-I-P *Report* No. 593, *Vulnerability Analysis in Business Planning*.)

Accounting is one of the professions hard hit by malpractice suits and by the difficulties of finding reasonably priced insurance coverage. Accountants' liability, particularly with respect to corporate audits, is likely to increase pressures for disclosure and for more thorough—and costly—audits. This situation would in turn be likely to reinforce the trend toward privatization and to increase concern among financial analysts about making stock purchase recommendations.

Boards of directors will continue to feel liability pressures. As indemnity insurance premiums skyrocket—while providing lower protection ceilings and more exclusions—the courts are toughening their attitudes toward directors' roles, decisions, and prerogatives. Unprotected companies will find directors virtually impossible to recruit, and the prohibitive costs of insurance will guarantee higher prices all along the line.

Social service professions, like day care and nursery administration, will face increasing difficulty in operating at a profit while maintaining a market; this market may be too small to spread the impact of greatly increased expenses, so the cost of these services to consumers may become unreasonable. Thus, at a time when privatization of government and social welfare services is a possible solution to public debt and inefficiency, liability and insurance problems are forcing purveyors of these services—from care givers to waste treatment facilities—out of business. ■

BACKLASH BEGINNING?

The declining availability and high cost of liability insurance are motivating both government and citizens to take action. Two examples:

- Although most large hazardous waste storage and disposal facilities remain open, most small facilities are closing because they can not meet federal requirements for insurance and groundwater monitoring. (Hazardous waste facilities are required to carry insurance that would cover the cost of cleaning up any toxic leaks from the facilities.) The Environmental Protection Agency is sufficiently concerned about effects on the industry that it has asked the congress to delay implementation of the insurance requirement (*The Wall Street Journal,* 9 December 1985, page 8).

- An initiative in California would eliminate the "joint and several" rule that allows a court to require one defendant to pay enlarged damages because a codefendant in the same lawsuit is unable to pay. Instead, the initiative would install a system allowing proportional payments based on degrees of liability determined by the court. The system would not cover economic damages—medical bills, loss of income, and other out-of-pocket expenses incurred directly by the victim; it would apply only to noneconomic damages such as mental and emotional stress. Backing the initiative is a coalition of businesses, insurance companies, taxpayers' organizations, and medical and business lobbies (*Times Tribune,* 14 December 1985, page A-16).

WORTH READING

For a brief overview of the crisis in liability insurance, see "The Search for Available Insurance: Where is it?" in *The Journal of American Insurance,* Fourth Quarter 1985. (This journal is published by the Alliance of American Insurers, 1501 Woodfield Road, Schaumberg, Illinois 60195-4980; telephone 312-490-8543.)

THE NEW PARAMETERS OF LIABILITY

ACKNOWLEDGMENTS

Principal Author: Arnold Brown - Weiner, Edrich, & Brown, Inc., New York
Contributions by: Brock Hinzmann, David L. Kolbus, William S. Royce, James B. Smith

The B-I-P *Index* lists this *Scan* under the following headings: • Business Environment • Employee Benefits and Services • Financial Institutions • Health Insurance • Insurance Industry • Litigation • Risk Management

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Bill would let federal labs share research

By EVAN ROTH
States News Service

WASHINGTON, D.C. — A House-Senate conference committee on Tuesday approved a compromise bill that would let federal laboratories share their scientific research with private companies.

The bill, originally sponsored in the House by Rep. Bob Michel of Peoria, would permit the creation of a public-private agricultural research and development consortium involving the Northern Regional Research Laboratory in Peoria.

The House passed the Michel bill in December. The Senate passed a similar bill in August. The bills went to a conference committee, which ironed out the conflicts this week.

Michel's press secretary, Johanna Schneider, said the conferees signed the compromise Tuesday, making it eligible for debate at any time before Congress adjourns.

Later in the day, Senate Majority Leader Bob Dole, R-Kan., told Michel that he anticipated no problem in bringing the bill up for a vote before Congress goes home, probably by the end of next week, Schneider said.

Tradition dictates that the Senate would vote on the bill first, she said.

The Technology Transfer Act, as the bill is called formally, would permit federal research agencies, such as the Peoria ag lab, to share their discoveries with private companies to permit commercial exploitation.

The act is required to allow the Peoria lab to get involved in a partnership with the University of Illinois Biotechnology Center and the University of Illinois Medical School.

The House has approved a $2 million appropriation as seed money for the consortium. The appropriation now being considered in the Senate is part of a massive $556 billion spending bill.

WASH. POST 10/28/86

15 U.S. Firms Seek Ventures With Soviets

By James L. Rowe Jr.
Washington Post Staff Writer

The Soviet Union has received proposals from 15 U.S. companies to participate in joint ventures with Soviet firms, a top Soviet trade executive said yesterday.

Last month, the U.S.S.R. announced a series of moves to decentralize its trade relations—including permitting Soviet enterprises to enter into joint ventures with private firms, including those from the West, and authorizing some ministries and enterprises to deal directly with foreign importers and exporters.

The U.S.S.R. does not now allow Soviet companies to engage in ventures with western firms. It also requires that nearly all exports and imports be carried out through the Foreign Trade Ministry—which makes it hard for enterprises to buy imports and difficult for individual Soviet firms to produce for export.

The details have not been completed either for the direct import and export of goods or for the proposal for the joint ownership of producing companies in the Soviet Union.

The Soviet Union is anxious to increase the efficiency of its industries and to broaden the base of its export earnings, now heavily dependent on raw materials, mostly energy. Joint ventures with foreign firms would introduce new technology into Soviet industries and produce higher-quality goods more efficiently.

Many experts question whether

See TRADE, F2, Col. 5

U.S. Firms Reportedly Seek Joint Ventures With Soviets

TRADE, From F1

the highly centralized Soviet bureaucracy is prepared for the high degree of decentralization that reforms in the foreign trade sector would require.

James H. Giffen, president of the U.S.-U.S.S.R. Trade and Economic Council, said in a telephone interview that the Soviets are serious about the changes—at all levels of government, from Chairman Yuri Gorbachev on down. He said the Soviets "will be flexible in writing the rules. They don't want to make the mistakes of other centrally planned economies that made the rules [on joint ventures] so rigid that there was no possibility of profit."

Yuri Shcherbina, chairman of the Amtorg Trading Corp., said in a speech here yesterday that joint ventures will involve relatively small enterprises at first, and that not less than 51 percent of each venture will be owned by the Soviet Union.

The law governing joint ventures has not yet been completed, Shcherbina said in an address to the U.S.-Soviet Trade Forum. But earlier this month, he said, the government set down "general conditions" for joint ventures that give the foreign partners some "privileges," including guarantees that they can repatriate earnings.

He also said that the foreign companies will receive "favorable tax treatment."

Among the industries that will be open to joint ventures are energy, food, chemicals, some consumer goods and mineral extraction, Shcherbina told the audience—which included business exeutives, trade association representatives and government officials.

He said that any joint venture will "have to aim at exporting" at least part of its output to produce enough foreign currency earnings to satisfy the needs of the foreign partner to pay dividends to its parent company.

Giffen, who also is chairman of the Mercator Corp., a New York investment bank, said that he and Archer-Daniels-Midland Chairman Dwayne Andreas proposed a joint soybean processing facility to Gorbachev two years ago. Giffen said that such a facility could be one of the first joint ventures approved.

Giffen said that a "substantial" venture probably would meet with their approval if it was interesting enough and well thought out.

Shcherbina said that trade between the United States and the Soviet Union has been diminishing in recent years. He blamed the decline on anti-Soviet attitudes in the United States that often make the country an unreliable supplier. Last year, trade totaled $1.4 billion and is expected to be smaller this year.

Historically, the Soviet Union has preferred trading with Western Europe rather than the United States. Whether those historical preferences can be overcome will have a major influence on how important the new Soviet attitude toward foreign trade and investment will be to the U.S. economy.

A questioner from the audience said that the United States' unreliability as a supplier looms no larger than the Soviet Union's unreliability as a buyer. He pointed out that, for the second year in a row, the U.S.S.R. will not buy as much grain as it is supposed to under an agreement between the two nations.

U.S. Sales in Japan Decline Despite Talks

By Stuart Auerbach
Washington Post Staff Writer

U.S. sales in Japan declined in the first six months after the Reagan administration declared that yearlong trade talks had succeeded in opening Japan's market for high technology goods.

Commerce Department figures for the first half of this year showed that U.S. sales declined compared with the same period in 1985 in the fields of telecommunications and electronics. These are sectors in which the Reagan administration and U.S. industry officials expected sales increases as a result of the trade negotiations.

The trade talks were the centerpiece of administration efforts through most of 1985 to ease the mounting U.S. trade deficit with Japan, which hit a record $48.5 billion last year and will be even higher this year. The intensive negotiations in four areas—called Market-Oriented, Sector-Selective (MOSS) talks—were initiated in January 1985 by President Reagan and Prime Minister Yasuhiro Nakasone to ease growing trade frictions between the two countries.

"We must begin to hear the cash registers ring," Secretary of State George P. Shultz said last year in defining how the success of the talks will be measured.

In January, Shultz hailed the end of the negotiations for tearing down Japanese barriers to sales of U.S. manufactured products and cited "very substantial purchases" by Japan as evidence of the talks' success.

The only major area covered by the MOSS talks showing an increase in sales of manufactured goods was pharmaceutical products and medical equipment, where sales increased by $36.5 million in the first half of this year. Sales of U.S. forest products showed gains of $106 million, but most of that was in unfinished logs, not Japanese purchases of manufactured goods that were supposed to increase as a result of the MOSS talks.

Administration officials said, "It's too early to judge" whether the talks are successful or not on the basis of increased sales. They added that the subject will be discussed by Japanese and U.S. officials later this month at a subcabinet-level meeting on economic affairs.

But Lionel Olmer, the former undersecretary of Commerce who played a major role in negotiating the opening of the Japanese telecommunications and electronics markets, said he was "disappointed in the starkness of the numbers."

Another former Commerce official who played a large part in the talks, Clyde Prestowitz, said, "the mountain of labor brought forth a mouse."

He added, though, that a new ease of doing business in Japan and increased sales of telecommunications services, which do not show up in the trade figures, make the picture less bleak than the numbers alone would paint.

Representatives of the U.S. electronics and telecommunications industries told their Japanese counterparts last month that they were disappointed in U.S. sales in the face of promises by 57 major Jap-

See TRADE, C2, Col. 1

The Washington Post
Saturday, October 18, 1986

TRADE, From C1

anese companies to increase their purchases of American-made goods.

"This year's rationale" from Japanese business executives was " 'our economy is way down' " and sales are slow for Japanese companies, said Ralph J. Thompson, senior vice president of the American Electronics Association.

On the plus side, Thompson said U.S. companies now have greater access to potential Japanese buyers. "It's a question of changing attitudes" so they will buy U.S. products, added Brian P. Wynne, AEA's manager of international trade affairs.

Democratic senators, who have been pressing the administration to do more to turn around four years of record trade deficits that now have become a brake to economic growth, expressed surprise at the decline of U.S. sales to Japan in electronics and telecommunications.

"It's just going to add fuel to those protectionist fires around here," said Sen. Max Baucus (D-Mont.).

Sen. Lloyd Bentsen (D-Tex.), who would become chairman of the Finance Committee if the Democrats gain control of the Senate next year, attacked the idea of the MOSS talks because they are based "on the mistaken belief" that Japan will give up its traditional way of doing business.

"In the Japanese view, they have been very successful and see no reason to change. But that's a lesson we never seem to learn," he said.

Chicago University, National Lab Seek Profit From Ideas

* * *

School, Argonne Set Venture To Help Commercialize Scientific Discoveries

By FRANK E. JAMES
Staff Reporter of THE WALL STREET JOURNAL

CHICAGO—The University of Chicago said it created a joint venture with Argonne National Laboratory to help commercialize scientific discoveries made at the two institutions.

The formation of Argonne National Laboratory/University of Chicago Development Corp., or ARCH, represents the first time a national laboratory and its research-university partner have teamed up to commercialize their discoveries. The University of Chicago operates Argonne as a contractor for the U.S. Department of Energy.

The move comes as the federal government is trying to stimulate the transfer of technology from federal laboratories to private industry. The effort is a response to the longstanding problem of most government-lab discoveries not being commercialized because of bureaucratic red-tape or corporate apathy. Companies have been unwilling to pursue such taxpayer-financed discoveries because they haven't easily been able to gain proprietary rights to the patents.

In 1984, Congress made it possible for companies to gain title to discoveries stemming from research at such labs as Argonne, although the law wasn't effective until July. And in legislation Congress passed last week, federal labs received authority to set up cooperative research-and-development pacts with businesses. The legislation also calls for government researchers whose inventions are licensed to get 15% of license revenue or a fixed payment.

The university also said that Steven Lazarus, group vice president of health-care services for Baxter Travenol Laboratories Inc., based in Deerfield, Ill., will head the venture.

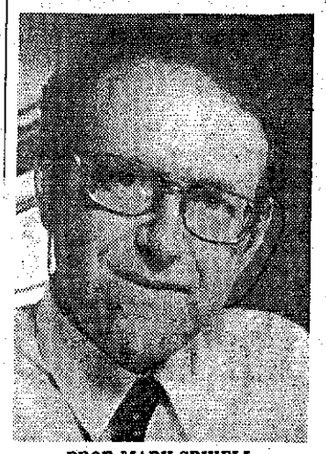
The university said professors and students at its graduate school of business will provide the venture with marketing proposals and business plans for the new technologies. Mr. Lazarus also has been appointed associate dean of the business school.

Argonne, the first national laboratory and one of the largest such laboratories, does research in a variety of fields, including nuclear and alternative energy, biomedicine, the physical sciences and the environment. Its annual budget is about $230 million and it has 4,000 employees.

The joint venture will be financed by the university and Argonne for its first five years and will be self-sustaining after that, the university said. Alan Schriesheim, Argonne's director, said in addition to the licensing of discoveries to businesses, the venture will allow the partners to get equity stakes in companies that may be started to develop the partnership's ideas.

WASHINGTON POST WEDNESDAY, OCTOBER 22, 1986

Professors Invent Collegiate Quandary



PROF. MARK SPIKELL
... invented high-tech clipboard

By D'Vera Cohn
Washington Post Staff Writer

No one knew quite what to do when Prof. Mark Spikell approached George Mason University officials a few years ago with an intriguing idea that he hoped could bring both of them money and recognition.

Spikell wanted paid time off from the state-supported Northern Virginia school to develop an invention: a high-tech clipboard to translate handwriting into computer data. It would allow sales orders scribbled by a traveling sales agent, for example, to be entered directly into the company's computer.

The problem was that the university had no policy governing its professors' products. In the end, Spikell and George Mason made a friendly deal; Spikell got the time off, and the university will get a share of the revenue if the invention, called DataPad, makes money when it is marketed next summer.

The outcome is not always so peaceful when universities and their professors sit down to negotiate ownership and revenue rights to "intellectual property," as a growing number are doing.

Money is one reason. Royalties from professors' inventions offer an attractive source of cash to universities suffering from budget cuts. Most inventions do not yield vast wealth, but in totality can be big business.

Stanford University, for example, made $3.9 million in gross royalties last year from products including a computer program to assist with airplane design. The University of Virginia makes $1 million a year from 126 licensed products, most of them medical devices or drugs. So far George Mason has made only a few thousand dollars.

See PATENTS, A15, Col. 1

Professors' Inventions Put Universities in Policy Bind

PATENTS, From A1

"Clearly the university deserves some return because they've given me a lot of encouragement and support," Spikell said of his deal with George Mason.

One problem case that still is talked about in academic circles involves Stephen Wolfram, a brilliant young physicist who left the California Institute of Technology four years ago in a bitter high-stakes dispute over ownership of a computer software program he designed. Wolfram, winner of a MacArthur Foundation "genius award," defected to Princeton's Institute of Advanced Studies, where he negotiated an agreement that lets him own the rights to his future inventions.

At the time, CalTech had no written policy governing ownership of computer software, which remains the thorniest area in intellectual property disputes. It later wrote regulations that give the university extensive rights and most of the royalties.

Spurred by inventions such as Spikell's and by a new state law, George Mason University's Board of Visitors recently approved tentative rules governing employes' inventions that can be patented and copyrighted. The law, passed this year by the Virginia General Assembly, requires all state-supported schools to draft intellectual property policies and is part of a growing academic interest in entrepreneurial ventures.

"We're always looking for the one invention that will make us rich," said Ralph Pinto, patent administrator at the University of Virginia, which has a well-developed program begun a decade ago.

Policies drafted by universities range all over the map. But many, including George Mason's, allow faculty to keep the rights and royalties from their copyrighted books or works of art. Patent policies, on the other hand, often require inventors to hand over ownership and a share of the revenues to the university.

A 1984 survey by the Society of University Patent Administrators found that half the 127 institutions it polled had adopted or revised policies in the last five years, and only four had none. The group's national membership has more than doubled in the last three years, from fewer than 200 to its current 500.

Some say a properly written policy can keep inventive professors from deserting academia for well-paying jobs in private industry, as happened with some of the nation's most gifted biotechnology researchers in the late 1970s.

"Historically we have given our best and brightest professors a black and white choice: Stay in the religious institution of chastity and obedience, or leave the institution and be an entrepreneur," Spikell said. "I've seen it over and over . . . entrepreneurs who have had to leave the university to start their own companies."

Computer software, a suddenly profitable field in which the rules of ownership are unclear, has accelerated interest in policies.

It was a lucrative computer software program for libraries developed several years ago by researchers at Virginia Tech that triggered the General Assembly action this year. Revenue from the discovery was not going to the state, but to a private university-affiliated foundation.

"Clearly the university deserves some return ...."

—Prof. Mark Spikell
George Mason University

House Speaker A.L. Philpott (D-Henry) was enraged, and demanded an investigation. The Joint Legislative Audit and Review Commission concluded that some of the work was done on state time, and suggested the state draft ownership rules so a similar situation would not happen again.

The library program's inventors later paid $50,000 to the general fund. To date, the invention has brought in more than $700,000.

The legislature ordered the Center for Innovative Technology—a Northern Virginia-based state project to promote technology by linking industry and academia—to act as licensing and marketing agent for state-supported schools. Universities in other states either have their own marketing organizations or turn to professional firms.

The CIT has negotiated agreements with five schools—Old Dominion University, Virginia Tech, Virginia Commonwealth University, James Madison University and the University of Virginia. It will sponsor a workshop next year on the subject of entrepreneurial professors.

Among the products in the CIT's pipeline—none is yet on the market—is an embryo technology developed by researchers at Old Dominion University that will enable farmers to transplant eggs from high-yielding dairy cows into poor producers, thereby upgrading the herd.

Another, developed by two professors at Virginia Tech, is a copyrighted software program to store digitalized blueprint information, compressing into a small amount of space the information that now overflows warehouses, according to Auzville Jackson Jr., the CIT's director of intellectual property.

"The role of the university is first education," Jackson said. "But it's become much more important to our society. The university is one of the most signficant forces we have in economic development."

"If a university can make a little money to defray the costs of education, that's well justified," said Randolph Church, a member of George Mason's board and its former rector.

University officials insist, however, that money is not the only reason. Supporters of copyright and patent policies say they encourage professors to market their inventions by offering help with the complexities of licensing and sales agreements. Many professors, they say, derive primary satisfaction and their academic reputations by publishing in scholarly journals, not from making money.

"Most universities are still in the mode that they've achieved what they need to achieve by getting it [scholarly discoveries] published," said Jackson, who believes a professor's patents should be considered in deciding whether to award tenure. "We want to see it utilized, rather than buried in an obscure intellectual journal."

University inventions still account for only a tiny fraction of new products. Jackson said universities file only 1 to 2 percent of patent applications now. He thinks the figure should rise to 5 percent.

Some warn that inventions never will be a golden goose for universities, despite hopes of some overeager administrators.

"What people don't realize . . . is that there's so much chaff and only a few grains of wheat," said Steve Bacon of Research Corp., an Arizona firm that helps universities patent their inventions. He estimates that out of every $1 million poured into university research, only one worthwhile invention results.

The GATT Mine Field

By JEFFREY E. GARTEN

When trade ministers from Washington east to Jakarta, and from Tokyo west to Buenos Aires, gather in Uruguay next week to launch a new round of negotiations, expect the standard pap about free trade and fair play. Harmless as this may seem, these talks may not be in Washington's best interests.

Sure, we're all for more trade. But these negotiations, pushed almost singlehandedly by the Reagan team for the past five years, are based on mistaken optimism that a new set of bargaining that encompasses everything from wheat to insurance and involves virtually all nations will lead to the freeing up of trade. Get everyone around a table to discuss all problems at once, so the reasoning goes, and the result will be lower barriers to the movement across borders of food, manufactures, technology, even banking.

Misplaced Faith

The fact is that the momentum is over for progressive trade liberalization through omnibus, multilateral marathons like the coming session under the General Agreement on Tariffs and Trade (GATT). The push ended when tariffs were negotiated down to insignificant levels in most countries, including the U.S. and Japan, leaving non-tariff barriers—such as quotas and regulations on procurement, customs procedures, and protection of national security—as obstacles to commerce.

The administration has advocated global trade talks because this is how the executive branch has done things in the past and because it believes they will reduce congressional pressure for more protectionism in the face of a looming $170 billion trade deficit. Unfortunately, such faith is misplaced.

Start with false historical analogies. Washington remembers such trade negotiations as the Dillon Round (1960-1961), the Kennedy Round (1963-1967), and the Tokyo Round (1974-1979)—which together gave a terrific boost to world trade by lowering tariffs from 40% to less than 5%. American officials recall that these events were successful because the U.S. was able to trade off concessions on its side for more-or-less equivalent breaks from other nations—lower duties on steel imports into the U.S. from Kobe, for example, for easier entry for Kansas grains into Japan.

The current scene is different. Unlike import duties, non-tariff barriers cannot be lowered with percentage cuts. Instead, a new system of regulation—a legal "code"—must be set up specific to each of the many different impediments to trade, agreed to by a host of countries, and monitored and enforced internationally. These highly detailed and legalistic arrangements provide very little opportunity for trade-offs. Is it realistic, for example, that Brazil would lower its national-security strictures against computer imports from all countries in exchange for everyone else's loosening up on health regulations concerning certain agricultural products? It is more likely, in fact, with so many countries and issues mixed together, that stalemate will prevail.

Another change of scene relates to America's negotiating leverage. In the past, U.S. economic dominance was overwhelming. Japan did not really become an economic superpower until the end of the Carter administration. The Brazils, Koreas and Taiwans have only recently become major world traders.

Now Washington is playing with a weak hand. It wants something very specific and precious to other nations: an opening of their technology markets, easier entry for our banks and insurance companies, tougher copyright laws, major reforms in Europe's agriculture. In the past the U.S. could promise others the quid pro quo of increased access to our market. But today we've given everything away unilaterally, thanks to our consumption-stimulating budget deficits, our no-strings-attached approach to deregulation of telecommunications and financial services, and Washington's blase attitude toward a soaring dollar between 1980 and 1984.

America's weakness is compounded by debilitating contradications between the administration free-trade rhetoric and its protective actions on steel, footwear, machine tools, motorcycles, textiles, shingles and sugar. In the past few months alone, the administration proposed and concluded a semiconductor pact with Japan that is a price-supporting cartel involving extensive government regulation. Washington has slapped subsidies on wheat to the U.S.S.R., mocking its own criticism of similar European practices and clobbering allies like Australia that do not subsidize. At bottom, moreover, U.S. trade policy consists of threats to unleash a protectionist Congress and further weaken the dollar, both of which will harm ourselves as well as others.

It is vital for the U.S. to focus on issues where substantial results are achievable soon. This calls not for a global jamboree, but for negotiations on a more manageable scale.

The great danger is that a new round will have a constricting and not liberalizing impact.

As in the past, the administration will have to pay a price to get negotiating authority from Congress and then to get legislative ratification for the subsequent agreements. It's a pattern known in arms-control pacts where the cost of appeasing the Pentagon with new tanks, ships and planes exceeds the weapons reduction in the disarmament agreement itself.

There is also the problem of false expectations. Both the administration and Congress believe the problem with U.S. trade is that others cheat on the rules, and Washington is determined that the new negotiations will address this problem head on. But in 1984, only 5% of imports to the U.S. were challenged before the International Trade Commission for unfair practices and only half of that amount was officially declared unfair. The frustration of dashed hopes could lead to a backlash of even more protectionism.

Moreover, the sheer number of countries involved in the global negotiations is apt to result in a lowest-common-denominator approach to trade policy and thereby reinforce the trend toward "managed trade," a euphemism for more regulation along the lines of the Multifiber Agreement, the most recent version of which was signed last month. Codes dealing with non-tariff barriers involving nations of so many different stages of development are particularly susceptible to more bureaucratic intervention, more red tape and more fine print, since they have to address so many different legal and administrative systems.

For the U.S., it is vital to focus on issues where substantial results are achievable, and soon. This calls not for a global jamboree, but for negotiations on a more manageable scale, sometimes bilateral, sometimes involving several nations. And to make real headway, trade will have to be discussed alongside other economic issues.

In fact, the GATT talks could divert attention from a really important trade agenda.

It is critical, for example, that the U.S. keep relentless pressure on Tokyo to open its markets, not just with lower quotas but also with a faster paced gross national product. Global negotiations make it easier for Japan to squirm out of the limelight and to defer decisions until "broad consensus" is reached.

The U.S. should intensively pursue a free trade and currency coordination pact with Canada; exports and imports with our largest trading partner exceed $100 billion annually. It should likewise propose a package of debt-relief and trade promotion with Mexico, our most important Third World market. Yet focus on these issues will be blurred in the hubbub of Punta del Este.

We ought to negotiate hard to free up trade in wheat, telecommunications and financial services, for example, but the task is best accomplished in smaller forums and not with all the world's trade bureaucrats at the same table.

Tied Hands

The biggest setback would be if the new trade round distracted attention from our own home-grown competitive handicaps—an antitrust policy that ties our hands against corporate giants from abroad, an approach to research-and-development promotion that centers on military and not industrial technology, and a failure to devise a market-oriented system to lessen the impact on workers and communities clobbered by imports. Most of all, Washington needs to devise a policy toward the dollar that doesn't extol its sky-high value one day, then dramatically diminish it the next.

Paula Stern, recent head of the International Trade Commission, put it well: "Our chief concern need not be the tilt of the playing field. We must concentrate, instead, on building up the American team."

Mr. Garten, a managing director of Shearson Lehman Brothers Inc., just completed a two-year assignment in Tokyo.

AN ANALYSIS

In the decades since World War II, courts have emerged as one of the most significant engineers of change in U.S. society. Court decisions have brought about extraordinary alterations in political structures, civil rights, criminal justice, and many other social and political arenas. Recent court activity in the definition and determination of liability promises to result in as much change in business as other decisions have created in other sectors of society. (For additional discussion, see "Management and the Law," in *Scan* No. 2029, May/June 1984.)

The past ten years have seen concepts of product liability undergo considerable change. For one, contributory negligence on the part of a plaintiff no longer keeps him or her from winning the suit. In addition, product liability has been extended to cover parties other than those directly involved.

Professional liability has also spread. Malpractice has gone far afield from medicine. Lawyers, architects, engineers, actuaries, consultants—even the clergy—all are increasingly being held accountable in the courts for undesirable consequences resulting from the practice of their respective professions. It is particularly significant that professionals are being successfully sued even when their competence is not in question. Perhaps even more troublesome, however, are decisions wherein determinations of liability are setting new precedents or radically changing old ones—and thereby fundamentally altering the nature of relationships and the structure of organizations.

One such area is personnel. For example, in 1985, decisions in states from California to New Jersey held that statements in a company's employment manual or job offer letter that may reflect on termination policies were the equivalent of contractual provisions and thus were binding on the company. Other decisions have set new restrictions on the rights of management to fire employees. Indeed, the common-law "fire at will" doctrine seems to have gone by the boards altogether. All such changes are forcing companies to think very carefully not only about how and when to fire, but also about how and who to hire. A further complication is the application of the Racketeer Influenced and Corrupt Organizations Act (RICO) to personnel disputes. Under RICO, for example, a pattern is two similar occurrences of wrongful discharge involving the mails over ten years, so a second ruling against an employer can result in treble damages.

The courts are also attempting to clarify the line of demarcation between individual and organizational responsibility, although the result thus far appears to be more questions than answers. In the area of health, particularly, the implications are hard to read. The current concern about stress, for example, has not yet had much clarification. A recent study on stress for the National Institute of Occupational Safety and Health (NIOSH) concluded that stress costs business as much as $150 billion annually. Workers compensation awards for stress-related problems are increasing geometrically. Companies by the hundreds are rushing to institute stress reduction programs. Unanswered yet is the question of how to allocate responsibility for stress, although the courts are clearly leaning toward putting the onus on the employer and discounting the variations among individuals in susceptibility to stress and self-inducement of stress.

Underlying much of the current activity in labor relations liability is the application to the office of an industrial mind-set. Safety and health, which were dominant labor issues in the factory, are now assuming similar importance in the office. The shift to a service economy has apparently left some issues unchanged.

Perhaps the most profound change has yet to receive much attention. Some court decisions are changing the nature of the corporation itself in fundamental ways. The 1985 decision convicting executives of a Michigan corporation of murder in the death of an employee working with a toxic substance was a landmark. Originally, the corporation was a mechanism for limiting personal risk—and not only financial risk. Courts now seem to say that the corporation is not a shield. Individual responsibility of managers and directors is increasing—and, ironically, it is increasing at a time when the responsibility of individual employees is decreasing. Courts are holding corporations more liable in areas where they used to consider the employee responsible (for example, individual health). ■

POSSIBLE IMPLICATIONS

IN THE WORKPLACE

According to the American Institute of Stress, stress reduction programs are already among the top employee assistance activities in most major corporations. This development has occurred practically overnight, and whether the possible consequences have had sufficient study is uncertain. Does the introduction of a stress reduction program imply acknowledgment of employer responsibility for stress, for example? What is the relationship, if any, between stress and productivity? Is stress reduction an integrated part of a coherent human resources strategy so

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POSSIBLE IMPLICATIONS (Continued)

that mistakes—such as following the announcement of a stress reduction program with an announcement of layoffs—are avoidable?

Some employers are looking to strategies that reduce the possibilities of liability. These attempts go beyond merely rewriting recruiting literature. For example, companies are using more contract, leased, and part-time workers. Other companies are taking the opposite tack: introducing expanded benefit programs—exercise and diet, substance abuse counseling, day care, biofeedback, and so on—as an effort to create a caring environment. Some are instituting what approaches guaranteed lifetime employment. And some are even reexamining opposition to unionization because the alternatives (especially lawsuits) have proved worse.

Health and safety in the office are almost certainly expanding issues. Even though a recent U.S. Congress Office of Technology study concluded that we know little about reproductive risks in the workplace, evidence suggests that debate about this topic will receive greater focus in the near future. The large group of educated, articulate, employed baby-boom women now having or contemplating having babies brings the weight of numbers to bear. Birth defects allegedly resulting from indoor pollution and the growing use of electronic equipment seem most likely to generate a substantial amount of litigation.

Given the above, managers may need to evaluate the extent to which their employees' health can be linked to their management style or the environment in which their employees work. For example, a management attitude that says stress is part of any job and that employees are paid for accepting stress may appeal to hard-line, bottom-line management, but it may not to a jury considering an employee's stress-related suit.

To monitor developments affecting health in the workplace, human resource managers may need to increase their surveillance of literature reporting such advances or to strengthen contact with researchers investigating stress, video display terminals, and other dimensions of workplace health. Human resource managers may need to improve channels of communication to senior management and those responsible for the company's legal affairs so that new developments affecting health in the workplace can be considered for their impact on human resource policies, management style, and potential liability.

Selection and training of personnel, including managers, will increase in importance as sensitivity to liability increases within the company and in society in general. Given the "deep pocket" approach to claims settlement, companies may need to be concerned about the selection and training of personnel in companies that they influence strongly. For example, given growing public awareness and concern about charges of child abuse in day-care centers, companies sponsoring such centers may need to take a more active role in the selection and supervision of their personnel.

IN THE MARKETPLACE

The insurance crisis is already having a serious effect—especially on small businesses. Large companies can self-insure to some extent or, as some have recently done, combine to create their own insurance carriers. But small companies are out in the cold. A movement to require insurance companies to provide property and casualty insurance appears to be growing. Proponents argue that insurance has a quasi-utility status and that its unavailability adversely affects business people's opportunity to earn a livelihood. If insurers are required to offer liability coverage, they may demand the right to intervene more directly in the setting and observance of safety conditions and work rules—much as they have done in fire prevention and, of late, in toxic waste handling.

The combined efforts of the courts and public interest groups have set in motion a trend toward broadening liability that seems at the moment irreversible without the intervention of Congress and state legislatures. The hoped-for remedies range from limitations on product liability and class action suits to modification of RICO. If business hopes to overcome the strength of the liability advocates (including, of course, the politically powerful trial lawyers), it will need a carefully developed strategy that will recognize both the requirements of business and the legitimate demands for equity and fair compensation.

The Saturday-night-special case troubles many observers. While it may be hard to defend the manufacturers of such weapons, is it just to decide a manufacturer's intentions on the basis of how some customers use the product? For example, could the manufacturer of a device that alerts drivers to radar used by the highway patrol to spot speeders be held liable for an auto accident? Some people may argue that the device encourages drivers to speed because it reduces their fear of being caught.

AMONG PROFESSIONALS

The trend toward holding people accountable for undesired consequences of their actions—thus toward more charges of malpractice—shows no sign of abatement, despite strenuous efforts by doctors and other adversely affected professionals. It would seem prudent for businesses to do a form of vulnerability analysis of potential trouble areas. For example, what implied promises exist in advertising or promotion materials that might later come

POSSIBLE IMPLICATIONS (Concluded)

back to haunt a company? If a company needs to exercise greater care in marketing, how can it do so without inhibiting creativity? (For a description of vulnerability analysis, see B-I-P *Report* No. 593, *Vulnerability Analysis in Business Planning*.)

Accounting is one of the professions hard hit by malpractice suits and by the difficulties of finding reasonably priced insurance coverage. Accountants' liability, particularly with respect to corporate audits, is likely to increase pressures for disclosure and for more thorough—and costly—audits. This situation would in turn be likely to reinforce the trend toward privatization and to increase concern among financial analysts about making stock purchase recommendations.

Boards of directors will continue to feel liability pressures. As indemnity insurance premiums skyrocket—while providing lower protection ceilings and more exclusions—the courts are toughening their attitudes toward directors' roles, decisions, and prerogatives. Unprotected companies will find directors virtually impossible to recruit, and the prohibitive costs of insurance will guarantee higher prices all along the line.

Social service professions, like day care and nursery administration, will face increasing difficulty in operating at a profit while maintaining a market; this market may be too small to spread the impact of greatly increased expenses, so the cost of these services to consumers may become unreasonable. Thus, at a time when privatization of government and social welfare services is a possible solution to public debt and inefficiency, liability and insurance problems are forcing purveyors of these services—from care givers to waste treatment facilities—out of business. ■

BACKLASH BEGINNING?

The declining availability and high cost of liability insurance are motivating both government and citizens to take action. Two examples:

- Although most large hazardous waste storage and disposal facilities remain open, most small facilities are closing because they can not meet federal requirements for insurance and groundwater monitoring. (Hazardous waste facilities are required to carry insurance that would cover the cost of cleaning up any toxic leaks from the facilities.) The Environmental Protection Agency is sufficiently concerned about effects on the industry that it has asked the congress to delay implementation of the insurance requirement (*The Wall Street Journal,* 9 December 1985, page 8).

- An initiative in California would eliminate the "joint and several" rule that allows a court to require one defendant to pay enlarged damages because a codefendant in the same lawsuit is unable to pay. Instead, the initiative would install a system allowing proportional payments based on degrees of liability determined by the court. The system would not cover economic damages—medical bills, loss of income, and other out-of-pocket expenses incurred directly by the victim; it would apply only to noneconomic damages such as mental and emotional stress. Backing the initiative is a coalition of businesses, insurance companies, taxpayers' organizations, and medical and business lobbies (*Times Tribune,* 14 December 1985, page A-16).

WORTH READING

For a brief overview of the crisis in liability insurance, see "The Search for Available Insurance: Where is it?" in *The Journal of American Insurance,* Fourth Quarter 1985. (This journal is published by the Alliance of American Insurers, 1501 Woodfield Road, Schaumberg, Illinois 60195-4980; telephone 312-490-8543.)

THE NEW PARAMETERS OF LIABILITY

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Principal Author: Arnold Brown—Weiner, Edrich, & Brown, Inc., New York
Contributions by: Brock Hinzmann, David L. Kolbus, William S. Royce, James B. Smith

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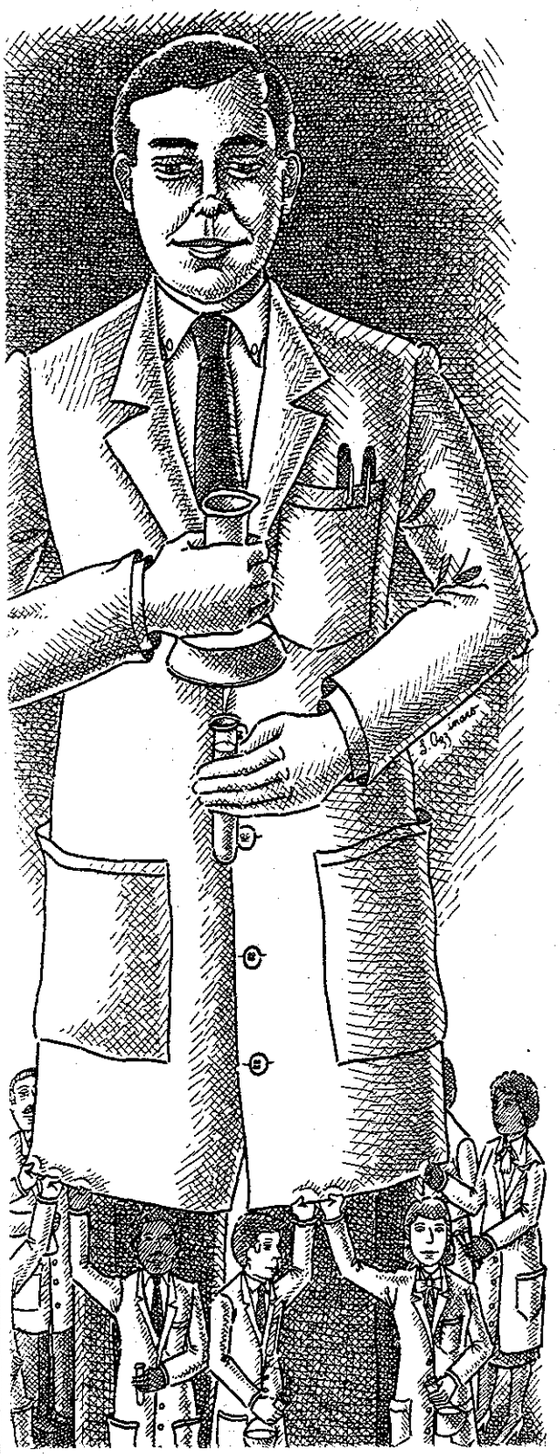

NIH's Doors Opening To Private Companies

New Rules Will Let Researchers Share Knowledge

By Malcolm Gladwell
Washington Post Staff Writer

The doors to National Institutes of Health are about to swing open to the nation's businesses.

A top-level committee at the federal government's giant in-house medical laboratory in Bethesda is drafting guidelines that will give companies unprecedented access to the institute's enormous research resources.

The NIH initiative follows legislation passed last year by Congress designed to improve the dismal track record of federal laboratories in commercializing their research. Since the 1950s only about 5 percent of the federal government's 28,000 patented inventions have been licensed for public use. The Technology Transfer Act, which affects the nation's 775 federal research laboratories, gives the country's 80,000 federally employed scientists and engineers the means and a "national mission" to share their work with industry.

While some business executives have doubts about that mission, the potential impact on jobs and businesses is enormous.

"Technology exists in our federal labs that is not readily available to private industry," Jack McConnell, corporate director for advanced technology with the Johnson & Johnson Co., told Senate hearings on the bill. "This technology provides the basis for creating entirely new products . . . [and] could be a source of thousands, even tens of thousands, of new private-sector jobs in the USA."

Under the proposals to be adopted by NIH, companies will be guaranteed exclusive licensing rights to the fruits of any research undertaken with a government laboratory. In addition, NIH scientists and laboratories will be given hefty incentives to seek commercial applications for their work, such as a share of royalties that would generally be denied a researcher in corporate laboratories.

"It's going to encourage scientists to seek collaborators and industry to seek out scientists," said Ithzak Jacoby, director of the office of medical applications and research at NIH. "Over the next few years we're going to see the building of a great number of fruitful cooperations."

Some of the changes about to be introduced at NIH have been in place informally for the past several years, and the institute has long worked with private industry either directly through scientific collaborations or indirectly through the funding of commercial research. Just this summer, NIH was instrumental in the development by Microgenesys Inc., a biotech firm based in Connecticut, of the first AIDS vaccine for human testing.

But never has the problem of getting technology out of government labs and into the marketplace been given such emphasis.

Just how the new joint agreements will work was demonstrated in July when the Department of Agriculture's Beltsville lab linked with a North Carolina biotechnology firm called Embrex. Under the terms of the

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INSIDE

NIH Scientists Get Means To Share Their Research

LABS, from page 1

agreement, the first of its kind under the Technology Transfer Act, the Agriculture Department and Embrex will produce a vaccine to combat coccidiosis, a chicken disease that can seriously hurt the $7 billion-a-year poultry industry.

Alan Herosian, president of Embrex, said he had been interested in exploiting some of the research done by the Beltsville lab, but "had no idea how to do it. We were looking for a way to make the synergy work, and luckily Congress came along and passed this law."

Without government help, Herosian said, developing the vaccine would be difficult if not impossible. But without the new licensing arrangement, his firm could not have been guaranteed exclusive marketing rights to the fruits of a joint venture.

"We used to have an arm's-length relationship with business," said James Hall, who runs the technology-transfer program at the Beltsville facility. "Now there's much more of a symbiosis. We expect to see steady growth in this area."

Expectations for NIH's program, which should be in place before the end of the year, are running even higher. Already the Washington-Baltimore corridor is home to one of the nation's largest concentrations of biotechnology companies. The hope is that the new licensing agreements and joint-venture arrangements will allow NIH to forge stronger ties with surrounding biotech firms. In fact, the reforms under consideration are modeled closely on those made by the patents and trademark amendments of 1980 that are widely credited with prompting the enormous growth in private-sector funding of university research during the past seven years.

"We are trying to do the same thing for federal laboratories that we did for universities 10 years ago," said Joseph Allen, a technology policy liaison with the Department of Commerce. "If you look at where the big high-tech growth has been recently, it's been around places like Stanford and Harvard in silicon valley and Route 128. We think the same thing's going to happen around NIH."

At present, the institute's ties to local firms are considered to be highly informal. "A lot of people left NIH to go into private industry and decided to stay in the area," Jacoby said. But beyond that kind of cross-pollination of talent, and the inevitable local concentration of biomedical service firms that do contract work for NIH labs, the institute hasn't courted private firms in anything like the manner that major research universities have.

Indeed, to the extent that NIH has worked with industry, institute officials confirm that local firms have played no more prominent a role than anyone else. Genex, one of the oldest and best known of Maryland biotech companies, didn't take any government money from NIH for its first six years. Biotech Research Labs, the Rockville firm that was licensed by the FDA in May to produce the "Western Blot" test kit for acquired immune deficiency syndrome, started almost exclusively as a contract firm for NIH but has moved markedly in the opposite direction in recent years. "We are moving into the commercial arena to minimize the fluctuations of federal funding," Biotech President Thomas Li said.

"When I think of companies with strong NIH ties, I think of firms in Philadelphia," said Parag Saxena, an analyst with Citibank in New York. "When something is right there, sometimes poeple don't take advantage of it. I know lots of people in New York who have never been up the Empire State Building. But I know that whenever I have visitors, that's the first thing they want to see. It's the same thing with Maryland firms and NIH."

Yet while restructuring NIH along the lines of a university might spark increased interaction with the surrounding industrial biotech community, NIH officials are quick to point out that substantial differences remain between the way in which government labs and universities relate to industry.

For one thing, NIH does not have the same dependence on the private sector for research money as do universities. While universities scramble to find new sources of cash from the business community, NIH is performing the opposite function. Last year it doled out $3.7 billion for research grants all over the country, with $44.5 million specifically targeted to small business.

Furthermore, while many academic scientists are given wide freedom to consult with private industry, in some cases being granted one paid working day a week for that purpose, the outside activities of NIH researchers are strictly controlled. Government scientists can't consult on anything directly related to their work—just on general knowledge—and have to do it on their own time. Further, they're limited to total annual outside earnings of $25,000, with no more than half of that figure from any one company.

"Getting access to scientists directly is a real problem," complained Steve Turner, CEO of the Gaithersburg biotech firm, Oncor. "Science itself has no value unless you can work with the people directly. If the Washington area ever wants to really compete with Boston and San Francisco it has to unleash the human potential which is presently locked up by the government."

But change is unlikely, some officials said.

"We've gone about as far as a federal agency can. We're a government agency and have to be held accountable to the public," Jacoby said, and other NIH officials spoke of the need for government employes to be "purer" than those in the private sector. Until a few years ago, NIH employes weren't allowed to consult with industry at all.

That commitment to basic research limits the immediate commercial potential of government research.

Bionetics Research Inc. in Rockville, for example, has a fairly close relationship with the National Cancer Institute at NIH. Bionetics is pooling its production facilities with NIH's clinical resources in search of a diagnosis for colon cancer. The principal result of the collaboration won't be a product for market, however, but a research paper for general publication. Working with NIH, said Michael Hanna, vice president and director of research for the firm, "takes us only 10 percent of the way. We have to do the rest of the work ourselves."

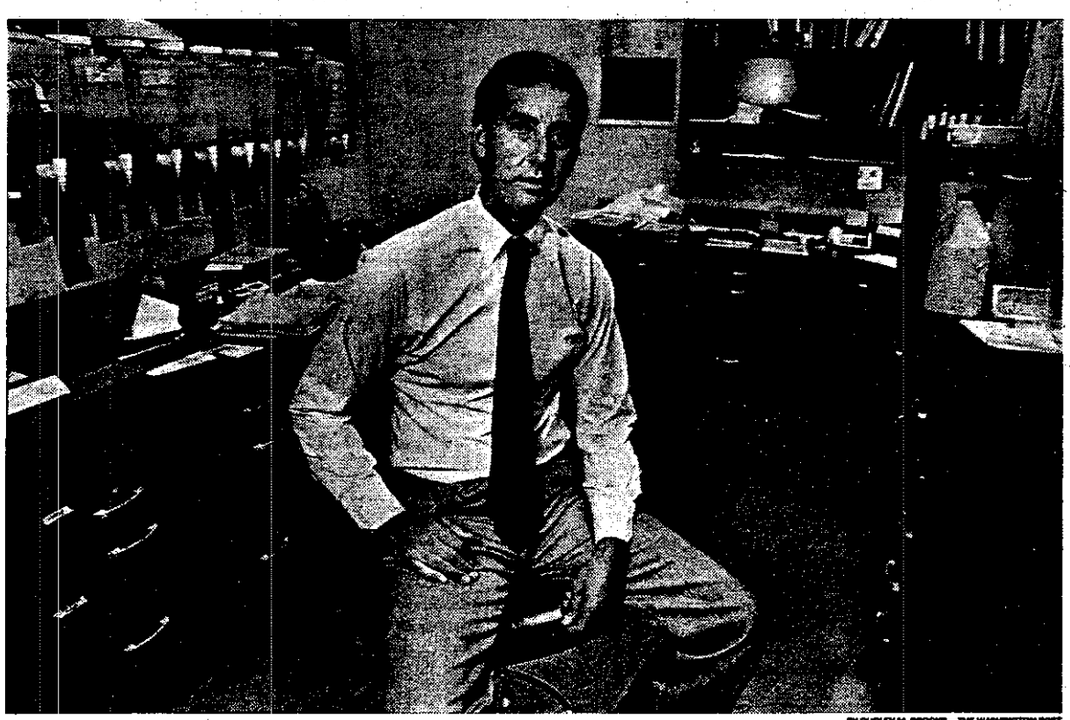
According to Richard Nelson, a professor of political economy at Columbia University in New York, industry-government relationships are "often very fruitful. However with few exceptions the benefit to the company is not a process or product but general help, understanding of how to do things."

J. Leslie Glick, formerly of Genex Corp. and now president of Bionix Corp. of Potomac, said, "We are going to see a lot more of these arrangements in the future. It permits a type of interaction with NIH that until recently you just couldn't have." ■



BY LUCIAN PERKINS—THE WASHINGTON POST

NIH's Itzhak Jacoby: "We've gone about as far as a federal agency can" in meeting industry.



BY DUDLEY M. BROOKS—THE WASHINGTON POST

Oncor's Turner: "Getting access to scientists directly is a real problem. Science itself has no value unless you can work with the people directly."

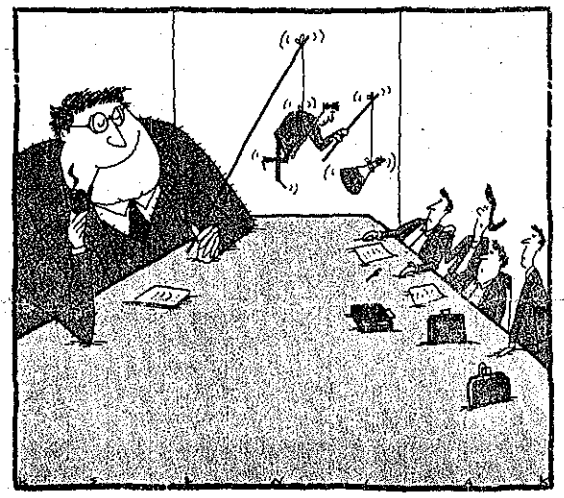
The Startup Insurance Trap

MEETING LICENSING DEMANDS CAN KILL SMALL COMPANIES

By Anne Simon Moffat

MEDSENTRY MAKES tiny water beds that could help save the lives of premature babies. An air pump sloshes water around in irregular wave patterns, simulating conditions inside the uterus and presumably easing the newborn's adjustment to the world. The novel water bed fits in standard incubators.

The product may not make it to market, however. The small company, run by the husband-and-wife team of Larry and Sue Browne in Santa Barbara, Calif., faces a financial crisis. The company licensed the technology the product uses from Stanford University, and the small startup (last year's sales: $62,000) cannot afford the liability insurance that Stanford is demanding as part of the licensing arrangement.



MARK KSENIAK

Such conundrums are not unique. Idec, a company in La Jolla, Calif., that is developing an antibody-based cancer therapy that uses Stanford research, almost hit the same dead end. The licensing deal was saved only after the university, which normally requires its licensees to have $5 million in insurance when they do clinical trials, agreed to be satisfied with the $500,000 insurance that the company could get.

The spectre of liability litigation has dampened the enthusiasm of many universities for licensing deals—a trend that threatens to cut small companies off from what has been a fertile source of new products. Particularly hard-hit are the high-risk arenas of medical equipment and pharmaceuticals. The liability issue is arising with greater frequency as universities increasingly conceive products in those fields and attempt to commercialize them. Even though the business that markets a product would be named in any liability suit, the plaintiff usually goes after everyone related to the product involved, and a wealthy licensor makes an especially juicy target. Top-notch research universities like Stanford and the Massachusetts Institute of Technology worry that their endowments, often amounting to hundreds of millions of dollars, will come under attack.

As a result, businesses that want to turn university research into profitable products are running into increasingly stringent demands from the universities. Those demands often create a Catch 22 for licensees: they can't get the technology unless they meet university demands, but meeting university demands may leave them financially unable to develop and market the product.

The insurance that universities require can kill a company before it gets going. Because many high-tech fields have no track record on which insurance companies can base risk estimates, insurance rates can be exorbitant—as much as $90,000 for $400,000 of protection.

Businesses also must sometimes deal through a middleman rather than directly with the school. For example, University Patents Inc. of Westport, Conn., specializes in taking title to patents and negotiating with prospective licensees. Although this arrangement appeals to some companies because it lets them negotiate with another business rather than an academic bureaucracy, the involvement of a middleman adds cost.

Universities also try to protect themselves from litigation by licensing concepts rather than products and barring an inventor from further involvement—financial or otherwise—in the company. From a business perspective, such a requirement can be an advantage; it's generally cheaper to license a product at a very early stage of development. The catch is that a company may be deprived of the inventor's expertise.

"Some sanity to tort law is needed to give entrepreneurs—and universities—a fighting chance," says John Preston, MIT's director of technical licensing. Until recently, there was hope that new legislation might stem the tide of liability suits and ease the commercialization of research by putting a time limit on claims and by eliminating licensors from liability, except in cases of clear negligence. But this year's juggling of congressional committees dimmed that prospect: The chairman of the Committee on Commerce, Science, and Transportation is U.S. Senator Ernest Hollings, an outspoken advocate of trial attorneys. Few expect the present Congress to change the law.

In the meantime, the small firms that have hit snags because of universities' fear of litigation are trying to find their own solutions. Says MedSentry's Sue Browne: "We are seeking to be bought out, hoping that a larger company can afford the insurance we need to continue doing business." ■

Anne Simon Moffat is a free-lance writer.

Harvard Business Review
March–April 1986

Robert B. Reich and
Eric D. Mankin

Joint ventures with Japan give away our future

Articles

Listen to what these four businessmen have to say about U.S.-Japanese joint ventures:

"They buy energy-intensive components here, like glass, tires, and steel. But when it comes to things that are labor-intensive, that stays in Japan." – Terrence J. Miller, official, Automotive Parts and Accessories Association.

"People we used to do business with, we can't anymore [because they aren't competitive]. Instead of buying a given part from a supplier down the street in Chicago, I buy it from a supplier down the street in Osaka." – Robert W. Galvin, chairman, Motorola.

"Cross & Trecker is committed to the business of machine tools, but it is not committed to build in the United States all or any portion of the machine tools that it sells here." – Richard T. Lindgren, president, Cross & Trecker.

"First you move the industrial part to the Far East. Then the development of the product goes there because each dollar you pay to the overseas supplier is ten cents you're giving them to develop new devices and new concepts to compete against you." – C.J. Van der Klugt, vice chairman, Philips N.V.

Each of these businessmen is commenting on aspects of a trend that is reshaping America's trade relations with Japan and creating a new context for international competition. Very simply, this is the situation: to avert rising U.S. protectionist sentiment, Japanese companies are setting up plants in the United States, either as joint ventures or on their own; to obtain high-quality, low-cost products and components, U.S. companies are making joint venture agreements with Japanese companies. At the same time, U.S. companies are licensing their new inventions to the Japanese. (The *Exhibit* lists recent U.S.-Japanese coalitions in high-technology industries.)

"The big competitive gains come from learning about manufacturing processes – and the result of the new multinational joint ventures is the transfer of that learning from the United States to Japan."

On the surface, the arrangements seem fair and well balanced, indicative of an evolving international economic equilibrium. A closer examination, however, shows these deals for what they really are – part of a continuing, implicit Japanese strategy to keep the higher paying, higher value-added jobs in Japan and to gain the project engineering and production process skills that underlie competitive success. (+)

In contrast, the U.S. strategy appears dangerously shortsighted. In exchange for a few lower skilled, lower paying jobs and easy access to our competitors' high-quality, low-cost products, we are apparently prepared to sacrifice our competitiveness in a

Mr. Reich, who teaches political economy and management at Harvard's John F. Kennedy School of Government, was director of policy planning at the Federal Trade Commission during the Carter administration. His most recent book is New Deals: The Chrysler Revival and the American System *(Times Books, 1985).*

Mr. Mankin is a doctoral candidate in economics and business at Harvard University. His research focuses on production management and industrial organization.

(+) Assumes that U. business has a materialist perspective. Is this true?

host of industries – autos, machine tools, consumer electronics, and semiconductors today, and others in the future.

Before this trend becomes an irrevocable destiny, U.S. business and government leaders need to review the facts carefully and decide if they should follow a different course. Two questions, in particular, frame the issue: What skills and abilities should be the basis for America's future competitive performance? And how does the current strategy of Japanese investments and joint ventures affect those skills and abilities?

The quotes cited earlier and an examination of U.S.-Japanese coalitions across a range of industries suggest disturbing answers to these questions. Through these coalitions, Japanese workers often gain valuable experience in applications engineering, fabrication, and complex manufacturing – which together form the critical stage between basic research and final assembly and marketing. U.S. workers, in contrast, occupy the two perimeters of production: a few get experience in basic research, and many get experience in assembly and marketing.

But the big competitive gains come from learning about manufacturing processes – and the result of the new multinational joint ventures is the transfer of that learning from the United States to Japan. The Japanese investment in U.S. factories gives the Americans experience in component assembly but not component design and production. Time after time, the Japanese reserve for themselves the part of the value-added chain that pays the highest wages and offers the greatest opportunity for controlling the next generation of production and product technology.

In the auto industry, for example, General Motors has formed a joint venture with Toyota, while Chrysler has teamed up with Mitsubishi, and Ford with Mazda. All three deals mean that auto assembly takes place in the United States. But in each case, the U.S. automakers delegated all plant design and product engineering responsibilities to their Japanese partners. The only aspect of production shared equally is styling. Under the Chrysler-Mitsubishi agreement, the joint venture will import the engine, transmission, and accelerator from Japan.

Or take the example of the IBM PC, which is assembled in the United States. The total manufacturing cost of the computer is about $860, of which roughly $625 worth, or 73%, of the components are made overseas. Japanese suppliers make the graphics printer, keyboard, power supply, and half the semiconductors. America's largest contribution is in manufacture of the case and assembly of the disk drives and the computer.

This trend spells trouble. If a Japanese company handles a certain complex production process, its U.S. partner has little incentive to give its skilled workers the time and resources required to design and debug new products and processes. Thus as their employers turn to Japanese partners for high value-added products or components, America's engineers risk losing the opportunity to innovate and thereby learn how to improve existing product designs or production processes.

Unless U.S. workers constantly gain experience in improving a plant's efficiency or designing a new product, they inevitably fall behind the competition. This is especially true in high-technology sectors, where new and more efficient products, processes, and technologies quickly render even state-of-the-art products obsolete. For example, as the Japanese moved from supplying cheap parts to selling finished products in the consumer electronics industry, vital U.S. engineering and production skills dried up through disuse. The U.S. work force lost its ability to manufacture competitive consumer electronics products.

The problem snowballs. Once a company's workers fall behind in the development of a rapidly changing technology, the company finds it harder and harder to regain competitiveness without turning to a more experienced partner for technology and production know-how. Westinghouse, for example, closed

Exhibit **A sampling of U.S.-Japanese joint ventures**

Bendix-Murata Manufacturing Company	Machine tools
Boeing-Mitsubishi Heavy Industries Boeing-Kawasaki Heavy Industries Boeing-Fuji Heavy Industries	Airplanes
Armco-Mitsubishi Rayon	Lightweight plastic composites
General Motors-Fujitsu Fanuc	Machine tools
General Motors-Toyota	Automobiles
Ford-Mazda	Automobiles
Chrysler-Mitsubishi Motors	Automobiles
Westinghouse-Komatsu Westinghouse-Mitsubishi Electric	Robots and small motors
IBM-Matsushita Electric	Small computers
IBM-Sanyo Seiki	Robots
Allen Bradley-Nippondenso	Programmable controllers and sensors
General Electric-Matsushita	Disc players and air conditioners
Kodak-Canon	Copiers and photographic equipment
Sperry Univac-Nippon Univac	Computers
Houdaille-Okuma	Machine tools
National Semiconductor-Hitachi	Computers
Honeywell-NEC	Computers
Tandy-Kyocera	Computers
Sperry Univac-Mitsubishi	Computers

its color television tube factory in upstate New York ten years ago because it could not compete with Japanese imports. That same plant will soon reopen as a joint venture with Toshiba – but only because Toshiba is supplying the technology. Westinghouse engineers, who had not worked on color television tubes for at least a decade, could not develop the technology alone.

On the other hand, continual emphasis on and investment in the production part of the value-added chain will result in low-cost, high-quality products and a steady stream of innovations in products and processes. If current trends persist, Japanese companies will keep gaining experience and skill in making products. They will continue to develop the capacity to transform raw ideas into world-class goods, both efficiently and effectively.

The implications of this trend for U.S. companies, workers, and the national economy are uniformly bad. The Japanese are gradually taking charge of complex production – the part of the value-added chain that will continue to generate tradable goods in the future and simultaneously raise the overall skill level of the population. The entire nation benefits from a large pool of workers and engineers with skills and experience in complex production.

The United States, however, will own only the two ends of the value-added chain – the front end, where basic research and invention take place, and the back end, where routine assembly, marketing, and sales go on. But neither end will raise our overall skill level or generate a broad base of experience that can be applied across all kinds of goods.

As more and more production moves to Japan, our work force will lose the capacity to make valuable contributions to production processes. An economy that adds little value to the production process can hardly expect to generate high compensation for less valuable functions. If the current trend continues, our national income and standard of living may be jeopardized.

Japan's investment in America

Japanese investment in the United States has given rise to automobile plants producing Nissans, Hondas, Toyotas and, in the near future, Mazdas and Mitsubishis. Japanese semiconductor and computer manufacturers have helped create a "silicon forest" in Oregon. In the last four months of 1984, Japanese electronics companies established 40 new plants in the United States that produce everything from personal computers to cellular mobile telephones. According to the Japan Economics Institute, there are now 522 factories in the United States in which Japanese investors own a majority stake.

Japanese companies are also building laboratories here. Nippondenso's research center in Detroit will focus on automobile electronics and ceramics, and Nakamichi's in California will develop innovations in computer peripherals. Furthermore, nearly every major Japanese company now funds research at American universities in return for the right of first refusal in licensing any products or technologies that are developed.

Although Japanese companies fund basic research at American universities, the results of that research go back to Japan for commercialization. At the other end of the manufacturing process, Japanese plants in the United States take the results of complicated production done in Japan and assemble the final products. NEC's new computer facility in Massachusetts assembles computers from Japanese central processing units and memory chips. The most sophisticated components and systems of automobiles are apt to be produced in Japan, even if the car is assembled in Michigan, California, or Tennessee.

Heart of the matter

At the heart of a growing number of U.S.-Japanese joint ventures is the agreement that the Japanese will undertake the complex production processes. These agreements need not automatically turn out this way. In fact, there are many different types of international joint venture, and each type has different implications for production, distribution, and division of profit between the partners.

Consider the recent agreement between AT&T and Philips N.V., under which Philips will distribute AT&T products in Europe. The two companies each contributed resources to the formation of a new jointly owned entity. AT&T's stated goal was to enter the European market; Philips presumably wanted access to AT&T's products. AT&T could have sold Philips an exclusive European license to manufacture and distribute its products; it could have leased Philips's factories or built its own in Europe and used Philips as a distributor; or it could have bought Philips, a move that would have given it the Dutch company's factories and distribution network, as well as all of its proprietary products.

U.S. companies planning joint ventures with Japan usually find that at least one of these options is unavailable: they cannot buy a Japanese company. Still, U.S. companies can enter a wide range of potential joint venture agreements. Most of the high-technology joint ventures that we examined, however,

were agreements in which the U.S. partner would sell and distribute the Japanese product; our study of 33 joint ventures between U.S. and Japanese companies in consumer electronics industries showed that roughly 70% took this form.

Under the typical agreement, the U.S. company buys products from its Japanese partner and sells them in the United States under its own brand name, using its own distribution channels. The IBM graphics printer is made by Epson in Japan. The Canon LBP-CX laser printer is manufactured in Japan and sold in the United States by Hewlett-Packard and Corona Data Systems. Even Eastman Kodak is joining the bandwagon: Canon of Japan will make a line of medium-volume copiers for sale under Kodak's name; Matsushita will manufacture Kodak's new video camera and recorder system, called Kodavision.

This type of arrangement is not unique to U.S.-Japanese joint ventures; European high-technology computer, semiconductor, and telecommunications companies are also entering into a disproportionately large number of sales and distribution agreements with the Japanese.

For many U.S. managers, these joint ventures make good business sense. Faced with seemingly unbeatable foreign competition, many U.S. companies have decided that it is more profitable to delegate complex manufacturing to their Japanese partners. Consider Houdaille Industries, a Florida-based manufacturer of computer-controlled machine tools. Beginning in 1982, the company set out to block imports of competing Japanese machine tools. It petitioned Washington for protection, accusing the Japanese of dumping and receiving subsidies from the Japanese government. When that strategy failed, Houdaille tried to persuade the Reagan administration to deny the 10% federal investment tax credit on equipment to U.S. buyers of Japanese machine tools. The administration rejected this proposal as well. Finally, Houdaille announced that it would seek a joint venture with Japan's Okuma Machinery Works.

The machine tool story

Houdaille is not the only machine tool manufacturer to look for Japanese partners. James A.D. Geier, chairman of Cincinnati Milacron, the nation's largest machine tool manufacturer, noted in 1984 that "50% of the products we sold last year did not even exist five years ago. We've gone from being an industry with very little change in products to one with a revolutionary change in products." Many U.S. companies were unprepared for such a transition and as a result can make money only by selling advanced products manufactured in Japan. In 1983, more than 75% of all machining centers sold in the United States were made in Japan (even though many ended up with American nameplates), and domestic production has declined dramatically.

As imports have increased, international joint venture activity in the machine tool industry has accelerated. A recent National Research Council report on machine tools noted that "most of these joint ventures have offered the potential for low-cost, reliable overseas manufacturing for the U.S. partner, and an enhanced marketing network in this country for the foreign one."[1] For example, Bendix sells a small turning machine in the United States for $105,000. It can produce the device in Cleveland for $85,000. The same machine, produced in Japan by Bendix's new partner, Murata Manufacturing, and then shipped to Cleveland, costs the company only $65,000. Such compelling economics underlie Bendix's decision to transfer nearly all its machine tool production to Japan.

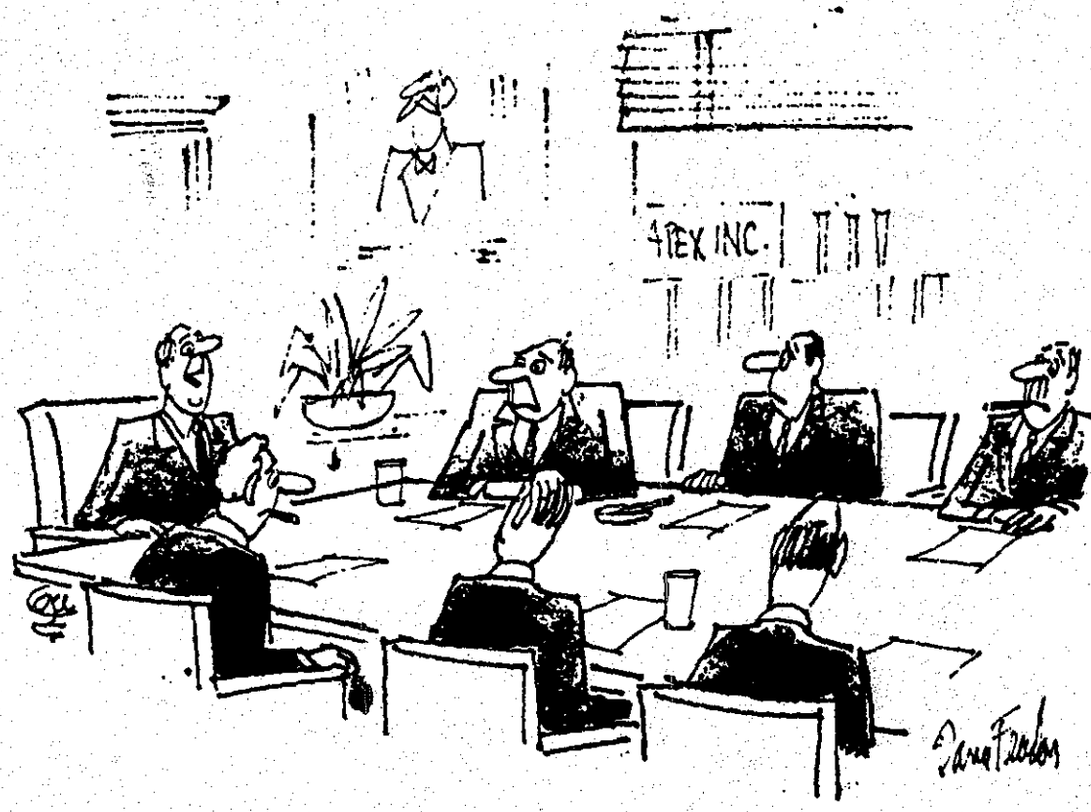
Or consider the case of Pratt & Whitney, which earns profits by distributing foreign-made machine tools. In July 1984, its president, Winthrop B. Cody, told the *New York Times*: "I wish we could make some of these machine tools here, but from a business point of view it's just not possible." Even U.S. companies that develop new products look to Japan for manufacturing. Acme-Cleveland's state-of-the-art numerically controlled chucker, jointly developed with Mitsubishi Heavy Industries, will be produced in Japan.

The semiconductor story

While not in quite the same straits as machine tool producers, U.S. semiconductor manufacturers also face increasing competition from Japan and thus increasing pressure to enter into coalitions with Japanese companies. Traditionally, the Japanese have entered semiconductor markets as followers, thereby enabling U.S. companies to reap high profits before the product's price drops. Once the Japanese enter, they rapidly gain market share by competing on the basis of a lower price.

Some of the most famous examples of the "Japanese invasion" come from the memory chip wars of 1973-1975 and 1981-1983, when U.S. chip makers ceded a large part of the 16k and then the 64k dynamic memory market to Japanese manufacturers producing at lower cost. In the spring of 1984, Japanese manufacturers controlled about 55% of the U.S. market for 64k RAM chips. Taking a lesson from these bat-

[1] Committee on the Machine Tool Industry, Manufacturing Studies Board, Commission on Engineering and Technical Systems, National Research Council, *The U.S. Machine Tool Industry and the Defense Industrial Base*, Washington D.C., National Academy Press, 1983, p. 44.



"Look at it this way, gentlemen. Minimum tax is better than maximum tax."

tles, some U.S. companies decided to delegate production to the Japanese at the start of a new project: in 1982, Ungermann-Bass made an agreement with Japanese chip maker Fujitsu by which Ungermann-Bass designs very large scale integrated circuits for local area networks. The company then sends the designs to Fujitsu in Japan for manufacturing.

Innovations and new products in the semiconductor industry are a predictable function of experience and engineering know-how: 16k RAM chips precede 64k RAMs; the development of the 16-bit microprocessor follows logically from the existence of its 8-bit forebear. Since technological leadership is linked so closely to production experience, the emergence of pioneering Japanese products will only be a matter of time. In December 1984, for example, Hitachi introduced a 32-bit microprocessor, thus signaling its intention to compete aggressively against U.S. companies in leading-edge semiconductor technologies. While both Motorola and National Semiconductor are producing a 32-bit chip, Hitachi's entry predates Intel's new product announcement. Intel introduced its new 32-bit microprocessor in October of 1985.

Hitachi's push toward state-of-the-art semiconductor production foreshadows a new round of sales and distribution agreements. Soon executives at Intel or National Semiconductor will realize that Hitachi or another Japanese semiconductor manufacturer can sell advanced semiconductor products at prices that U.S. companies cannot match. These semiconductor companies might go to Washington looking for trade protection. More likely, however, they will try to preserve their profitability by negotiating sales and distribution agreements. National Semiconductor already has trading ties with Hitachi through which it markets Hitachi's computer in the United States.

A comparison of two joint ventures – National Semiconductor-Hitachi and Amdahl-Fujitsu – illustrates the different approaches U.S. and Japanese companies take toward joint ventures. Fujitsu and National Semiconductor both fabricate integrated circuits, while Hitachi and Amdahl manufacture IBM-compatible mainframe computers. Both ventures link a computer and a semiconductor manufacturer.

The agreement between National Semiconductor and Hitachi is similar to sales and distribution agreements in other industries. In an attempt to diversify downstream, National Semiconductor will sell Hitachi's IBM-compatible mainframe computers in the United States. Hitachi, however, will be under no obligation to use any National Semiconductor products in making its computer. National Semicon-

ductor may thus find itself in the position of manufacturing chips for Hitachi's competitors while selling a Japanese-made computer that contains none of its own components.

In contrast, Fujitsu purchased a controlling interest in Amdahl in 1983. As a result, Amdahl will now buy from Fujitsu most of the semiconductors it uses in the manufacture of its mainframe computers. Fujitsu will not, however, sell Amdahl computers in Japan. In both cases, Japanese companies add to their manufacturing experience. Complex production stays in Japan, and the final products are sold in the United States.

The story behind the stories

What lies behind Japan's direct investment in the United States and the coalition-building activities of U.S. and Japanese high-technology companies? What motivates U.S. and Japanese managers?

The Japanese hope to mitigate future U.S. trade barriers by investing in the United States and allying with U.S. companies. In 1981, nontariff import restrictions protected about 20% of U.S. manufactured goods; by 1984, protection covered 35%. To the Japanese, the trend is clear. If the Reagan administration succumbed so readily to protectionism, what can the Japanese expect from future administrations that may be less ideologically committed to free trade? Mazda is investing $450 million in a new auto assembly plant in Flat Rock, Michigan because quotas had prevented Mazda from importing enough cars to meet demand. Despite the recent expiration of voluntary import restraints on Japanese automobiles, Chrysler and Mitsubishi came to an agreement in April 1985 to assemble Mitsubishi automobiles in Illinois. Concern over future trade barriers was a strong motivating factor for Mitsubishi.

From the Japanese perspective, joint ventures with U.S. companies will also help forestall further protectionism. RCA was notably absent from the 1977 dumping case over Japanese color television sets. Because it had licensed technology to Japanese television manufacturers, RCA was benefiting from Japanese imports. In the same way, now that RCA is distributing a PBX system manufactured by Hitachi, it has no interest in pushing for trade barriers in telecommunications equipment.

In both joint ventures and direct investments, U.S. companies and workers become partners in Japanese enterprises. Japanese direct investment puts Americans to work assembling Japanese-made components. Joint ventures and coalitions employ Americans selling Japanese products. If trade barriers limit the flow of products from Japan, American workers will lose their jobs assembling and distributing these goods and U.S. corporations will lose money.

Why do U.S. companies find joint ventures with Japanese companies so attractive? Companies in emerging industries often view a joint venture with a Japanese company as an inexpensive way to enter a potentially lucrative market; managers in mature industries view the joint venture as a low-cost means of maintaining market share. In industries ranging from consumer electronics to machine tools, the Japanese have the advanced products American consumers want. Joint ventures allow U.S. companies to buy a product at a price below the domestic manufacturing cost. The Japanese partner continues to move down its production learning curve by making products destined for U.S. markets. Thanks to these joint ventures and coalitions, the efficiency gap between U.S. and Japanese manufacturing processes will continue to widen.

A Japanese strategy

The trends of the past 40 years as well as current Japanese actions in the United States suggest the existence of a long-term Japanese strategy. The overriding goal of Japanese managers is to keep complex production in Japan. They intend to develop national competitive strength in advanced production methods. U.S. managers who want to take advantage of Japan's manufacturing strength may do so by selling Japanese products in the United States. They may also set up production facilities in Japan, provided they are run and staffed by Japanese.

Increasingly, American managers are aiding the Japanese in achieving their goals by channeling new inventions to Japan and providing a sales and distribution network for the resulting products. Burroughs and Hewlett-Packard, for example, have just set up buying offices in Japan to procure high-tech components from Japanese manufacturers. Over the next five years, we expect sales and distribution agreements to result in lower profitability and reduced competitiveness for the U.S. companies that enter into them.

The reason is simple: the value provided by the U.S. partner in a sales and distribution agreement is potentially replaceable. The U.S. company gives away a portion of its market franchise by relying on a Japanese company for manufactured products – in essence, it encourages the entry of a new competitor. As shown by the Japanese-dominated consumer elec-

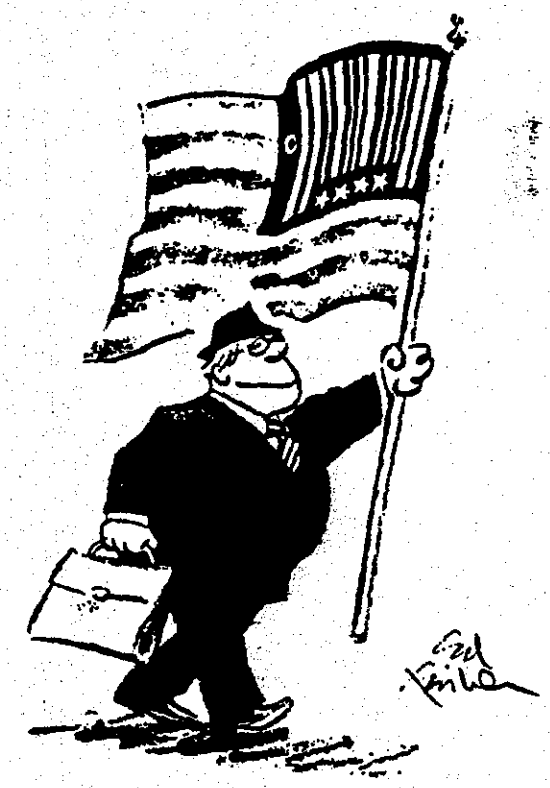
tronics industry, these agreements can act like a Trojan horse: the U.S. company provides the Japanese company access to its customers, only to see the Japanese decide to go it alone and set up a distribution network on the basis of a reputation gained with the help of the U.S. partner. Even if the Japanese do not terminate the agreement after establishing a presence in the United States, Japanese manufacturers are in a position to squeeze their U.S. distributors' profit margins precisely because sales and distribution functions are so vulnerable to replacement.

U.S. companies are selling themselves too cheaply; in letting their Japanese partners undertake product manufacturing, they are giving away valuable production experience. Instead, U.S.-based companies could begin to invest in more sophisticated production within the United States. They could seek to develop in our work force the same base of advanced manufacturing experience that Japanese managers are now creating among their workers. Unfortunately, from the standpoint of a typical U.S. company, the guaranteed return on this sort of an investment is often not enough to justify its cost, especially when the alternative of Japanese manufacture is so easy to choose.

Production experience is essentially social. It exists in employees' minds, hands, and work relationships. It cannot be patented, packaged, or sold directly. It is thus a form of property that cannot be claimed by the managers who decide to invest in it and the shareholders they represent. This form of property belongs entirely to a company's work force. It will leave the company whenever the workers do.

An economic fable

Imagine the following: the chief executive of a U.S. company decides to invest in production experience. Instead of relying on a Japanese supplier for a complex component, top management decides to produce it in America, inside its own operation. The component costs more to produce here than in Japan – the equivalent of $1,000 more per employee. The higher cost partly reflects the overvalued dollar, but it occurs mainly because the Japanese have already invested in producing this component cheaply and reliably. The chief executive sees the added expense as an investment. Once the workers and engineers gain experience in making the component, they will be better able to make other products. They will learn about the technology and will be able to apply that learning in



countless ways to improve the company's other processes and products. As a result, the company will gain $1,500 per worker in present-value terms. Thus the initial $1,000 investment is well worth it.

As might be imagined, the chief executive cannot get anywhere near the $1,500 return envisioned from this investment. As soon as the workers and engineers realize their increased value, they ask for more money. In this fable, they can, of course, ask for $1,499, since they are now worth an extra $1,500.

If the executive refuses to give the workers a raise, they can simply leave the company and work for the competition. Faced with a sizable loss on the investment, our executive vows that from now on the company will buy advanced components from Japan.

This fable is not so farfetched. Studies show that companies retain an average of only 55% of their engineering trainees after two years. In one study, the factor cited most often by departing engineers was "inadequate compensation," followed closely by "uncertain future with the company" and "higher salary offer elsewhere."[2] Thanks to such high job mobility, the engineers responsible for developing a new product or designing a cost-saving manufacturing process at one company in one year may find themselves using their expertise to help another company in another year – perhaps their first employer's chief competitor. Thus, companies that invest in production experience may ultimately produce profits for the competition.

2 Eugene Raudsepp, "Reducing Engineer Turnover," *Machine Design*, September 9, 1982, p. 52

3 Andrew Weiss, "Simple Truths of Japanese Manufacturing," HBR July-August 1984, p. 119

The Japanese system of lifetime employment eliminates this problem. While not all Japanese companies subscribe to such a policy, most of the large companies making advanced products for export do. This system makes it unthinkable for workers to join the competition; they would leave behind friends, homes, social status—in short, much more than a job. In this atmosphere, an investment in production experience comes quite naturally. Benefits resulting from such an investment tend to remain with the company.

Furthermore, because of the abundance of engineers and because engineers stay with their original employers, Japanese managers can give factory workers more engineering support. As Andrew Weiss noted in an HBR article, for high-volume, low-technology products like radios, the ratio of production workers to engineers in Japan is about four to one. In divisions making more sophisticated products, such as very large scale integrated circuits, the Japanese manufacturers observed by Weiss employed more engineers than production workers. Weiss attributes the high levels and rapid increases in Japanese companies' labor productivity to heavy investment in engineering.[1] Most conventionally organized U.S. companies, faced with high turnover, cannot afford to invest so heavily in their engineers.

As a result of these organizational differences, U.S. managers have little incentive to invest in production experience. The Japanese, however, will be able to capture most of the returns from their investments in Japanese workers. U.S. managers are happy to buy components from the Japanese or build new factories in Japan, thus further contributing to the production experience of the Japanese work force. But what is really at stake is not where company headquarters are located or profits remitted, but rather the value added by a nation's work force to an increasingly global process of production and the capacity of that work force to generate new wealth in the future. We are falling behind in this high-tech race, and actions taken by both U.S. and Japanese companies only serve to further weaken the U.S. work force.

Changing course

The current situation has severe drawbacks for U.S. companies over the next five years. Over the long term, U.S. companies that enter joint ventures with Japan cannot maintain high profitability by providing services, such as assembly and distribution, which add very little value to the product being sold. The resulting interplay, while superficially promising, could really be just an extended dance of death.

Profit sharing?

As profits dwindle, management might at last look to profit sharing or other forms of employee ownership that reduce turnover rates. The lower the turnover, the more profitable are investments in the work force. Furthermore, profit-sharing programs will enable workers to gain directly from a company's investments in them. To return to our fable, when workers in a company practicing profit sharing demand their raises, our chief executive need only say, "Wait, and you will get higher compensation when our investments start paying off and the company makes more money."

In practice, however, it may be impossible to devise a profit-sharing system that solves the problem. In a large company, for example, employees of different divisions would have to be compensated based on their divisional performance—a difference sure to create resistance to transfer among divisions, which makes it hard to share production experience. Furthermore, a new system of ownership and an immediate change in managerial or worker attitudes do not automatically go together. Consider Hyatt Clark Industries of Clark, New Jersey, a worker-owned company in which management refused to distribute company profits, or the Rath Packing Company of Waterloo, Iowa, a worker-owned company in which the workers went out on strike.

Moreover, corporate objectives are often inconsistent with a goal of profit sharing or employee ownership. Unlike workers, corporations can move overseas. Why make risky investments in workers when safer Japanese alternatives present themselves? If we wait for U.S. corporations to increase their investments in their workers, we may have to wait too long. The plants that these companies will eventually sell to their workers will be obsolete, and America's comparative disadvantage will be too great to overcome.

Public benefits, private costs

In this situation, government has an appropriate role. The difference between the social and private returns on investments in production experience is an example of what economists call an "externality." Other examples of externalities abound: when a company pollutes the air, it is using a public resource—clean air—for which it is not paying. The private company is, in essence, shifting a cost to the public—and thereby boosting its rate of return at public expense. In this case, government's role is to ensure that the company's costs reflect the value of resources used in production. The clean air regulations of the

1970s made managers include the costs of pollution—or pollution cleanup—in their investment decisions.

In the case of production experience, the balance between cost and reward is reversed: society as a whole benefits more than do most companies from investments in workers and engineers. Government should thus create incentives for companies that are doing business in the United States—regardless of where the company is headquartered—to invest in complex production here, using American workers and engineers. Companies should reap an extra public reward for investing in production experience to make up for the diminished short-term private reward of doing so. The government could subsidize investments in production experience through, for example, a human investment tax credit. The object would be for government to accept part of the economic cost of creating an important national economic good: more highly skilled, trained, and experienced workers and engineers.

In addition, government could support private investment in production experience in other, less direct ways. Federal and state governments could sponsor "technology extension services" modeled on the highly successful agricultural forerunner. An extension service could inform smaller businesses about the latest methods in manufacturing technology and undertake pilot programs and demonstrations. By sharing information and conducting classes, an extension service could help smaller manufacturers—the underpinnings to the industrial base—keep pace with change.

For another perspective on this same topic, see "Cooperate to Compete Globally" by Howard V. Perlmutter and David A. Heenan on page 136 of this issue.

Antitrust laws could be modified to permit American companies to invest jointly in complex production in the United States, thereby spreading the cost of the investment over several companies. The Federal Trade Commission allowed General Motors and Toyota to form a joint venture; would it have also approved a GM-Ford deal?

Our future national wealth depends on our ability to learn and relearn how to make things better. The fruits of our basic research are taking seed abroad and coming back home as finished products needing only distribution or components needing only assembly. America's capacity to produce complex goods may be permanently impaired. As a production-based economy, the United States will be enfeebled. What will also be lost is the wealth—the value added—contributed by the center of the value-added chain. And that is a prospect that should concern executives and government leaders alike.

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Jim J. Tozzi
Editor

Volume II, Number 8 *August 1987*

RISK: PERCEPTION AND REALITY

Bruce Scott Levinson

ACTIVITY OR CAUSE	ANNUAL FATALITIES (One Million Individuals*)
1. Smoking	3,000
2. Motor Vehicle Accidents	243
3. Work	113
4. Murder	107
5. Radon (indoor air)	87
6. Groundwater Contamination from Inactive Hazardous Waste Sites	14
7. Saccharin	5
8. Lightning	0.5
9. DES in Cattlefeed	0.3
10. Uranium Mill Tailings (active sites)	0.02

The above table describes the risks associated with a variety of hazards. Although the nature and danger of the hazards vary, one conclusion is evident. There is little relation between the riskiness of a particular hazard and the level of resources the Federal government allocates to protect its citizens from that hazard.

This conclusion was reached by a recent EPA task force that examined threats to health and the environment. The task force found that budget priorities tended to reflect public perception of risk rather than actual risk levels.

Despite serious environmental problems such as radon exposure, stratospheric ozone depletion, and nonpoint source water pollution, the bulk of Federal environmental funds are focused on the comparatively low risk problem of groundwater contamination from Superfund and RCRA sites. Regulations being drafted under the latter statute could require an even disproportionately higher amount be spent on commercial and municipal solid waste landfills.

As the growth in public spending becomes increasingly limited, failure to target Federal funds to the most serious sources of real risk will result in the American people being exposed to needless danger. In addition, and possibly of greater financial significance, the expenditure of Federal funds in low priority areas could force the private sector to spend even greater sums on these areas.

Since perception drives policy, both education and political rhetoric may play a role as important as scientific facts in determining the course of actual environmental protection.

**Source: EPA / OMB Documents / Statistical Abstract of the U.S.*

Tests, demonstrations and experiments related in any way to a commercial activity or enterprise can also be infringements.

Thus, the experimental use exception is very narrow and has been confined to a use for the "sole purpose of gratifying a philosophical taste or curiosity or for mere amusement."

Federal Technology Transfer (FT^2) Program Moves Ahead - Early Snags Being Addressed

Like any major piece of legislation, the FT^2 Act passed last year (IPH 6/87) has run into early implementation snags that must be overcome. One of the first snags is the requirement for an individual federal agency to delegate authority to its labs. To date, no such delegation has taken place.

First -- what constitutes a federal lab? The entire National Institutes of Health may be considered a lab, and each of its 11 member institutes could be considered a lab, too. Furthermore, each of the institutes contain multiple labs within their infrastructure.

Secondly, who has a say-so in over-viewing the delegated authority? Service groups within a given agency all wish to have a piece of the action rather than a straight delegation of everything down to the labs. (Is this the way excessive bureaucratic red tape is procreated?) Obviously, such turf fights are slowing the process down.

A major issue is whether the FT^2 Act and the President's Executive Order cover government-owned, but contractor-operated, laboratories (GOCOs). It would appear clear that the Act and Executive Order generally cover such GOCOs and that patent ownership is to be distributed to all contractors. For some time, university contractors have been receiving the rights, but the Executive Order for the first time with the force of law extends similar rights to profit-making contractors such as Martin Marietta -- operator of the Oak Ridge National Laboratory. Lawyers of the Department of Energy are balking at this interpretation on the grounds that they are prevented by law from making such a transfer. However, the statutes they quote show a transfer to be discretionary, and, reportedly, the Office of Management and Budget is opposed to DOE's position.

Another issue is the difficult task of preparing a model cooperative research and development agreement.

Questions about the FT^2 Act also expected to arise include the inventor's rights. Under what conditions can a FedLab inventor force the Government to release the patent rights to the inventor because the Government has failed to adequately protect the invention or license others? Also, how will the government divide the royalties when a single licensed product is covered by

IPH

NEWS BRIEF

R. File w/ Articles NOL

INTELLECTUAL PROPERTY HAPPENINGS

July, 1987

IPH is a monthly news brief for technology executives, inventors and software creators. News covered includes information, behind the scenes events and insights into the development of intellectual property and its protection through patents, copyrights, trade secrets, trademarks and similar rights.

Research and Development Labs New Target for Patent Infringement Suits -- Can't Rely on "Experimental Use" Exception

Corporate labs that use inventions from unexpired patents of others do so at their peril. These inventions are sometimes used to get a head start toward commercializing a product when the patent expires, so the product can be ready to go without waiting for the normal R&D and test period after expiration. Also, labs may use these inventions to garner more information about a competitor's technology so they can make leapfrog improvements.

Many thought these acts were excused by an "experimental use" exception to infringement. However, this exception is very limited. If it is coupled in any way with a commercial purpose, the exception does not apply.

Here is one example of infringement: A pharmaceutical company ordered and used a small quantity of a patented compound from a foreign source six months before the patent's expiration date, so that testing for FDA approval could begin immediately. Note: Since that case, a new law does permit -- as a very special exception from infringement liability -- uses solely for purposes of satisfying reporting requirements of federal drug laws.

Another example is the use of a patented biotech product to determine the amino acid sequence to assist in cloning a gene of the patented product. This did not fall within the narrow limitations and was therefore an infringement.

Still another infringement occurred when a developer of an automatic paper winding machine made and tested all of the various sub-assemblies and shipped them to a customer for complete assembly after the expiration of the patent. The machine was never completely assembled until after the patent expired.

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multiple patents of different inventors, especially when one patent is the basic patent and the other patents are only minor improvements? Still further, in view of the shortage of Government patent attorneys, how will increased demand for patent legal services be handled? Is the government liable for failure to protect the inventor's rights?

Continue to Patent Animals

Recent efforts by a few legislators to delay the patenting of animals have stopped. The Patent Office has no discretion in granting such patents since it has been determined that the patenting of animals is provided for by the present law. If the Patent Office is to change, the law must be changed. Hearings will be held, but the importance of inventions in this area should be understood: Patenting of animals can help the hunger situation in Africa. It can aid the shifting of U.S. farm crops from tobacco to fish. Such facts make it clear the law should not be changed. Remember that patenting of animals in no way relates to humans; emotional arguments in that direction are without foundation.

State Universities and Schools May Be Immune from Copyright and Patent Infringement

A court in California now joins with courts in Illinois, Michigan and Virginia in stating that state universities are excused from being liable for damages for copyright infringement and, by implication, patent infringement by the Doctrine of Sovereign Immunity under the Eleventh Amendment of the U.S. Constitution. The California case was a suit against the University of California, which allegedly copied copyrighted computer software. This issue will ultimately either have to be decided by the U.S. Supreme Court or by a change in the Federal statutes explicitly stating that states can be sued for copyright and patent infringement. If one or the other is not done, state schools will be free to start making their own piractical copies of video cassettes and books as well as computer programs, armed with a license to steal.

U.S. Patent Office Gives Most Comprehensive Search

It will come as a surprise to many, but the U.S. patent examiners perform a more comprehensive search than examiners in the European Patent Office or the Japanese Patent Office. In an effort to determine the similarities of the examining process with implications under both the trilateral (U.S.-Europe-Japan) and regional (U.S.-Japan-Canada-Australia) cooperative initiatives, foreign patent examiners have been searching alongside U.S. patent examiners and the U.S. Patent Office. The finding is that the U.S. search is far more comprehensive than the others. The Japanese patent examiners were reportedly astounded at the amount of prior art examined by the U.S. patent examiner in making his normal search.

It has been thought for many years that the Japanese searches and even more so the European searches were better than searches of the U.S. Patent Office. Either this was never correct or the situation has changed.

Windows May Be Transparent and Still Contain $3.2 Million Worth of Trade Secrets

Boeing sued its former supplier of cockpit windows for supplying the windows to the after market in violation of Boeing's trade secrets and in breach of their contract and breach of their confidential relationship. The vendor was found liable for all three, and Boeing was awarded $3.2 million. As an interesting side note, the breach of confidence claim was considered separate from the trade secret claim because it did not depend on whether or not trade secrets existed.

Patenting Software Is On the Rise

If the underlying concept involved in software is new and important, the best way to protect it often is by patents. The main advantage of patent protection over copyright protection is that it covers the underlying concept of the program.

At an earlier time, there were some indications that patent protection was not available for software and this misinformation is still widespread today. However, the only software that cannot be patented today is that for a mathematical algorithm. Other algorithms are patentable provided they meet the criteria normally used in determining patentability.

Examples of recently patented software inventions include: a process for a management control system, a program that checks for spelling errors, and a program that converts one language into another. Patents for software systems involving artificial intelligence and for manipulating graphic images are other examples.

An outstanding example of a lost opportunity is the case of Dan Bricklin who invented VisiCalc -- the first personal computer-based spread sheet program. A patent would have dominated such programs as Lotus 1-2-3 and the other electronic spreadsheets. As Mr. Bricklin says, "I'll go down in history as the inventor of VisiCalc. With a patent, the only difference would have been several hundred million dollars."

Major computer companies are rapidly shifting from hardware to software and services for their income. By 1992 they are expected to receive only 50% of their income from hardware. With the ever increasing importance of software, major software houses and computer companies are increasing their efforts to obtain patents on the pure software and the combination of software and hardware.

AUZVILLE JACKSON, JR.

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Export Controls of High-Technology Goods

The impaired ability of the United States to compete internationally and even at home in high-technology products is a matter for searching examination. Our failures come from many sources. Recently, U.S. procedures for controls of exports of high-technology goods have been added to the list of causes. The National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine have rendered a public service by sponsoring a major study that has illuminated the need for changes in our system of controls.*

Japan, France, and members of NATO have recognized that advanced technology confers military advantages over the Communist Bloc and have cooperated to limit transfer of technology there. However, the United States has imposed controls that go beyond those of its allies. In earlier times, we enjoyed a monopoly on high technology. But that status is gone. Japan and some members of the Common Market have been joined by Hong Kong, Singapore, South Korea, Taiwan, and others as exporters of microelectronics goods. Today, the United States purchases only 30 percent of the high-technology goods sold on the world market. If our manufacturers are to achieve economies of scale, they must distribute their products globally.

In spite of these developments, the United States behaves as if it still had the monopoly it enjoyed 20 years ago. We continue to assert "jurisdiction over goods and technology even outside the territorial United States when (i) the product or technology in question originated in or is to be or has been exported from the United States; (ii) the product or technology incorporates or uses products or technology of U.S. origin; (iii) the exporter is a U.S. national or is owned or controlled by U.S. interests." Thus when a U.S. subsidiary operating in West Germany wishes to export a high-technology item, permission must be sought from Washington.

The machinery for control of exports from the United States is slow and not very discriminating. The interval measured from when the application leaves the company to when the company receives an export license averages 54 days. In Japan, export licenses are processed in 2 to 3 days. Expeditious schedules prevail in other competing countries.

Delays and uncertainties handicap U.S. firms. Competitors can supply many of the high-technology items at lower prices or with better quality than can the U.S. firms and without delays. A survey conducted showed that many erstwhile customers of U.S. suppliers are turning to other sources.

An example from the report illustrates effects of U.S. export controls. In March 1983, a U.S. company sought a license to export a $450,000 nuclear magnetic resonance spectrometer to a medical research institute in Eastern Europe. The application was not approved until November 1985. Although U.S. firms pioneered the development of NMR, German and Japanese companies now hold two-thirds of the world market for such instruments. During the review period in Washington, a German competitor sold several similar NMR systems to Communist Bloc customers. The NMR instruments do not appear on the U.S. control list, but the equipment was subject to licensing because it contained 32-bit array microprocessors and 30-megabyte Winchester disk drives.

To obtain information for the report, teams were sent to Europe and Asia. They heard many comments about deleterious effects of delays of processing export licenses and were reminded of the problem of the "$2 microchip in the $20,000 machine." When the U.S. chip was used, the entire product had to receive a U.S. re-export license. They also conversed with U.S. customs officers stationed abroad. One officer complained that on instructions from Washington, he spent most of his time "chasing" personal computers.

The United States is trying to control items produced by the millions in many countries. In 1979, legislation was enacted that called for elimination of controls on items that the Soviet Union either can make for itself or freely buy from uncontrolled sources. However, the will of Congress has been thwarted. Substantial progress has not been made in eliminating outdated controls.—PHILIP H. ABELSON

Balancing the National Interest* (National Academy Press, Washington, DC, 1987). See also, C. Norman, *Science* **235, 424 (1987).

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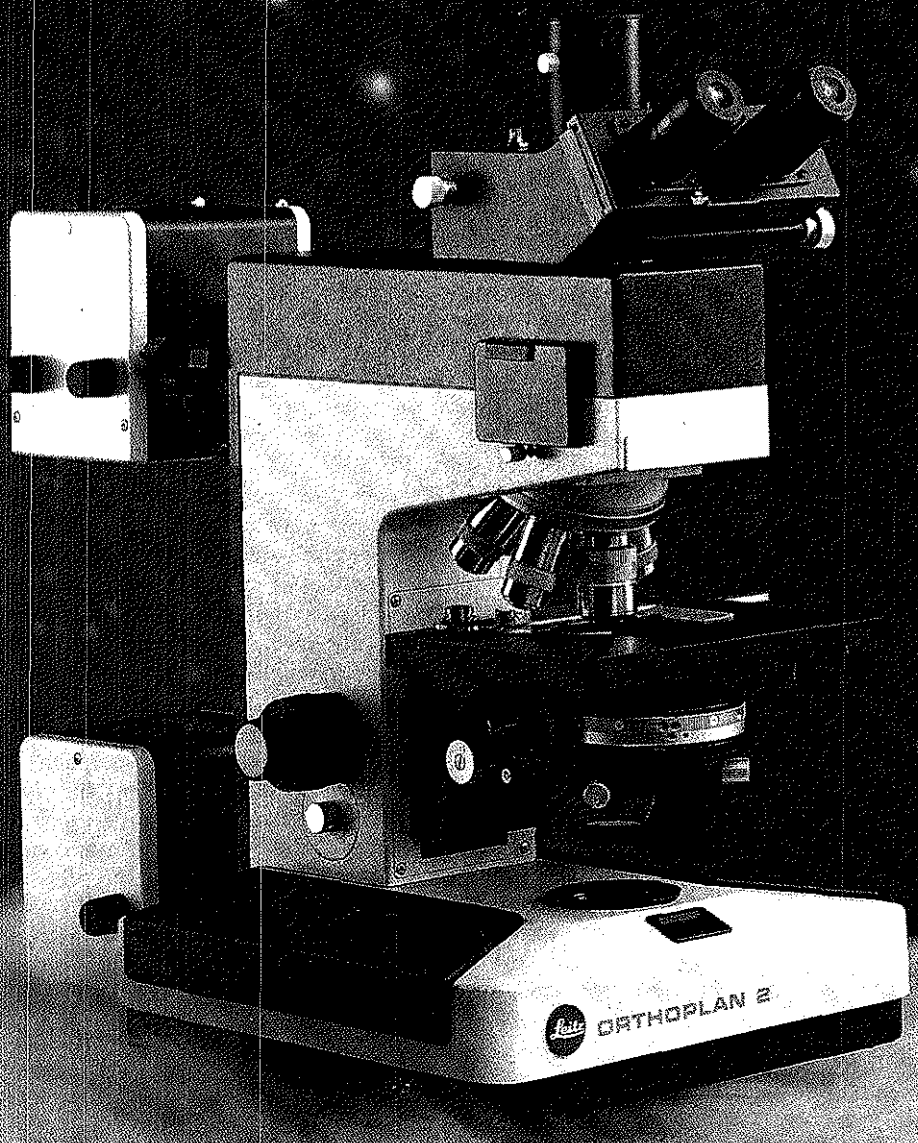

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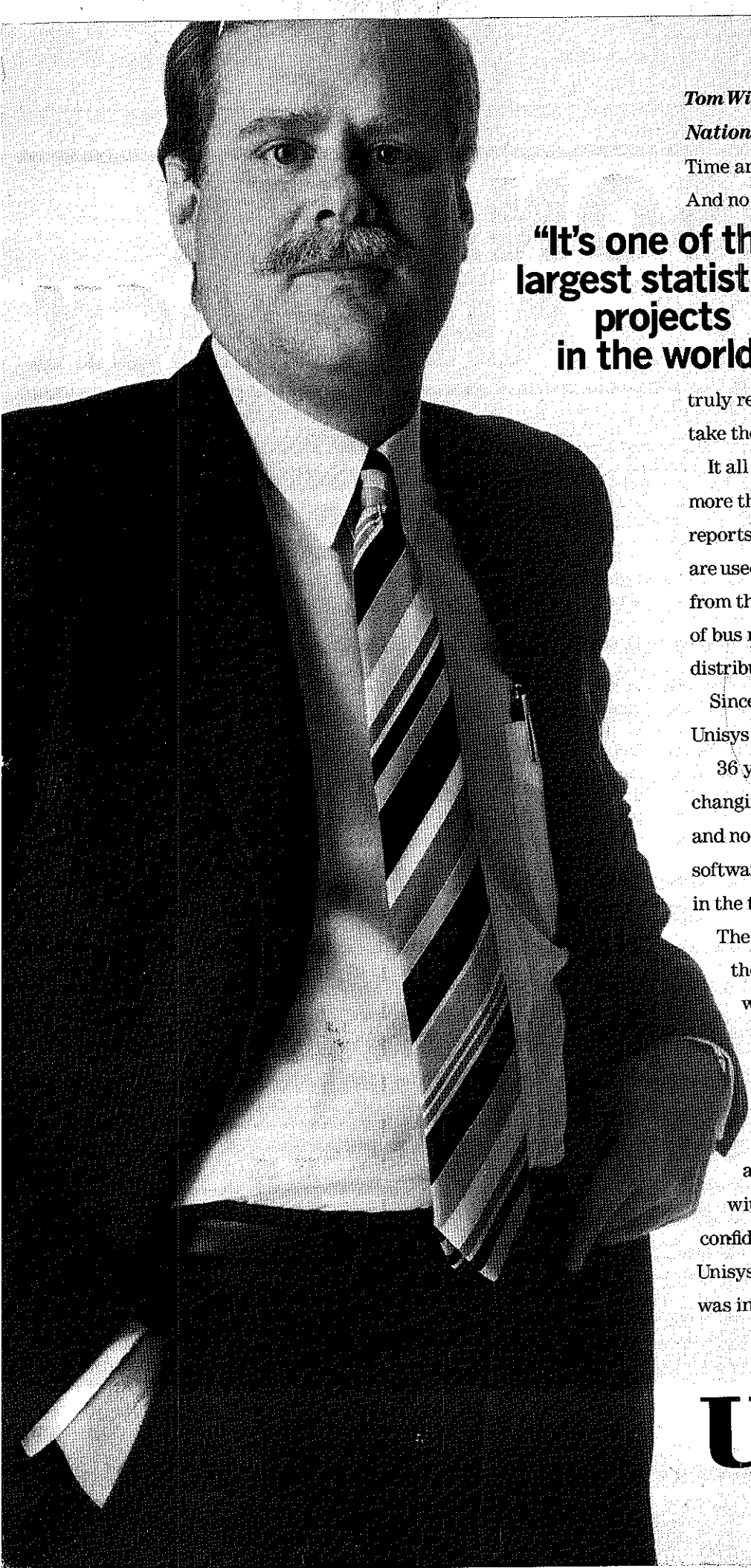

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MANAGING

PERSONALITY TESTS ARE BACK

The latest management tool dates to Carl Jung. It slices executives into 16 categories and purports to help different types communicate. Some managers like the test so much they give it to their children. Which type are you? ■ *by Thomas Moore*

"ESFJ SPOKEN HERE," reads the sign on the accountant's desk at Compass Computer Services in Dallas. Her boss, the controller, has a card that says he speaks "ISTJ." The scrambled letters have also been spotted in Transamerica's pyramid in San Francisco, at the Naval Surface Weapons Center near Washington, and at Virginia Power Co.'s headquarters in Richmond. They turn up in church-group discussions, on license plates, even in personal ads—"ENFP female desperately seeking INTJ male."

No, the proliferation of these mysterious initials does not represent an invasion of extraterrestrials or even the rise of a new order of Masons. The four-letter combinations are the hallmarks of a theory of psychological types that is spreading rapidly out of counseling circles into corporate America. According to the tenets, people of different psychological types may have a hard time working together mostly because each has a distinctive way of perceiving the world and making decisions. Make people aware of which types they and their co-workers are, the theory goes, and *voilà*, communication improves and with it productivity. While some psychologists are not impressed, business people are lapping this stuff up.

The letter combinations stand for personality traits first posited by the Swiss psychologist Carl Jung in 1921 and further amplified after World War II by a mother-daughter team in the U.S., Katherine Briggs and Isabel Briggs Myers. Just as people are born with a predisposition to be left- or right-handed, says the so-called type theory, they are also predisposed to be either extroverted or introverted (E or I), sensing or intuitive (S or N), thinking or feeling (T or F), and perceiving or judging (P or J). Extroverts are oriented toward the outer world of people and things, introverts toward the inner world of ideas and feelings. Sensing types sniff out detail, while intuitive souls prefer to focus on the big picture. Thinkers want to decide things logically and objectively; feelers base their decisions on more subjective grounds. Perceiving types tend to be flexible and to seek more information, while the judging sort want to get things settled.

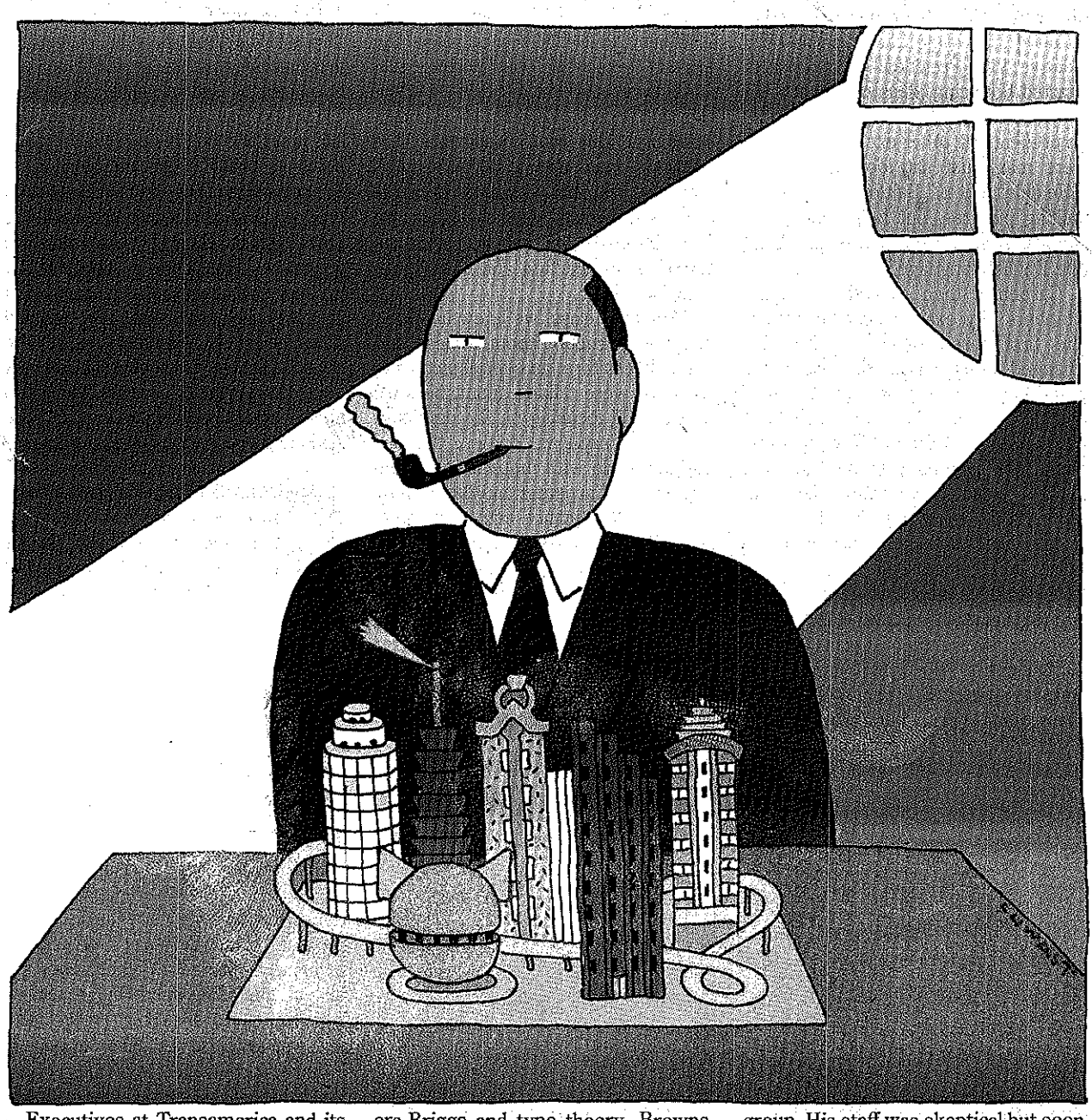
Type theorists divide people into 16 distinguishable personality types according to these four dimensions (see table). In the course of 20 years' work, Briggs and Myers developed a test—or inventory of preferences, as they called it, since there are no right or wrong answers—that indicates an individual's predispositions. It does not measure intelligence, motivation, maturity, or mental health.

The Myers-Briggs Type Indicator, or MBTI as it is commonly known, poses over 100 questions about how the test taker usually feels or acts in particular situations. For instance, in a group, do you often introduce others, or wait to be introduced? (Extroverts tend to introduce, introverts to be introduced.) Do you find it harder to adapt to routine or to more-or-less constant change? (Judging types have a tougher time with change, perceiving types with routine.) Would you rather work under someone who is always kind or always fair? (Feelers go for the kind boss, thinkers prefer a fair boss.) Research suggests that about 60% of men are thinkers, about 60% of women feelers. But the majority of women executives are thinkers, as likely as their male counterparts to neglect others' feelings.

In 1986 some 1.5 million people took the MBTI, according to its publisher, Consulting Psychologists Press in Palo Alto, California. It is almost certainly the most widely used personality test in the U.S., at least among the allegedly normal population, and the test whose use is growing fastest. Average cost of the test: less than $1. The corporate world is by far the biggest user, and businesses accounted for 40% of test sales last year, double their share of three years ago. Companies that give it include Allied-Signal, Apple, AT&T, Citicorp, Exxon, GE, Honeywell, and 3M. Colleges, hospitals, churches, and the U.S. armed forces also administer the test.

MOST COMPANIES use the Myers-Briggs Type Indicator primarily in management development programs, to help executives better understand how they come across to others who may see things differently. Converts are going forth to apply type theory to chores ranging from job assignment, performance appraisal, and negotiation to strategic planning and marketing. In defending the new gospel, they stress the damage that botched communications and internecine conflicts can do.

REPORTER ASSOCIATE *Wilton Woods*



Visionary

INTJ

This type is introverted (I), intuitive (N), thinking (T), and judging (J). While INTJs make up only a small percentage of the population, a disproportionate number rise to become chief executives.

Executives at Transamerica and its subsidiaries, past and present, rank among the most fervent of the believers. In 1979 Lad Burgin, a former offensive tackle from Ohio State with an MBA and a Ph.D., created the company's management development program using ideas on motivation developed by Harvard psychologist David McClelland. Burgin concluded, however, that "an important piece of the puzzle was missing." He found it when he began working with a former history professor turned management consultant, Alan Brownsword, who had become a leading expert on Myers-Briggs and type theory. Brownsword specialized in applying the theory to team building—getting a bunch of individuals to work together effectively. Says Burgin: "We found that by joining the theories of motivation and type, we can solve a lot more problems in the business world."

One of their most successful students was David Carpenter, chief executive of Transamerica's Occidental Life Insurance Co., which generated 60% of the parent holding company's profits in 1986. After he took over in 1983, Carpenter insisted his top management team take the course as a group. His staff was skeptical but soon found type theory a big help in transforming the subsidiary from a sleepy life insurance bureaucracy to a streamlined, competitive financial services company. Carpenter says, "We've used the theory to help us change our corporate culture; it has turned out to be one of the most meaningful things we've done."

An example: Shortly after he took over, Carpenter called in two top executives to talk about how to turn the company's five-year management plan from a dull cover-your-behind forecast to a visionary, best-guess document

ILLUSTRATIONS BY SEYMOUR CHWAST

that laid out the changes they hoped to bring about. While Carpenter and Executive Vice President Simon Baitler started bouncing ideas off each other about the new "picture" they wanted to present, the other executive, a numbers man, just sat looking puzzled. "He didn't get it," Baitler says. "We're talking pictures, but he's looking for details. To him, we're not even talking the English language."

Carpenter then spelled out to the numbers guy exactly how he wanted the first three tables in the plan changed. But when the executive came back with the new plan, two of the tables were the same as before. Carpenter was furious. "The guy must think he's brighter than me," he told Baitler. In fact, the executive had concluded that he wasn't in the same league as Baitler and Carpenter; he was thinking about quitting.

Two weeks later Carpenter and his top management team took the week-long course on type theory, and as Baitler put it, "the lights went on." It turned out that the finance guy, like many number crunchers, was an ISTJ, a very different personality type from Carpenter and Baitler, who were an ENTJ and an ENTP, respectively. The financial executive was introverted, while they were extroverted—a situation that promoted constant misunderstandings. But more important, the numbers man was a sensing type, someone who thinks largely in terms of facts and detail, while the other two were intuitives, people who think in terms of context first and fill in pertinent facts later.

"After the class, we knew he didn't hear the instruction about Tables 2 and 3, much less form an overall picture of what we were talking about, because he was still focusing on the details of Table 1," explains Baitler. "It had nothing to do with motivation and intelligence." Carpenter and Baitler now often ask the finance man to summarize what was agreed upon at a meeting and then they fill in any gaps. They have also come to recognize that an ISTJ, whose type is more realistic and pragmatic than theirs, has a better grasp of the risks in any big-picture idea than they do—an invaluable asset that can save them from intuiting their way into a debacle.

In turn, the financial executive now thinks twice about how he is going to present information to the chief. At one point he had to make a report to Carpenter that combined ten pieces of bad news and one big element of good news—a positive that outweighed all the negatives. True to his orderly ISTJ type, he had planned to list each bad news item and then give Carpenter the good news. But Baitler advised: "If you present it that way, Carpenter, being an ENTJ, will judge each piece of bad news adversely. Why not give him the overall picture first—that you've got good news that outweighs some bad news—and then fill in the details?" The revised presentation worked nicely.

COMPASS COMPUTER, a computer reservations company owned jointly by Hilton Hotels and Budget Rent-a-Car—and formerly owned by Transamerica—is a virtual laboratory on the chemistry between different types. President Michael Carrico and some of his top managers went through Transamerica's course and tried to put what they learned to work. Says Carrico: "We had some morale problems. I realized I had a mixed bag of people reporting to me and that this could help us understand each other better and also understand how we make decisons."

Over 100 of 180 employees have taken Brownsword's team-building program. Executives say it helped the company adjust to a recent major upheaval after Hilton and Budget forced Compass to drop a big project and make major cutbacks. As an introvert, Carrico was inclined to withdraw and make decisions alone when under pressure. But with the training in mind, he went out of his way to get his management group's advice on where to cut back. One piece of advice he accepted was to continue the team-building program, which had cost the company $400,000 over two years. Says Linda Edwards, the company's human resources vice president: "We wouldn't have made it through without type training."

Other outfits experimenting with type theory tell similar stories. Apple Computer uses it to help different teams work on task force projects together. West Jersey Health Systems,

Organizer

ESTJ

He or she is extroverted (E), sensing (S), thinking (T), and judging (J). It is one of the most common types in the general population as well as among managers.





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Morgan Guaranty

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Allied-Signal Inc.

has sold its aerospace division,

Air Equipement

to

Thomson-Lucas S.A.

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Morgan Guaranty

SmithKline Beckman Corporation

has purchased through a "Dutch Auction" self tender offer 12,570,450 shares of its common stock at $96.00 per share for a total cost of $1,206,763,200

The undersigned advised and acted as dealer manager for SmithKline Beckman Corporation in this transaction.

Morgan Guaranty

Household International, Inc.

has sold

National Car Rental System, Inc.

to

Griffith Acquisition Corporation

The undersigned acted as financial advisor to Household International, Inc. in this transaction.

Morgan Guaranty

The C. Reiss Coal Company

has been acquired by

Koch Carbon Inc.

a subsidiary of

Koch Industries, Inc.

The undersigned initiated this transaction and acted as financial advisor to The C. Reiss Coal Company.

Morgan Guaranty

FP Acquisition Inc.

has acquired through a leveraged buyout

Pandick, Inc.

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Morgan Guaranty

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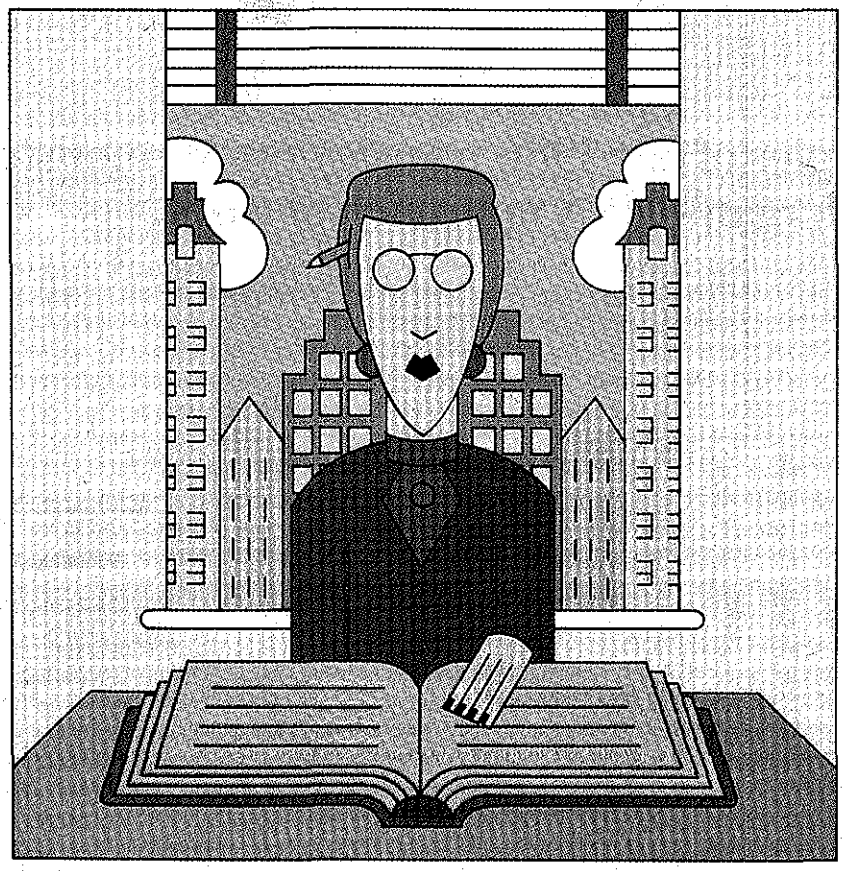
Traditionalist

ISTJ

These introverted (I), sensing (S), thinking (T), and judging (J) souls may be sticklers for detail and rules. ISTJs often become accountants and financial executives.



a small nonprofit hospital group, is using a type program to help its nurses, doctors, and managers come up with ways to make patient services friendlier. Virginia Power uses type theory in strategic planning workshops to jar managers into thinking more competitively. The utility industry may be deregulated down the road, and the company wants to explore new ventures—a discipline many of its executives have never undertaken. "Everybody knows we're in a new ball game, yet they keep doing what they've always done," says Wylie WanVeer, senior training specialist. "We've got a lot of sensors who worry about the next five quarters, but we need intuitive thinking that focuses on the next five years."

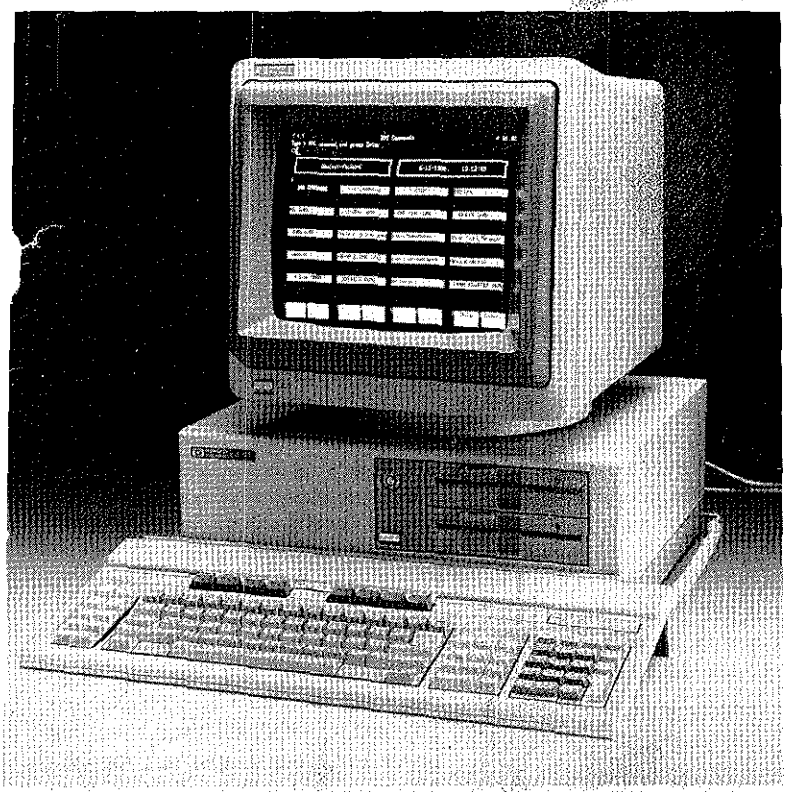
Knight-Ridder's *Charlotte Observer* used type theory as a basis for team building in a fractious newsroom that had been jolted by a series of management changes. The outcome was so successful, says publisher Rolfe Neill, that he and his executive team took the same course and then turned loose the trainer, Dolly

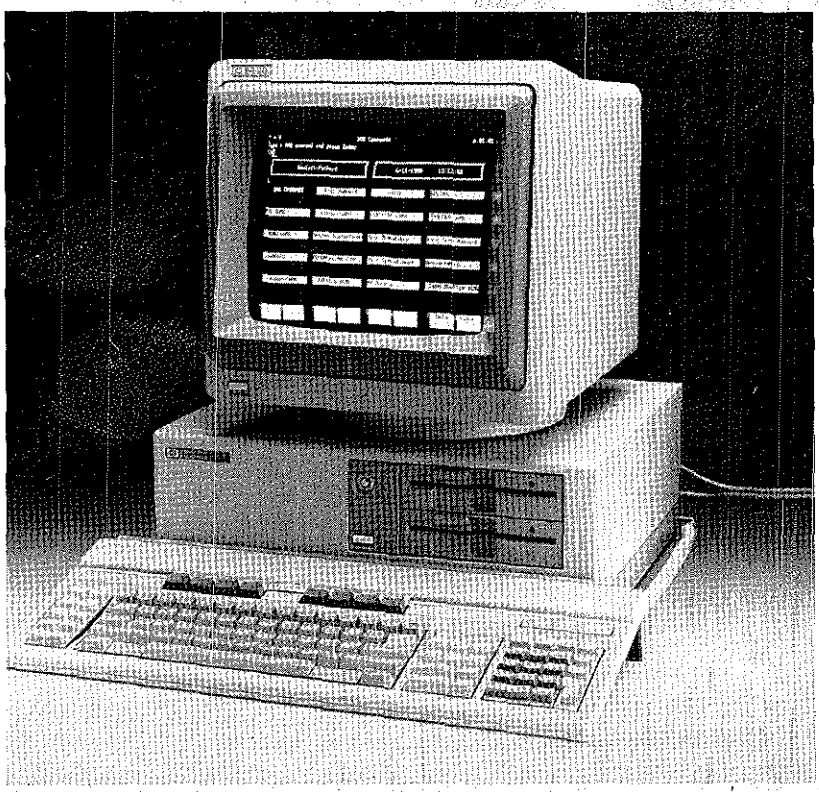
THE 16 DIFFERENT PERSONALITY TYPES

		SENSING TYPES S		INTUITIVE TYPES N	
		THINKING T	FEELING F	FEELING F	THINKING T
INTROVERTED I	JUDGING J	**ISTJ** Serious, quiet, earn success by concentration and thoroughness. Practical, orderly, matter-of-fact, logical, realistic, and dependable. Take responsibility.	**ISFJ** Quiet, friendly, responsible, and conscientious. Work devotedly to meet their obligations. Thorough, painstaking, accurate. Loyal, considerate.	**INFJ** Succeed by perseverance, originality, and desire to do whatever is needed or wanted. Quietly forceful, conscientious, concerned for others. Respected for their firm principles.	**INTJ** Usually have original minds and great drive for their own ideas and purposes. Skeptical, critical, independent, determined, often stubborn.
INTROVERTED I	PERCEIVING P	**ISTP** Cool onlookers—quiet, reserved, and analytical. Usually interested in impersonal principles, how and why mechanical things work. Flashes of original humor.	**ISFP** Retiring, quietly friendly, sensitive, kind, modest about their abilities. Shun disagreements. Loyal followers. Often relaxed about getting things done.	**INFP** Care about learning, ideas, language, and independent projects of their own. Tend to undertake too much, then somehow get it done. Friendly, but often too absorbed.	**INTP** Quiet, reserved, impersonal. Enjoy theoretical or scientific subjects. Usually interested mainly in ideas, little liking for parties or small talk. Sharply defined interests.
EXTROVERTED E	PERCEIVING P	**ESTP** Matter-of-fact, do not worry or hurry, enjoy whatever comes along. May be a bit blunt or insensitive. Best with real things that can be taken apart or put together.	**ESFP** Outgoing, easygoing, accepting, friendly, make things more fun for others by their enjoyment. Like sports and making things. Find remembering facts easier than mastering theories.	**ENFP** Warmly enthusiastic, high-spirited, ingenious, imaginative. Able to do almost anything that interests them. Quick with a solution and to help with a problem.	**ENTP** Quick, ingenious, good at many things. May argue either side of a question for fun. Resourceful in solving challenging problems, but may neglect routine assignments.
EXTROVERTED E	JUDGING J	**ESTJ** Practical, realistic, matter-of-fact, with a natural head for business or mechanics. Not interested in subjects they see no use for. Like to organize and run activities.	**ESFJ** Warm-hearted, talkative, popular, conscientious, born cooperators. Need harmony. Work best with encouragement. Little interest in abstract thinking or technical subjects.	**ENFJ** Responsive and responsible. Generally feel real concern for what others think or want. Sociable, popular. Sensitive to praise and criticism.	**ENTJ** Hearty, frank, decisive, leaders. Usually good in anything that requires reasoning and intelligent talk. May sometimes be more positive than their experience in an area warrants.

SOURCE: INTRODUCTION TO TYPE BY ISABEL BRIGGS MYERS.

WHAT MAKES ONE MORE COMPATIBLE THAN THE OTHER?





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Government has become interested too. It should come as no surprise to learn that city managers in trendy San Francisco are taking type training. But the General Accounting Office? The federal agency uses type theory to help improve the effectiveness of its teams of analysts. The Foreign Service Institute applies the theory to teaching languages. Otto Kroeger, a Myers-Briggs consultant, has taught over 4,500 officers at military colleges, including top brass at the National Defense University. Some graduates now call him in to help them with their managerial headaches.

A military chaplain had him come to West Germany a couple of years ago to analyze certain troublesome incidents at isolated defense posts. The symptoms included drug abuse, vandalism, shootings, bar fights, and suicide. Says Kroeger: "What you had was a bunch of SPs [sensing-perceptives], action-oriented kids who dropped out of high school, loved Army training, and then were shipped off to some little outpost where they were told to be constantly on alert. They sat there waiting for something to happen, but nothing ever did. So they ended up dropping a wrench somewhere to stir up a little excitement."

To make things worse, many outpost commanders were SJs (sensing-judging types) and thus sticklers for daily reports and routine procedures —the bane of SPs. Kroeger negotiated a truce between types rather than ranks. The officers relaxed some rules and cut back on paperwork, and in return the soldiers made sure they got their job done. Accidents and hooliganism declined, says Kroeger.

Despite the growing popularity of type theory, many psychologists and managers remain skeptical. An operations chief from 3M stared hard at the grid of 16 types and asked, "Why does the word *Communism* pop into my mind?" The charges that Myers-Briggs stereotypes people, that it is a static, undynamic theory that traffics in labels much like astrology, have dogged the theory for years.

Doubts linger even in some centers of faith. Transamerica Corp.'s chief executive, James Harvey, who never took the course, has decentralized t parent company's sponsorship. No each division or subsidiary chooses whether to pursue the training. Says Reed Gregg, head of Transamerica's audit department and a champion of the theory: "The top management group wanted to see something tangible, but how do you measure a change in attitude?"

SOME SKEPTICAL managers wonder whether type theory may turn out to be just another management fad. David Fry, a British-born vice president of systems development at Compass Computer and one of the few disbelievers on the staff, jokingly compares its spread through the company to a religious revival. He rejects the theory on purely scientific grounds. "You can't measure the results, and the consequences are not predictable," he says. "It does seem to make people feel better. But when the preacher leaves, I think the Christians will become heathens again."

For their part, many Myers-Briggs proponents say the test should be used only as an instrument to improve the test taker's self-awareness, and never to screen employees for jobs. They argue that type skills could be used to help, say, an introverted salesperson learn to develop the necessary extroverted behavior for the job. Other psychologists defend the MBTI as one of a battery of tests and techniques that can be used together in making evaluations. "It is a tried and true instrument," says Richard Diedrich, a clinical psychologist with Rohrer Hibler & Replogle, a consulting firm that advises corporations on matters psychological.

On balance, the theory may well be less significant than the communications it seems to foster. Talking about what type you are and what type I am and the differences between the two often proves to be an unthreatening way for people to raise and resolve problems. Indeed, many executives who have been exposed to Myers-Briggs urge their spouses and children to take the test. Some report that the results help explain behavior that has puzzled them for years. F

Conceptualizer

ENTP

This type is extroverted (E), intuitive (N), thinking (T), and perceiving (P). ENTPs love new possibilities and hate routine. They're more often entrepreneurs than corporate executives.



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Patents Resulting from NSF's Engineering Program*

Robert S. Cutler, National Science Foundation, Washington, DC 20550, U.S.A.

Summary

This report presents the results of a study of engineering research project grants funded by the National Science Foundation (NSF) between 1968 and 1977. The purpose was to determine the extent to which the grants led to patented technology and to estimate the economic value of those patents.

From the names of the principal investigators supported by NSF Engineering grants, who are also named as inventors on engineering patents registered with the U.S. Patent and Trademark Office, an examination was made by technology experts from SRI International, Inc. to determine the relevance of each grant to its associated patent. An independent assessment was also made to evaluate the commercial potential of each patent and to estimate its economic value.

The study found that from some 4077 NSF Engineering project grants awarded between 1968 and 1977, about 2.6 grantees in 100 produced patents linked to his or her grant. Some 248 patents were examined in this study. Although few patents produced any economic value, seven of these patents were licensed, with royalties ranging from $10 000 to $250 000 annually.

The total long-term royalties expected from the linked patents investigated is estimated as high as $52.5 million. The aggregate value to the U.S. economy from the sales of products derived from those patents could range between ten and twenty times that amount, depending upon the industry.

One observation from the study is that a strong patent licensing program is becoming valuable to universities, not just for producing royalty income, but for the additional sponsored research funds it attracts from industrial firms.

*This paper was presented at the Eleventh Annual Meeting and International Symposium, Technology Transfer Society, Indianapolis, IN, 24 June 1986.

The author is a Senior Staff Associate on the Program Evaluation Staff of the National Science Foundation, Washington, DC 20550. The views expressed here are those of the author and do not necessarily reflect those of the National Science Foundation.

†For example, The Patent and Trademark Act of 1980 (P.L. 96-517) gives general authorization to universities and colleges to promote inventions resulting from government funded research.

Introduction

Whether valuable patented inventions have resulted from academic research supported by National Science Foundation (NSF) grants has been debated among members of the National Science Board and by committees of Congress for some time. The recent agenda of the House Science and Technology Committee's Task Force on Science Policy included a review of government research support and patent policy as one of the issues to be studied.(1)

An academic scientist typically is interested in teaching, doing research, and in disseminating new scientific knowledge through publication and related activities. The discovery of commercial applications for an idea or invention has been of secondary importance. However, recent changes in U.S. patent policy have awakened interest among academic institutions to transfer their research results to the marketplace.

Although the Federal agencies have routinely recorded their contractor and grantee invention disclosures since the 1960s, few systematic studies have been undertaken to assess the significance of such patent activity or its value to the national economy. Moreover recent legislative developments† have focused attention on the need to identify and evaluate patented inventions as discrete and measurable outputs of Federally-supported research.

This paper summarizes a study of NSF Engineering patents performed during 1984 by SRI International, Inc., Menlo Park, CA, under NSF Contract EVL-83 19583. The work builds upon an earlier patent study of the NSF Chemistry Program performed by Research Corporation, New York, in 1982.(2) Both studies attempt to establish reliable baseline data for making future comparisons of university patent activity resulting from NSF grant support. The procedures used can be applied, with comparable effort, to evaluating patents associated with similar research grant programs elsewhere.

Purposes and Objectives

The purposes of this study are to determine the extent to which NSF Engineering Program grants produced

In view of the contents described it is clear that the aim of the video is to be an introduction to the expanding use of computers in the daily work at the EPO. The target audience is in the first place new staff at the EPO as part of their introductory training. In the meantime, however, the video has proved to be a success when shown to visitors. The simple but accurate explanation of the mutual relations between the different databases was the feature most appreciated.

On the other hand, it is obvious that it was a low budget production, with no budget at all for special effects. But the camera, the recorder, the player (both U-matic), two monitors, a small mixing table and a lot of black coffee were excellent.

Only one concession was made. It proved to be difficult to take pictures directly from a terminal screen, especially when parts of that screen were to be enlarged for higher readability. Therefore print-outs were made from each screen output and then videoed.

Finally, the credits. The 15 minute video was made on U-matic cassette for the PAL system by two senior examiners, Mr. G. Mees and the author of this article.

patented technology and to estimate the economic value of those patents. In addition, the study develops a systematic method for evaluating patents associated with university research grants and provides some quantitative statements useful for describing the university technology transfer process.

The objectives were to:

(1) Determine whether links exist between certain U.S. patents and NSF engineering grants.
(2) Determine whether the patents identified were ever licensed or judged commercializable.
(3) Estimate the aggregate economic value of those patented inventions found to have resulted from NSF Engineering Program support.
(4) Establish a reasonable basis for evaluating patents resulting from Federally-supported university research.

The approach taken was to examine a 10-year set of 4077 NSF engineering research grants in order to determine the extent to which those grants led to patented technology and to commercial use.

Scope of Study

The study involved some 722 patents issued between 1975 and 1982 to the 4077 principal investigators supported by NSF Engineering Program grants between 1968 and 1977. Because of grant document retrieval problems, which proved to be random,* only 149 grants associated with 248 patents were actually examined. This sample is considered to be representative of the total set of 4077 grantees.

Procedure

The first part of the study sought to determine the number of research grants supported by NSF's Engineering Program which also produced U.S. patents. The second part, performed by members of the Patent Review Board of SRI International (SRI), estimated the commercial potential and economic value of the patents found. They followed the patent evaluation process typically used in industry, which is summarized below. The results of an earlier patent study of NSF chemistry grantees[3] was used to provide a basis for comparison.

*Although attempts were made to retrieve these retired grant documents from the U.S. Archives, many of the original grant folders were not found due to misplaced, lost, or destroyed records. A statistical test (chi-square, equality of proportions along five attributes) confirmed that the missing data was random: thus the available sample of 149 is considered representative of the original population of 4077 grantees.

Caveat on Baseline Estimates

This study attempts to plough new ground in an uncertain and difficult area: the relationship between university research, patented inventions, and economic impact. The database used was constructed from the best information available at NSF and U.S. Patent and Trademark Office computerized files, which may have been incomplete. The results were derived from very conservative estimates, because of the nature of the PI/Inventor name-matching process used and the restricted availability of the licensing data. The time periods selected for analysis were chosen to best approximate the mainstream of grant-patent activity within the constraints of the data. Nevertheless, the evaluation method used is straightforward and provide a reasonable basis for arriving at the results found.

Sources of Data: Patents Related to NSF Engineering Grantees

The primary data sources used were the 'NSF Engineering Program History Tape', an unduplicated alphabetical listing of some 4077 principal investigators (PIs) supported by NSF's Engineering and applied research divisions between 1968 and 1977, and the U.S. Patent and Trademark Office's (PTO) computerized list of patents issued between 1975 and 1982. (Only U.S. patents issued after 1 January 1974 were accessable by computer from the PTO files.)

Typically it takes about 2 years after a grant is awarded to do the research, from 2 to 4 years to prepare and file a patent application based on that research, and an additional 2–7 years for prosecution in the PTO before a patent is issued. Based on these time requirements, it was assumed that grants awarded between 1968 and 1977 most likely supported the research which 7 to 10 years later produced patents issued between 1975 and 1982. This constituted the search grid for the study.

Using the names of the 4077 NSF Engineering Program grantees between 1968 and 1977, we made computerized matches were made with the names of inventors listed in the PTO's database files of engineering patents (mechanical, electrical, chemical, and structural) issued during the period January 1975 to December 1982. Similar name-matches had previously been made for the list of 3766 NSF Chemistry Program PIs receiving grants for basic chemistry research between the years 1964 and 1974.

The use of comparative data from the earlier NSF chemistry patent study was considered useful since both sets of grantees are based primarily on their scientific merits. The applied nature of engineering research, however, may have included the additional criterion of practical utility, which was expected to account for significant differences in the results.

Selection Criteria

The first step in carrying out this study was to determine the extent to which the research supported by NSF's Engineering Program between 1968 and 1977 produced United States patents. The names of the PIs were matched by computer against the names of inventors listed on all patents issued by the PTO. For each match, a grantee institution was determined by reference to the inventor's name, address, and assignment of the patent. This information was later used to verify the name-identity of particular PIs and inventors.

To organize the substantive examination of the study, the full text of each patent identified was obtained from the PTO search and assigned to one of three categories using the selection criteria given in Table 1.

Table 1. Relevance of patents to grants

Category	Assignment criteria
Directly related	PI and patent inventor names are identical; NSF support acknowledged in patent.
Probably related	PI and patent inventor names are identical; Titles and/or subject matter of both grants and patents are related; Patent application date is concurrent with or follows grant award date.
Possibly related	PI and patent inventor names are identical; Titles and/or subject matter of both grants and patents are similar; Patent application date follows grant proposal date; University and geographic proximity.

Procedure for Determining Linkage of Patents to Grants

Each of the selected patents in which a named inventor and PI are identical was examined by a subject expert for possible 'relevance' of the subject matter of the patent to the research performed under the grant. About one in five of the patents (29 out of 149) contained acknowledgements to specific NSF grant support; for these no further examination for 'linkage' was considered necessary.

For the remaining grantees, the examination comprised a review of the original grant proposal, each interim and final technical report, and any publications resulting from the research. The technical details in these documents were compared with the specifications and claims in the associated patent. Finally, a 'patent relevance' judgment was arrived at by the subject expert and recorded on a special worksheet.

Findings:

The results of this part of the study are:

- 395 of 4077 (9.7%) NSF Engineering Program PIs were named as inventors on U.S. patents between 1975 and 1982.
- 722 patents were issued to the 395 NSF grantees; 248 of these 722 patents were issued to 149 PIs involving technology associated with the research supported by NSF.
- 51 (21%) of the 248 patents examined were found to be linked to NSF sponsored research.
- 40 of the 149 Engineering PIs had patents linked to their NSF grant. 17 patents issued to the remaining 109 grantees, which included funding acknowledgements to other NSF programs, were judged as not related to the research supported by the NSF Engineering Program.
- Median time from grant award to patent filing date was 3.8 years.

Economic Value of Patents

An economic assessment of each 'linked' patent was developed from information requested from the inventor, from the university patent administrator, or from patent owners to whom assignment of the patent had been made. A questionnaire was used to obtain information on whether the patent had been licensed, date of first sale if marketed, and estimates of total volume of business over the life of the patented products or processes. Although it is too early for full commercialization of patents covering research conducted in the 1968–1977 time period, the information on the early use of the patent itself provides a basis for estimating its potential value.

A majority of the patents examined were not licensed. For each "linked" patent, the technology covered, type of claims, and problems visualized in licensing the claims were analyzed. Most of the patents found were considered of doubtful licensability, i.e., they have limited commercial application, present insurmountable difficulties to protect against infringement, or have no apparent economic advantage over existing processes.

The actual economic value, to date (sales of patented products or processes) of these NSF Engineering patents is relatively small. This is because the full economic potential can take from 15 to 25 years longer to be realized. Also, the selection method used in this study rejected seventeen patents which were invented

by NSF grantees, who were not strictly Engineering program PIs during that time period.

A conservative estimate of the economic value of those patents resulting from NSF Engineering program support is on the order of $52 million. This estimate was based on SRI's experience in evaluating patents and in licensing high-technology inventions, including many which have resulted from basic university research.

The results of this analysis are:

- Seven of the 51 patents resulting from NSF-supported engineering research have been licensed or assigned to an industrial company and have contributed directly to industrial technology; eleven of the remainder are considered potentially licensable.

- The aggregate economic value of the eighteen NSF engineering patents found licensed or licensable is estimated at between ten and twenty times royalty income over the life of the patented product or process. (The total sales to date of the licensed patents cannot be determined with accuracy since adequate proprietary information was not available).

Analysis of Findings

The reasons for differences between the grant-patent data for the NSF Engineering Program and Chemistry Program are complex. A number of probable factors are suggested from related observations.

A comparison is shown (Table 2) between the Engineering and Chemistry program outputs. Basic research is more likely to result in dead ends or non-patentable results than is applied research or engineering.

The research proposals submitted to the NSF Engineering Program are inherently more applied in nature than those sent to the Chemistry Program. The review process employed by the two NSF programs differed; Chemistry evaluated their proposals by mail, whereas Engineering divisions used both external mail reviewers and *ad hoc* panels of experts who met to rate project proposals. While reviewers were instructed to rate proposals for 'scientific merit', there are indications in their written comments that engineering reviewers also gave weight to the practical utility of the anticipated research results.

For those 18 patents found to have commercial value, all were linked to PIs who admitted having been

Table 2. Comparison of results

	NSF Engineering Program	NSF Chemistry Program	Research Corporation chemistry grantees
Period covered	1968–77 (10 years)	1964–77 (14 years)	1964–74 (11 years)
Number of principal investigators (PIs)	4077	3766	915
Number of PIs named as inventors on any patent	395 (149)	73	57
Number of patents issued to these PIs	722 (248)	195	32
Number of patents linked to NSF sponsored research	148* (51)	95	16
Number of PI/Inventors whose NSF grants linked to patents	106† (40)	39	9
Patent ratio: (PI/I per 1000 grantees)	25.9 per 1000	10.4 per 1000	9.8 per 1000
Median time from grant award to filing patent application	3.8 years	5.2 years	6.4 years

*Factor of 0.205 used to project data (51/248 × 722 = 148 patents).
†Factor of 0.268 used to project data (40/149 × 395 = 106 PI/I)

consultants to industry or had prior industrial experience.

Why the Engineering Program patents were commercialized in less time than the other two groups is unclear. The data suggests that PIs who had prior industrial experience were better able to effect the commercial success of their patents.

Estimated Economic Value

As described earlier, the analysis of linked patents was limited by two conditions: (1) the difference between the period in which the grants were awarded (1968–1977) and the period in which the patents were issued (1975–1982), and (2) the lack of information about 474 patents known to be issued but for which grant information was not recovered. To reach quantitative conclusions about all linked patents issued to the grantees of interest, two statistical adjustments were made.

These two adjustments were made on the aggregate statistics of the patents examined. Considering the uncertainties of the evaluation process, this approach made it unnecessary as well as impractical to estimate the probability distribution of royalty income for each patent. Therefore, the midpoint of the range of potential royalties for each patent was used.

The sample of 248 patents showed that 92.7% of them had no commercial value. The midpoint value of the estimated royalties for the remainder was found to be approximately lognormally distributed.

A Monte Carlo simulation yielded a best estimate of the potential royalties of the 474 patents of $23.0 million. Combining this figure with the midpoint of the estimated royalties of the 248 patents examined gives an estimated total of $31.5 million in royalties for all patents known to have been issued.

To adjust for the difference between the grant award and patent issue periods, the distribution of the time lag between grant award and patent issue was determined. From this distribution, it was estimated that 60% of the patents that have been issued to the grantees were issued in the period 1975–1982. Therefore, the total royalties for all patents issued or to be issued to the group of PIs studied was estimated to be $52.5 million.

Additional Observations

One observation from this study is that a strong patent licensing program is becoming valuable to universities, not just for producing royalty income which typically is small, but for the additional sponsored research funds it attracts from industrial firms, both in the U.S. and from abroad.

Although there is insufficient evidence, to date, to know whether the recent (since 1980) shift in Federal and university patent policies toward commercializing university research results has affected U.S. competitiveness in high-technology markets, this study suggests a method for identifying and assessing the extent of university patent output attributable to Federal research grant programs.

Conclusions

Based upon the analysis of findings, the following conclusions are reached:

- Few commercialized patents resulted from NSF grants for engineering research or from the PIs who conducted the research. However, the findings for both the Engineering (3.6%) and Chemistry (1.04%) grantees studied are comparable suggesting that this is due more to the nature or direction of the research than to poor performance by the investigators.
- The PI/Inventor ratio of 26.8 per 1000 grantees, for the NSF Engineering Program, appears significantly higher than the comparable ratios (10.4 per 1000 and 9.8 per 1000, respectively) for the two more basic Chemistry research grant programs.
- The patents examined, which are linked to NSF Engineering research grants, had only a slight impact on technology to date, and can be expected to have a modest economic value in the long run.
- The PI's recognition and awareness of patents is greater today than it was 10–15 years ago.
- The median time (3.8 years) between grant award date and patent filing date is appreciably less than that found for the more basic chemistry grants.
- A strong university patent licensing program is becoming more valuable, not only for producing royalty income, but for the additional sponsored research funds it attracts from industrial firms.

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