(38)

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.

OUTPOSTS

Every week in "Outposts," Outlook examines contemporary ideas that are changing our lives and expanding our intellectual frontiers. This week, Tom Peters argues that organizations must change radically to compete in the volatile, high-tech future. Peters, who co-wrote "In Search of Excellence," is the author of "Thriving on Chaos," from which the following is adapted.

MANAGEMENT

Business in the Future Tense

By Tom Peters

THERE ARE no excellent companies. The old saw, "If it ain't broke, don't fix it," needs revision. I propose: "If it ain't broke, you just haven't looked hard enough. Fix it anyway."

No company is safe. IBM is declared dead in 1979, the best of the best in 1982, and dead again in 1986. People Express is the model "new look" firm, then flops 24 months later. In 1987, and for the foreseeable future, there is no such thing as a "solid," or even substantial, lead over one's competitiors. Too much is changing for anyone to be complacent. Moreover, the "champ-to-chump" cycles are growing ever shorter.

There are two ways to respond to the end of the era of sustainable excellence. One is frenzy: Buy and sell business in the brave hope of staying out in front of the growth industry curve. This is the General Electric idea: In the last six years, it has acquired over 325 businesses at a cost of over $12 billion, and dumped more than 225, getting $8 billion in return.

The second strategy is paradoxical—meeting uncertainty by emphasizing a set of new basics: world-class quality and service; enhanced responsiveness through greatly increased flexibility and continuous, short-cycle innovation; and improvement aimed at creating new markets for both new and apparently mature products and services.

Five areas of management constitute the essence of "proactive" performance in our chaotic world: (1) an obsession with responsiveness to customers, (2) constant innovation in all areas of the firm, (3) partnership—the wholesale participation of and gain-sharing with all people connected with the organization, (4) leadership that loves change instead of fighting it, and (5) control by means of simple support systems aimed at measuring the "right stuff" for today's environment.

Revolution and Control

The last category—control—will require radically new methods. Most traditional measurement methods are dangerously misleading. Take the standard cost-accounting system. It "allocates" overhead costs such as the accounting department, engineering, utilities, machinery and management to direct labor. That is, direct labor "hours" are the most readily counted indicator; all of the other expenses are appended to this one, visible expense. In fact, each typical "direct labor hour" may carry an overhead "burden," as the accountants call it, of as much as 1,000 percent. That's why, when a manager is pushed by higher-ups to cut costs, there is but one sensible target under this accounting regimen: to cut direct labor, which, on the books, includes that huge "burden." Thus, for accounting purposes, when he cuts a direct labor hour, he will usually be credited with the reduction in the "burden" as well, whether it actually occurs or not.

Suppose a manager decides to subcontract production of a labor-intensive part. He saves 100 hours of direct labor a month at $20 per hour ($2,000 in all). But on the books, he saves not only the direct labor costs, but the 1,000-percent burden as well—for a credited monthly savings of $22,000. The subcontract to a smaller, low-overhead, perhaps offshore operation costs, say, $5,000 a month. The net "booked" savings, then, is $17,000. Much applause goes to the plant manager."

Unfortunately, the real story is different from the accounting story. In fact, actual factory overhead is not reduced much or at all by the act of subcontracting (you can't shut off the heat around one idle machine). Most likely, overhead is increased, because the plant manager has to negotiate and administer a contract with the new supplier and handle the incoming components. Not to mention the increased uncertainty of delivery and quality in the early days of dealing with any supplier—that also carries real costs. So the true net saving is the $2,000 saving in direct labor minus the $5,000 subcontract minus, say, $1,000 in real, added overhead—or a loss of $4,000. Nonetheless, thanks to the miracle of modern accounting, the plant manager still takes a bow.

And there are sins of outright omission that are far worse. Our fixation with financial measures leads us to downplay or ignore less tangible nonfinancial measures such as product quality, customer satisfaction, order lead time, factory flexibility, the time it takes to launch a new product, and the accumulation of skills by labor over time. Yet these are increasingly the real drivers of corporate success over the middle to long term.

Treating Workers as Partners

In conjunction with new forms of measurement, future success requires a revolutionary realignment in employe relationships.

- *Keep performance evaluations and pay schemes simple and to the point.* Appraisal must be constant, not focused primarily on the big annual "event." To ensure this, middle managers should evaluate first-level managers on the degree to which they give their people constant feedback, both good and bad. Appraisal is and should be very time-consuming, and it should involve a small number of performance categories and no forced ranking.
- *Require that a manager and each subordinate jointly and literally sign off on a one-to-two-page written "con-*

port markets, and (d) educational incentives to induce much more foreign-language education.

■ *Support expanded research and development.* The R&D tax credit and the basic-research credit which supports business and university linkages will both be phased out by the end of 1988, thanks to the 1986 tax act. At the least, they should be restored. Support for high levels of basic research, especially in non-defense areas, is a must. Additionally, we might provide special tax breaks to firms that bring university researchers on board, or that support cooperative education programs, especially in engineering and science.

This brief sketch flies in the face of the basic intention of tax reform—less use of the tax code to manipulate firms' outcomes. While I acknowledge the adverse consequences of thousands of special-interest loopholes, I think this is precisely the wrong time to turn our back on the most effective weapon to aid rapid industrial transformation: tax policy.

The Winning Look

Today, loving change and even chaos is a prerequisite for survival, let alone success. Every variable is up for grabs. The successful firm of the 1990s and beyond will be:

- flatter (have fewer layers of organization structure);
- populated by more autonomous units (with more local authority to introduce and price products);
- oriented toward differentiation, producing high-value-added goods and services, creating niche markets;
- quality-conscious and service-conscious;
- more responsive;
- much faster at innovation;
- a user of highly trained, flexible people as the principal means of adding value.

—Tom Peters

MCC Team 'Right on Schedule'

MCC, From D1

pected scientists individually recruited by Inman himself. Clearly, Inman has not lost his Washington-honed touch for assuring a comfortable level of autonomy.

Flashing the smile, Inman declines to view it that way, saying only that "we've been damn lucky" in getting the people he's recruited. "I think he's a very effective leader," said MCC board member Samuel H. Fuller, Digital Equipment Corp.'s vice president for research and architecture. "He's strong and outspoken, and when you're trying to get 21 corporations to cooperate on something, that's what you often need to be."

Another board member, who asked not to be identified, asserted that Inman liked to create or impose a consensus rather than seek one. But he conceded that Inman was "very, very effective at managing us and managing our expectations."

Though MCC has been in operation for less than three years and has yet to publish any significant research, it already has captured some of the top researchers in computer science and a reputation as an intellectually exciting place to work. Teams of computer scientists are exploring futuristic forms of computer software that would imbue computers with a "common sense" capability at problem solving, for example. Other specialists are looking at computer-aided approaches to help crowd hundreds of millions of circuits on a silicon chip. Inman unabashedly asserts that MCC "is clearly a winner."

But MCC's member companies and Inman all concede that the real test of the consortium is just now beginning: Will MCC's research and development efforts ultimately translate into innovative products and services that give its members a technical edge in the marketplace?

"We've completed the start-up phase and it's now down to the business of research," said DEC's Fuller. "The hard problem is going to be technology transfer."

"My primary worry is technology transfer," said Inman. "I can't guarantee that all these companies will use these technologies."

In fact, that issue is of such paramount concern that Inman formed an ad hoc committee to force MCC members to address the technology-transfer questions within their own companies.

Even in the fast-paced high-technology industry, effecting a smooth transfer from basic research to prototype to production model has proven to be one of the thorniest problems facing American companies. Academic commentators on industry from Robert Reich to Ezra Vogel all comment that Japanese industry's skills at quickly bringing innovations to market give it a competitive edge.

"There's one resource that's scarce and that's time," said Palle Smidt, MCC's senior vice president of plans and programs. "There's more competition out there now. Revenue life cycles are down, product life cycles are down."

That creates an inherent tension in MCC, Smidt concedes. As computer product life cycles shrink with the pace of technological change, figuring out what constitutes useful long-range research becomes increasingly difficult. When does "long range" research blur into something with immediate commercial possibilities?

Inman and Smidt are leaving that up to the individual companies to decide.

"Our shareholders now have uninhibited access to the developmental know-how in their programs," said Smidt. "And in 12 to 18 months I think we'll see experimental uses and elements of our output in commercial use."

However, Inman concedes that MCC can succeed brilliantly as a research and development organization but ultimately fail in its mission if member companies are unwilling or unable to accommodate themselves to the flow of technologies that emerge from the consortium.

Indeed, Inman and Smidt agree that, with 21 major organizations participating, the odds are great that not all of them will prove adept at swiftly assimilating MCC technology. That could mean that four or five of the most aggressive corporations with a clear technology transfer plan reap the commercial benefits of the investments made by the other members. In essence, the slower companies effectively will have subsidized their competitors' advantage. That could lead to several companies choosing to drop out of the consortium.

In other words, MCC's very success could sew the seeds of discord. Inman says the consortium "could be viable with 14 or 15 members," but he hastens to add that he doesn't expect more than two or three of the 21 companies to drop out over the near term.

Actually, Inman seems more intent on attracting and keeping key researchers than mollifying certain shareholder problems. "I've tried to give them the feeling that they're the members of a club—an exclusive group, an elite group," far more so than he's done with his shareholders, Inman said.

The Austin location has not proven detrimental in attracting researchers from California or Ivy League climes, and Inman cleverly has secured a diversity of shareholders ranging from Boeing Co. to Eastman Kodak Co. to Minnesota Mining & Manufacturing Co. to assure that researchers have a broad market of companies for their innovations.

A random sampling of researchers affiliated with MCC reveals that they are happy with their working environment, adequately compensated and optimistic about the prospects for the application of their research.

"I think Inman has set the right tone for this place," said Doug Lenat, an artificial-intelligence researcher who came from Stanford University and the Xerox Palo Alto Research Center.

However, the tone also includes an overwhelming concern for the proprietary nature of the research. Elevators are equipped with special locking devices that prevent individuals without the appropriate card keys from having access to certain floors at the Austin complex of black glass buildings. Indeed, the seven programs are carefully partitioned so that companies not funding certain programs are expressly prohibited from receiving information from them.

Similarly, researchers—who traditionally have published papers and presented their findings in conferences—are reluctant to disclose anything beyond the sketchiest details of their work.

Indeed, Inman declines to publicly disclose the research milestones of MCC, arguing that, as a private enterprise, the organization is under no obligation to do so. Consequently, though, there is no real external way then of measuring how well MCC's disparate research programs are doing.

DEC's Fuller insists that "It's at least as ambitious as Japan's Fifth Generation" goals and that the 10-year research program is "right on schedule."

Inman visibly bristles at suggestions that this concern for secrecy reflects his national security background. He points out that he has a responsibility to protect his shareholders' investments—more important, he stresses that the lines between basic and applied research and development have blurred to the point that more information has to be considered proprietary and protected accordingly.

BOBBY RAY INMAN
. . . skills "serving me well here"

However, it may well be that MCC—as a consortium—helps define the new level of proprietary emphasis as companies increasingly rely on secrecy as well as innovation to protect a technical edge in the marketplace.

Rather than see secrecy emphasis as a threat to innovation, Inman sees it as a part of the reality of intensifying global competition.

The current membership is Advanced Micro Devices Inc., Allied Corp., BMC Industries Corp., Bell Communications Research (Bellcor), Boeing, Control Data , Digital Equipment, Eastman Kodak, Gould Inc., Harris Corp., Honeywell Inc., Lockheed Corp., Martin Marietta, 3M, United Technologies Corp., Motorola Inc., NCR Inc., Rockwell International Corp. and Sperry Corp. Reportedly, General Motors Corp., flush with its acquisitions of Electronic Data Systems Corp. and Huges Aircraft, also is exploring an MCC membership.

HOW JAPAN PICKS AMERICA'S BRAINS

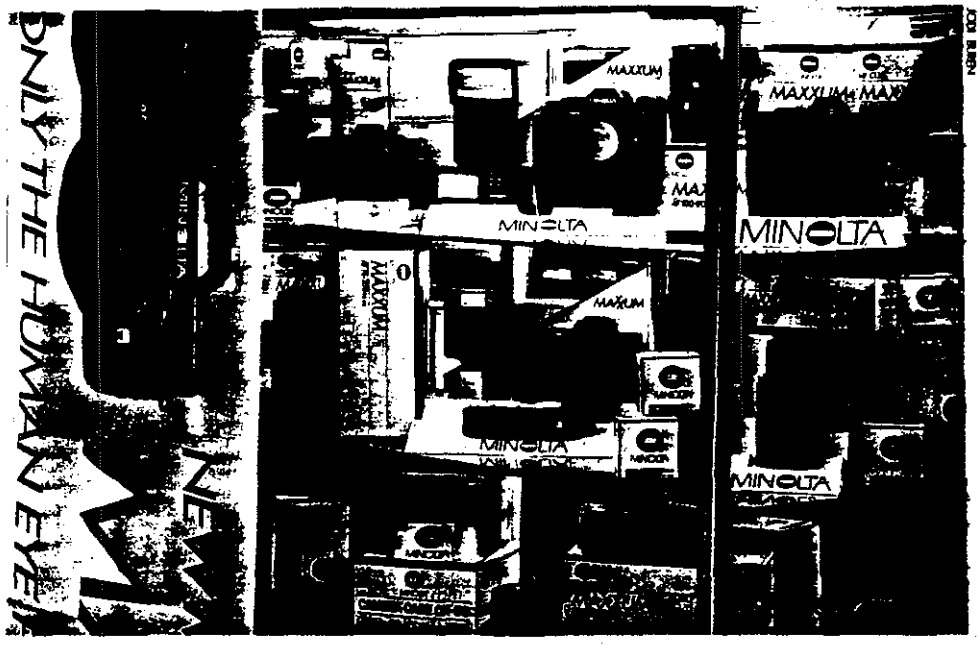
Much of its economic success has been built on bought, borrowed, or stolen technology. Now U.S. companies are striking back—but a two-way street is still far off. ■ *by Joel Dreyfuss*

AFTER ITS DEFEAT in World War II, Japan was content to take foreign inventions—the transistor, the laser, the videotape player—and convert them into products that it could market around the world. Japan acquired much of its base of Western technology, most of it American, perfectly legally through licensing, careful study of scientific papers and patents, and imitation. But when the U.S. wasn't willing to share, some Japanese companies simply copied with little regard for patents and other intellectual property rights that the courts have only recently begun to define in many areas of high technology.

The U.S., confident of its technical superiority, "sold out to the Japanese," says G. Steven Burrill, head of the high-technology consulting group at Arthur Young, a Big Eight accounting firm. "We let them share our brain." Now, belatedly awake to the recognition that Japan has been eating their breakfast, lunch, dinner, and bedtime snack, American companies are stirring. IBM vs. Fujitsu over computer software, Honeywell vs. Minolta over automatic focusing, Corning Glass vs. Sumitomo Electric over fiber optics—these are only the latest, best-publicized complaints that Japan has stolen American technology.

Even as those legal battles are fought out, the copycat cliché is becoming obsolete. A series of studies financed by the U.S. government since 1984 warn that Japan has caught up with the U.S. or passed it in the development of integrated circuits, fiber optics, computer hardware engineering, and ad-

High-tech visitors: *Japanese companies often send to the U.S. graduate students like these at MIT, mostly in science and engineering.*



Two lawsuits: *Honeywell claims Minolta uses its autofocus system in Maxxums (left). Corning Glass forced Sumitomo Electric to abandon a key fiber-optic design (above).*

vanced materials like polymers. It is pressing hard in some areas of biotechnology, and lags primarily in computer software. Already there are signs that the Japanese, buoyed by their new prowess, have assumed the arrogance of the U.S. along with its technology.

WHILE skirmishes over trade balances continue to dominate the governmental dialogue between Tokyo and Washington, technology is rapidly becoming the main battleground. "The future of U.S.-Japan trade negotiations is increasingly high tech," says a top Western diplomat in Tokyo. Indeed, technology has been at the root of a number of recent diplomatic flaps between the two countries: sanctions against Japanese electronic products in response to microchip dumping, the illegal sale of Toshiba machine tools to the Soviet Union, demands for access to a big part of Japan's market for U.S. supercomputers, and attempts by Japanese bureaucrats to restrict foreign competition in domestic telecommunications.

Sometimes protectionist sentiment spills into the technical arena. White House officials barred foreign scientists last July from a Washington, D.C., conference on superconductivity, where international competition is intense. The University of Rochester's business school was widely criticized in September for succumbing to pressure from Kodak and barring an employee of its archrival Fuji Photo Film, who wound up at MIT. And in its turn, MIT in November ruled out buying a supercomputer made by Japan's NEC, after a U.S. Commerce Department official warned the university that it might bring antidumping charges if the price was too low.

"Are the Japanese picking our brains?" a congressional staffer asks. "Yes. They're doing it very well. They're doing it legally. The question is whether we have a two-way street." As in the broader case of equal access to each other's domestic markets, building a two-way street isn't easy. For one thing, much U.S. basic research is done at universities or government centers—and so is generally in the public domain; because Japanese universities have neglected basic research, much of it is done by corporations—and so is proprietary.

Says Daniel Burton, an official of the nonprofit Council on Competitiveness: "You can't get the same information from Hitachi that you can get from a university. If you're a company, you have a vested interest in keeping intellectual property within the company." Moreover, as their research and development matures, the Japanese will have less reason to need U.S. technology. According to the National Science Foundation, among the U.S., Britain, West Germany, France, and Japan, the U.S. did 69% of the R&D in 1965, during the post-Sputnik boom; by 1985, the U.S. share was just 55%.

Corporations in the U.S. are beginning to realize that intellectual property may be their most valuable asset in competing with Japan. And with the Koreans, Taiwanese, and Brazilians, whose lower manufacturing and labor costs promise to make them serious rivals. Companies that may have viewed Japanese imitation as an annoying form of flattery a decade ago are now aggressively trying to protect their hard-earned knowledge. The three most recent cases:

▶ Corning Glass persuaded a federal judge this fall that Sumitomo Electric stole its patent for making fiber-optic cable, a discovery central to the development of all-purpose, high-capacity telecommunications. The judge ruled that Sumitomo had blatantly copied Corning's design for adding selected impurities to glass fiber so it will carry light efficiently. Sumitomo had to stop manufacturing the fibers at its North Carolina plant.

▶ Honeywell accused Minolta, one of Japan's biggest manufacturers of 35-mm cameras, of infringing Honeywell's patents on automatic-focusing technology. Honeywell demonstrated the technology for several Japanese camera makers five years ago and eventually sold licenses to a few. Minolta attended a demonstration but did not get a license from Honeywell. In two years its Maxxum and Alpha autofocus cameras have become worldwide best-sellers and revived a moribund business. Honeywell doesn't accuse Minolta of stealing, but argues that its patents cover the autofocus concept so thoroughly that Minolta must obtain a license. No trial date has been set.

▶ IBM and Fujitsu finally settled in September a copyright dispute that began way back in 1982. IBM accused Fujitsu of copying the software that controls its mainframe computers. After an initial agreement fell through, the companies turned to the American Arbi-

REPORTER ASSOCIATE *Carrie Gottlieb*

KENT BARKER

ROBERT WALLS - IBI PICTURES

Two views: *What are the prospects for more and better home-grown research in Japan? Susumu Tonegawa, 48 (top), an MIT researcher who won the 1987 Nobel Prize in Medicine, argues that much in Japanese culture is hostile to the individualism needed to do creative science. Michiyuki Uenohara, 62 (bottom), executive vice president of NEC, who regularly sends researchers to U.S. universities, insists that Japanese companies like his are pressing hard to do original work that leads to patents.*

tration Association. The arbitrators gave Fujitsu tightly controlled access to IBM's operating-system software for five to ten years—probably at a stiff price. In turn IBM will have the right to examine Fujitsu's software for violations of the agreement. But the ruling apparently obliges IBM to reveal trade secrets to Fujitsu, which could make the Japanese company an even stronger competitor.

The underlying reason that the Japanese need to tap American brainpower is to make up for the great weakness of their industrial juggernaut: the lack of basic research and creativity. Susumu Tonegawa, a Japanese-born researcher at MIT who won this year's Nobel Prize in Medicine, is highly critical of the absence of commitment to basic research in Japan. He contends that scientific concepts are essentially Western inventions and that Japanese culture remains a major block to true creativity. Scientific thinking, he argues, is a product of individualism, and "in Japan, individualism has never been of personal value." The Japanese excel at applied science, says Tonegawa, because teamwork is important to success.

After the war Japan failed to invest in basic research because it was too expensive and time consuming. That tradition has continued. "The Japanese buy patents rather than developing their own technology, which requires enormous investment," says Tonegawa. "They buy the patent, perfect it, synthesize it, sell it, and reinvest the money in another patent." The numbers support him: The U.S. maintains a healthy and growing surplus with Japan in license fees and royalties. In 1986, the Commerce Department reports, Japanese companies paid $697 million to U.S. firms, up from $549 million in 1984.

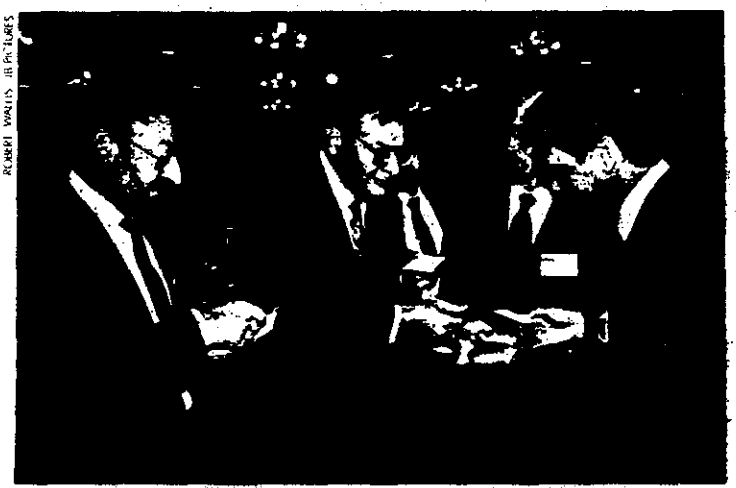
In the relentless pursuit of new technology, Japanese companies have built a solid pipeline to America's research centers. Barely 800 U.S. citizens are studying at Japanese universities. But the National Science Foundation says that some 13,000 Japanese are studying in U.S. universities. In 1985, 95 Japanese nationals won Ph.D.s in engineering and science from American institutions. More than 300 Japanese scientists work at the National Institutes of Health—the largest group of foreigners at the government-funded research center in Bethesda, Maryland. Probably the biggest batch of foreign researchers in Japan—around 35—is at the National Laboratory for High Energy Physics. Japanese corporations pay for 14 professorships at MIT, and they are cranking up their other donations to U.S. universities. National Science Foundation surveys show that those contributions rose from $3.7 million in 1983 to $9 million in 1985.

BECAUSE Japanese companies prefer to hire undergraduates and train them their own way, most Japanese researchers sent to the U.S. are not academics but company employees. That corporate affiliation raises the fear that they will take leading-edge technology back to Japan, where it will be turned into more crushing exports. Japanese researchers strongly disagree. Michiyuki Uenohara, director of research at NEC, insists that he sends people to the U.S. not to bring back technology but to develop international connections and broaden their approach to problem solving.

Uenohara, an Ohio State Ph.D. in engineering who spent ten years at AT&T's Bell Labs, says it is wrong to view Japanese researchers as spies. While at Bell Labs, he says, many of the projects he worked on were patented by Western Electric, AT&T's manufacturing arm. American scientists agree that Japanese researchers make excellent contributions outside their stifling home environment. R. M. Latanision, professor of materials science at MIT, says those he gets "work hard and do first-class research." But unlike researchers from developing countries, most of the Japanese who study or work in the U.S. go back home after their studies are completed, taking their talent and newfound knowledge with them.

Japan has tapped American brains in other

ways. Close to 50% of Japanese corporate investment in research and development goes overseas, mostly to the U.S. The Japanese have been particularly interested in innovative small companies of the type they lack at home, where entrepreneurship is still in its infancy. Between 1980 and 1982, Japanese companies invested $2 million to $3 million in emerging growth firms in the U.S. By 1986 that figure had jumped to $200 million a year, says Mark Radtke, a vice president of Venture Economics, a consulting firm in Wellesley Hills, Massachusetts. For money-starved startups, Japanese investment can be irresistible, says Radtke. "The Japanese companies can be very attractive to help them crack the Asian market," he adds. But the investments also enable Japan to acquire new technology early.



ROBERT WALTS IR PICTURES

Exchanging ideas *along with business cards, European, American, and Japanese participants in an October symposium at Tokyo's Keio Plaza Hotel pondered how to protect computer software programs from infringement by others.*

The fear of getting left behind can bring out the worst in Japan Inc. In computer software, for example, the Japanese seem unable to catch up despite well-organized efforts. The Ministry of International Trade and Industry (MITI) proposed a law in 1984 that appeared to force foreign companies doing business in Japan to license their software to Japanese companies. In the ensuing international uproar the government backed down, but copyright experts at a recent conference on software protection in Tokyo say the Japanese haven't given up. Says Roy Freed, a U.S. copyright lawyer who is a visiting researcher at Tokyo University: "They continue to display a 'have-not' mentality. They see themselves as users, not producers." Adds Hisao Ishihara of the government-financed Software Information Center: "We have to be made aware that invading copyright is the same as stealing something."

The cavalier attitude of some Japanese companies toward intellectual property may also reflect a new arrogance. As the Japanese evolve from "have-nots" to "haves," it becomes more difficult for them to admit needing anything from the U.S. Recently the Japanese media have been ballyhooing the national effort to get into the aerospace business, where the U.S. is far ahead. Much has been made of a second-stage liquid oxygen–liquid hydrogen rocket developed by Mitsubishi Heavy Industries. There is almost no mention that the huge first stage and its engine were designed by McDonnell Douglas and Rocketdyne, both U.S. companies.

Paying for the use of patents or copyrighted material can be expensive, and the strong yen has triggered a heroic effort to trim costs. Japanese managers complain that U.S. companies are jacking up prices. Says NEC's Uenohara: "We're getting pressure to accelerate our own development of intellectual property."

A MEASURE of Japan's progress can be found in the number of patent filings in the U.S., Japan's most important export market. The U.S. patent office in 1986 granted 14,000 patents to Japanese nationals vs. 38,000 to Americans. In fact so many Japanese are thought to have filed for patents at home in the hot new area of superconductivity that U.S. companies have complained that Japanese are trying to preempt the field. Risaburo Nezu, a MITI planner in basic technology, says the filings are probably defensive, reflecting concern that someone in the U.S. may take out a broad basic patent that blocks everyone else, as Corning did in fiber optics. But all those Japanese patents will have an impact far in the future. Gerhard Parker, director of technology development at Intel, the California chipmaker, says that as U.S. patents expire and newer Japanese patents remain in effect, U.S. royalties to Japan will rise.

There are other signs that Japan is no longer waiting for America to hand it technology—possibly because it has already made off with the best available. Boasts Genya Chiba, director of Japan's Exploratory Research for Advanced Technology program: "As Japan becomes more competitive, it becomes increasingly difficult to find superior technology in the rest of the world." To stimulate basic research, the Japanese government has poured money into new research labs and prodded companies to cooperate. Fujitsu R&D director Bun-ichi Oguchi says his company is now spending one-third of the research segment of his R&D budget on basic research. Since 1985, Nippon Telegraph & Telephone, the telecommunications giant, has nearly tripled its research labs from four to 11.

THE FACT that Americans now worry about their access to Japanese technology is an acknowledgment of Japan's new scientific competence. When the Japanese were known primarily as copycats, the flow of technology was essentially in one direction. It was also cheap. Aaron Gellman, president of a consulting firm, says that for years U.S. firms licensed technology to the Japanese without asking for a grant-back, the right to use any improvements they made. Says Gellman: "This was very arrogant and implied that no one could improve on our technology."

Ignorance of Japanese advances can be costly for rivals. Bruce Rubinger, director of studies for the Global Competitiveness Council, a high-tech research firm, says many U.S. patents are invalid because companies have not adequately searched foreign precedents. He cites a major U.S. semiconductor company that had been successfully suing American companies over a process for programming logic chips. When the company sued NEC, however, a patent search showed that the Japanese company had developed and patented the same procedure three years before the U.S. firm.

Not all the blame for the absence of a two-way street in technology falls on Japan. U.S. scientists and companies have failed to take advantage of opportunities to tap Japanese academic research. "What's wrong here is pure laziness," says Martin Anderson, an analyst with the MAC Group, a consulting firm in Cambridge, Massachusetts. He complains that few Japanese technical papers are translated and that few American scientists are

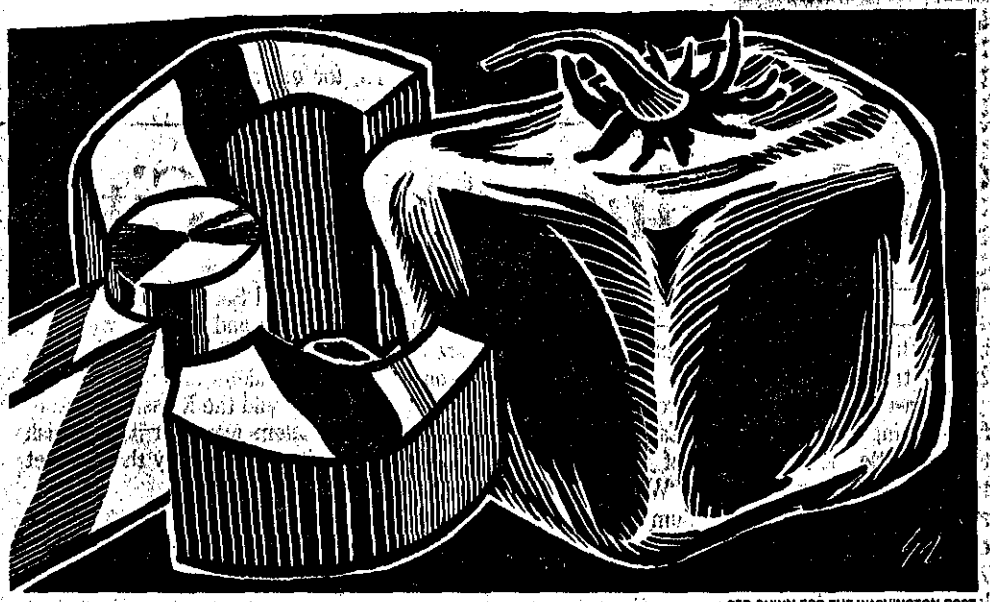
going abroad. Says Anderson: "In order to keep generating ideas, you've got to constantly see new things."

A recent survey of large Japanese companies by the National Science Foundation found that about half were willing to accept visiting U.S. scientists in their research labs, many more than NSF had expected. But candidates are difficult to find because of the language and the lingering conviction that there is little to learn there. Says Richard J. Samuels, director of the MIT-Japan Science and Technology Program: "Americans have become rather smug. They don't read foreign journals and they don't know a foreign language." MIT and a handful of other universities have started Japanese language programs for scientists and engineers; MIT actually places students in Japanese laboratories. U.S. databases are adding more translations of Japanese scientific publications.

ON THEIR END, the Japanese are trying to adjust to their new role as a scientific leader. "We have to accept that our facilities have not been open to foreigners," says Chiba. He believes a consensus is forming in Japan that government and company laboratories must do more to attract Western scientists and to translate more Japanese research. At the same time, Chiba says, there are other barriers. Foreigners haven't been beating down the doors of Japanese institutions, in part because "we are not known so far as a place for young scientists to prove themselves."

While Japan struggles to open up, U.S. companies are becoming more protective of their technology. The recent rash of lawsuits shows that they are paying more attention to patents and pursuing violators more vigorously. They have also become more careful about joint ventures and licensing. Intel has refused to license its newest generation of 32-bit 80386 microprocessors to anyone but IBM; a company that wants to clone the most powerful of the new IBM PS/2 personal computers would have to buy the 80386s outright. Intel and NEC have exchanged lawsuits; Intel has accused the Japanese company of infringing its copyright on another chip.

William Norris, chairman emeritus of Control Data, warns that any effort to achieve a balanced flow of technology between the U.S. and Japan will require concerted action and patience. "It'll probably take ten years to get to the point where we should be now," says Norris. "Let's face up to it and get it done before things get out of control." ■



GER QUINN FOR THE WASHINGTON POST

The Agri-Biz Bonanza

How Your Tax Dollars Produced the Cubical Tomato

By Ward Sinclair

DON WILSON was laughing as he sorted fresh eggs, laughing as if to say that in a perfect world, in a world in which all other problems had been solved, this invention might have had some merit.

The talk at Wilson's farm near Boston was about the square ear of sweet corn created by a University of Massachusetts agricultural researcher. The need was obvious: Square corn would not roll off dinner plates.

Science marches on.

The square corn has become a totem of scorn for Massachusetts farmers like Wilson, increasingly frustrated with scientists at their state land-grant university, increasingly annoyed by research with little apparent day-to-day practicality. In Massachusetts, the cry is for help that will keep farmers competitive, reduce toxic chemical use, provide new crop varieties.

Exasperation is similar in New York, Kansas, California, Wisconsin, Iowa and Pennsylvania, to name a few. As never before, farmers are questioning the research priorities of the land-grant system that was created a century ago on behalf of agriculture and consumers. The research network today consumes well over $1 billion a year in federal, state and private money.

But it isn't doing much good for Don Wilson and Massachusetts truck farmers, who must grow top-quality sweet corn to keep customers coming to their produce stands. And that is part of the rub: Sweet corn is so prone to bug damage that some farmers must spray it with pesticides 20 times in a growing season.

Not only is this expensive. It could be the beginning of the end for corn growers. In an intensely urbanized state where town and farm coexist in uneasy proximity, public pressure has put farmers on notice that chemical abuse and groundwater pollution will not be tolerated. Either new ways must be found to farm or the farms will be no more.

Wilson has come to terms with these pressures, but he faults university research for devoting time to such oddities as

See FARM, C4, Col. 1

Ward Sinclair covers agriculture for The Washington Post.

The Agri-Biz Bonanza

FARM, From C1

square-eared corn when farmers have more pressing needs. Survival, for instance.

From state to state, criticism is harsh: An old friend has strayed from purpose and become a purveyor of technology hastening the exodus of farmers from the land. It is attacked for developing chemical-based farming techniques that have created environmental nightmares. It is upbraided for rushing toward mechanization without weighing the consequences to farm workers and rural communities. It is under fire for what many see as a bias toward factory-style farming in which only the affluent can succeed. It is excoriated for encouraging farmers to expand—often to their peril, as the farm depression of the 1980s has demonstrated.

The achievements of this pioneering federal-state system are nonetheless beyond question. It has produced dramatic conquests of animal disease; perfected seed and animal breeding techniques; stimulated spectacular yield and productivity gains for U.S. farmers; eased the workload with new machinery; fostered improvements in fruit growing and storage; developed health protection and convenience for consumers and the food-processing industry. The examples are endless.

And in more ways than most realize, the American lifestyle, for better or worse, is shaped by this research. Land-grant scientists determine the taste and quality of many of our vegetables and meats. They have speeded breakthroughs in packaging and food preservation that often put convenience ahead of nutrition and freshness. The results of their work range all across the food system, much of it cloaked in the name of consumerism, but in fact of more use and profit to growers and their agribusiness brethren.

The system is based in the land-grant universities, created in 1861 by the Morrill Act, which provided federal lands as endowments for publicly-funded universities. The Hatch Act of 1887 provided federal grants to these schools to set up agricultural experiment stations, where the bulk of the research occurs. The Smith-Lever Act of 1914 added the Cooperative Extension Service as a third leg of the system to deliver research results to farmers.

Watching over all this is the Department of Agriculture, which administers and monitors federal funding for the experiment stations. USDA's Agricultural Research Service carries out further experimentation and provides additional money to independent researchers. In theory, it all is rooted in the Hatch Act.

In 1977, Congress reaffirmed its commitment, saying "to foster and encourage the family farm system of agriculture . . . it is the policy and express intent of Congress that no such program be administered in a manner that will place the family farm at an unfair economic disadvantage."

James R. Pearson, then a Republican senator from Kansas, explained that the idea had endured "from the Revolutionary period to the present" and was "based on the conviction that for social and political reasons small-scale, family farming was preferable to large-scale estate farming." Congressional intent could hardly have been clearer.

The reaffirmation was to some degree a response to "Hard Tomatoes, Hard Times," a bare-knuckles critique of the system published in the early 1970s by Jim Hightower, a journalist who went on to become the Texas commissioner of agriculture. The study documented charges that the land-grant complex had abandoned its purpose and become a handmaiden of agribusiness.

"The complex must, again, become the people's university—it must be redirected to focus the preponderance of its resources on the full development of the rural potential, helping to make the American countryside a place where millions of people can live and work in dignity," Hightower concluded.

The agriculture establishment largely dismissed Hightower's polemic, but now the heat has been turned up. Last November, A California Superior Court judge ruled that the University of California had conducted agricultural research in violation of the Hatch Act. UC's $116-million-per-year research program is the nation's largest.

Judge Raymond L. Marsh ordered the university to revamp its program within 90 days and said he would maintain a five-year monitoring program to assure compliance.

The university announced its intention to appeal the decision—a chief objection is that Marsh infringed on academic freedom—and many observers in California consider the case so pivotal that they see it eventually reaching the U.S. Supreme Court.

The suit was brought in 1979 by California Rural Legal Assistance and the old California Agrarian Action Project on behalf of farm workers who contended that they had been displaced by university mechanization research financed in part by Hatch Act funds. As much as it was a challenge to the university, it was an indictment of the industrialization of agriculture by the land-grant system as a whole.

The workers were not attempting to stop mechanization, nor were they insisting that back-breaking hand labor needed court sanctification. Their complaint was that technology had been pushed forward without adequate consideration of the consequences of economic concentration and labor displacement.

"I've argued that the university has somewhat mindlessly fallen into a set of procedures that link it to large-scale agriculture," said William H. Friedland, a UC/Santa Cruz professor of rural sociology and longtime student of farm mechanization. "The more profound problem is that many researchers think in terms of high technology, rather than low technology. They orient themselves only to the cutting edges of their fields. It's not that they're mean and nasty people, because they're not."

No example is quite so telling as the development of the tomato-harvesting machine at the UC/Davis campus in the 1960s, which evolved as a centerpiece of the "mechanization suit," as it came to be known. Predictably, the evolution of the harvester created a need for a tomato that would endure machine battering. Davis met the need by developing what breeders call "determinate" tomatoes, squarish types that grow on stockier vines and ripen simultaneously.

The results of the Davis work were dramatic. The cost of the machines (today more than $150,000 each) meant that only the most capitalized farmers could take advantage of the technology. Parallels can be found in other highly mechanized crops such as cotton, rice, sugar beets, grapes and carrots.

Ten years after the harvester hit the market, the number of processing-tomato growers in California had dropped from about 4,000 to 597. The average tomato plot grew from 32 acres to 363. As Hightower noted, canned tomato prices rose 111 percent—far above the average for other processed fruits and vegetables—and hand-harvesting ended completely.

By some estimates, 30,000 tomato jobs were eliminated. But that was not all. Important processing-tomato production in other parts of the country, such as Ohio, Indiana and Maryland, was knocked for a loop as the industry began to concentrate in California. The processing tomato, used for sauces and cooking, is now a major vegetable crop in the state.

Friedland, for one, thinks that if Judge Marsh's ruling is sustained "it becomes feasible to consider new trajectories in agriculture . . . [Davis] produced what I would call a 'machine vine', but if they had a different ideological fix, they could create a 'labor vine' that would extend the natural indeterminate characteristic of the plant and facilitate use of labor on a longer basis to help stabilize the work force."

UC officials defended the Davis work as a logical result of the federal government's ending its *bracero* program, which had assured California growers a steady and dependable labor force by allowing Mexican workers to come freely into this country. But there was another side—the growers' fear of farm-labor organizing. One university researcher put it succinctly: "The machine won't strike. It will work when the growers want it to work."

In its way, the tomato harvester was only part of a larger story. In "Breaking the Land," a 1985 study of the mechanical revolution in cotton, rice and tobacco, Pete Daniel wrote that "single-minded pursuit of higher production" by government and private industry created havoc among the South's small farmers and changed the face of farming there, perhaps forever.

Daniel, agriculture curator at the Smithsonian Institution, noted that in its rush to boost output with new machines and sophisticated technology, the government in effect ignored marginal small farmers and their relationship to the land. The machine-forced dispossession of the rural poor, in other words, was someone else's problem.

"The Extension Service worked with middle-class farmers, people who could buy into the mechanized agriculture," Daniel said recently. "The experiment stations worked on science that only those with money could buy. People on the bottom could not take advantage of the changes. The development that Davis has done has always been aimed at the bigger farmers."

While it applies only in California, Judge Marsh's ruling has ramifications well beyond the state. Land-grant researchers elsewhere and their professional organizations closely followed the progress of the suit. The Hatch Act issues raised in California are under discussion from coast to coast.

In one sense, the debate over mechanization is almost academic—machines already have drastically altered the shape of U.S. farming and freed up millions of hands for work elsewhere. Yet in another sense, the Marsh ruling comes at a new jumping-off point for the land-grant research complex—the world of biotechnology.

Researchers at a number of institutions, for example, are avidly at work on gene-splicing techniques that promise startling increases soon in milk and pork production, although there is little evidence that the potential impact of their work on farmers and rural society has been thoroughly weighed.

"The arguments that the harvester left the barn 30 or 40 years ago may be true with mechanical equipment," said lawyer Ralph Santiago Abascal, who litigated the case for California Rural Legal Assistance. "But there is a whole host of other technologies with scale impact that could be affected by the case. There has been a substantial shift into biotechnology in the land-grants and we ought to be analyzing the consequences. It doesn't take agitators like me to rile up farmers—they understand what is occurring."

More importantly, movers and shakers too are beginning to think along the same lines. Listen to the parting remarks of James B. Kendrick Jr., who retired last year after 18 years as UC's vice president for agriculture:

"The leadership of state agricultural experiment stations and Cooperative Extension urgently need to begin adjusting their programs so that the public interest is served. It is debatable to assume that research and extension programs designed primarily to serve the needs of the 50,000 largest U.S. farming units are in the public interest."

"The most significant change required for the future," Kendrick wrote, "involves Cooperative Extension. For a substantial number of the moderate-size farming units to survive, Extension will need to direct its primary attention to this group. If this isn't done, an important feature of our rural environment will disappear and rural America will be damaged."

Don Wilson would agree. Instead of square corn and other exotica, he'd like to see researchers in Massachusetts come up with a thicker-husked sweet corn to prevent worms from burrowing into the ear. That such a corn already is available on a limited basis elsewhere underscores his point.

"We need it here—the kind of research that could benefit both farmers and consumers," he said. "If we had a corn with the extra-thick layer of husk, we would use less pesticides and less energy; the environment would be protected; our costs would be lower; consumers could feel more secure. Everybody would be ahead."

Space Industries Inc.

Artist's rendering of a proposed commercial space station.

U.S. May Back Private Venture For Space Base

By WILLIAM J. BROAD

A senior White House policy group has agreed in principle that the Government should back a private plan for construction of a small, inexpensive space station that would fly into orbit years ahead of NASA's multibillion-dollar space outpost, Federal officials said yesterday.

The National Aeronautics and Space Administration, which views the proposal as a serious threat to its space station plans, denied that an agreement had been reached. A spokesman for the head of the senior policy group refused to comment.

But a Federal official familiar with the meeting said, "We've been running the space program with one hand, the private sector, tied behind our back. Now that's going to change."

Use in 1991 Is Foreseen

The reported action came in the form of a proposed recommendation to President Reagan that the Goverment use Federal funds to lease part of the small space station, which could be orbiting the Earth as soon as 1991, whereas the NASA station would be ready by 1997 at the earliest. Private companies could also use it for a variety of industrial purposes.

The commercial venture, headed by Space Industries Inc. of Houston, would advance the Administration's goal of promoting the nation's fledgling space industry in the face of increasing international competition. A Federal move to support the small proposed station would guarantee a major customer, greatly increasing the chances of the the plan's realization.

Experts in and outside Government said such a leasing arrangement, if acted upon by the Administration and viewed favorably by Congress, might mark the end of the beleaguered NASA space station and would undoubtedly be a turning point in the history of the nation's space program, with commercial initiatives playing an increasing role.

Government participation is considered crucial. Industry has expressed great interest in having facilities for experiments and manufacturing best performed in the weightlessness of space. But few companies have been willing to invest in an exclusively private project that might never be given the necessary priority for launching by the space shuttle.

The proposal has been vigorously fought by NASA, which fears that the private facility would undermine political and financial support for its more costly and ambitious station goal.

Final Decision Denied

Shirley M. Green, head of public affairs for NASA, yesterday denied that a final decision that would result in a recommendation to the President had been reached by the senior group, the White House Economic Policy Council. The NASA Administrator, James C. Fletcher, is a member of the council, which is headed by Treasury Secretary James A. Baker 3d. A spokesman for Mr. Baker declined comment.

The proposal for a small station has already won some support from Congress, which before Christmas directed NASA to spend $25 million to explore leasing the facility. In addition, the Commerce Department has vigorously promoted the leasing idea within the White House.

The proposed small space station is designated the Industrial Space Facility. Costing up to $700 million, its components could be launched as early as 1991 by one or two flights of the space shuttle and would be relatively easy to deploy.

The facility, powered by a 200-foot-long array of solar panels connected to a cylindrical module up to 46 feet long, would be visited periodically by astronauts from the space shuttle. The astronauts, working in its interior, would get their air, food and water from the attached shuttle. The facility itself would have no life-support system. In essence, it would be an automated, orbiting laboratory and factory that got occasional maintenance by visiting astronauts.

> 'We've been running the space program with one hand tied behind our back.'

Use as Science Laboratory

Limited though it may be, the facility might be used for many of the tasks of the big station, especially as additional modules are added. In its most rudimentary form it would be a science laboratory to investigate new materials, grow crystals, make drugs, and tinker with new kinds of electronic circuits.

In contrast, NASA's station would be the nation's first permanently manned outpost in space, with accommodations for a crew of eight. It would be a hotel, factory, observatory, research center, service station, and launching pad for missions to other planets.

When first proposed in 1984, the NASA station was to cost $8 billion and be orbiting by 1992. The space agency now estimates that a scaled-down version measuring 445 feet long would cost $14.6 billion, although other experts put the bill at about $26 billion. These cost estimates do not include the 20 or so shuttle flights needed to boost it into space.

Details to Be Worked Out

At best, the scaled-down NASA station would be completed by 1997, although new delays are likely since Congress recently cut the station's proposed budget for this fiscal year by more than 40 percent, to $425 million.

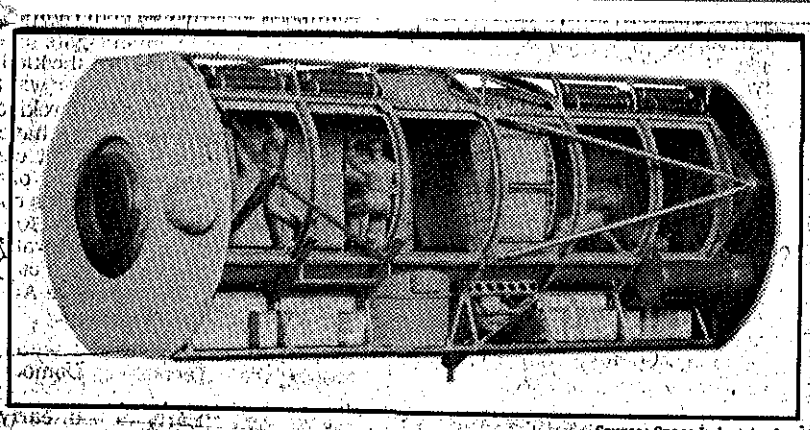
Federal officials said yesterday that although a decision to back the small station had been reached at a meeting of the Economic Policy Council on Thursday, critical details, such as what fraction of it would be leased by the Government, remained to be worked out.

"There is a commitment," said one official. "The numbers are to be negotiated."

Aviation Week & Space Technology, a trade magazine, also reports in its forthcoming issue that a firm decision has been reached by the White House council to go ahead with the small-station leasing idea.

Dr. Peter E. Glaser, vice president of Arthur D. Little Inc., a Cambridge, Mass., a consulting concern that works on aerospace issues, remarked: "Clearly, a Government lease is key to getting industry interested in this kind of thing. And the facility is good at what it does. On the other hand, if it's a success, Congress may ask whether it should influence our plans for the NASA station. To me, the small facility is not enough to demonstrate U.S. commitment to leadership in space."

Some Congressmen, disappointed with the space agency's recovery from the Challenger disaster and eager to cut the Federal Government's budget deficit, have already said they would scrap the big station in favor of the small one.



Source: Space Industries Inc.

Astronauts would visit the proposed private space station to tend scientific experiments and manufacturing processes.

N.Y. Times
1/9/88

Complementary Role Seen

But the industrial promoters of the small facility say it complements rather than replaces the NASA vision.

"It's not as exotic or versatile," said Dr. Joseph P. Allen, executive vice president of Space Industries Inc., who is a former astronaut. "We're basically a mobile home with no plumbing. But we do have electricity and people can go in from time to time to do all kinds of experiments."

The small proposed facility is the major project of Space Industries Inc., whose president is Dr. Maxime A. Faget, formerly a top NASA designer for the Mercury, Gemini, Apollo and space shuttle programs. So far the company has signed up no industrial customers for the facility, although it says a stampede would start if the Government leased some capacity. NASA might use it as a test bed for its larger station, and the Defense Department might use it for experiments to develop circuits and sensors for military satellites, among other uses.

Commerce Department officials see the small facility as a way to spur the nation's private space industry and meet rising international competition from Russia as well as Europe and Japan.

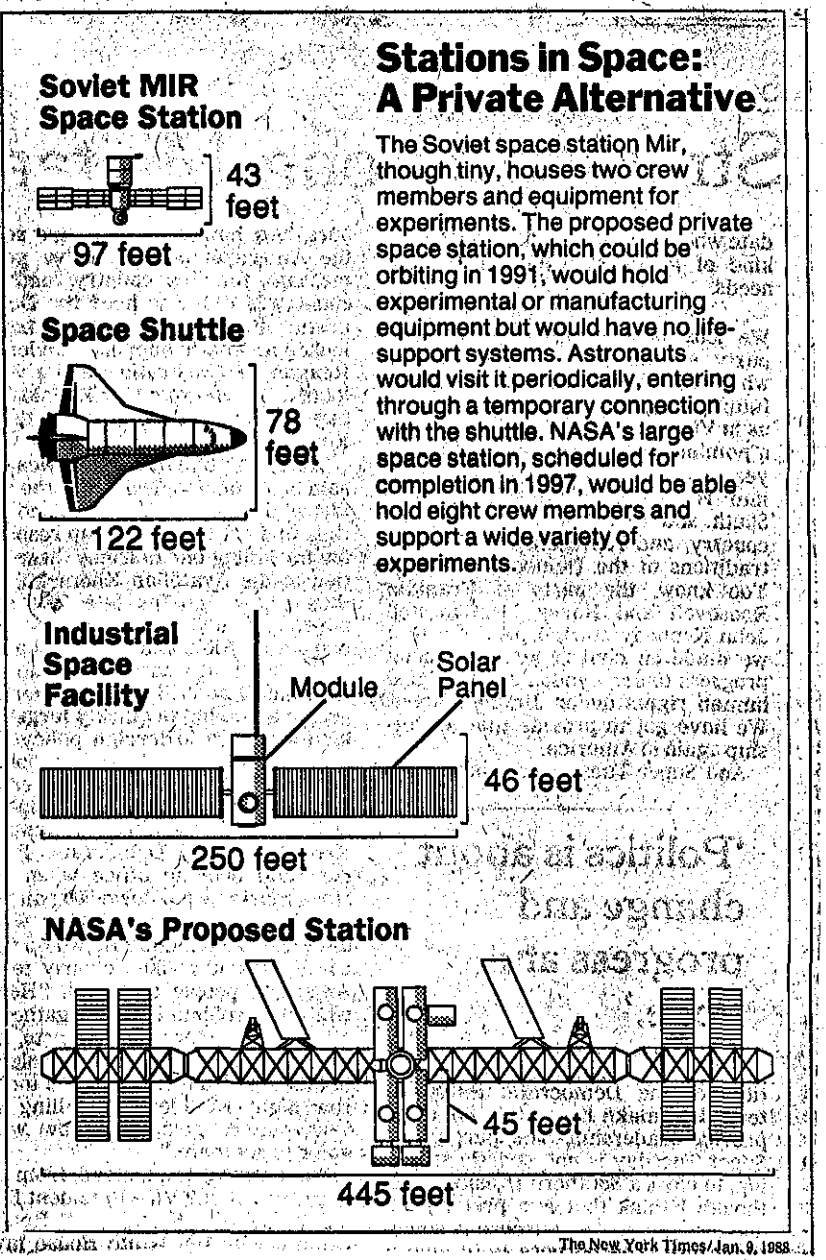
"The United States is third or fourth and slipping fast in the pursuit of advanced space materials research," said Gregg R. Fawkes, director of the department's Office of Commercial Space Programs. He noted that the Europeans plan to loft Eureca, a small, "man-tended" space station in 1991, that is similar in many respects to the Industrial Space Facility.

While praising the private station, Mr. Fawkes refused comment on the outcome of the White House meeting.

In recent days, the space agency has vigorously fought the leasing idea in the White House and Congress. On Wednesday, NASA's Administrator, Mr. Fletcher, wrote the House Appropriations Committee to say the space agency's proposed leasing of the small station had "serious policy, legal, schedule and budgetary difficulties," adding that NASA "does not now have identified needs that would justify a major commitment."

Stations in Space: A Private Alternative

The Soviet space station Mir, though tiny, houses two crew members and equipment for experiments. The proposed private space station, which could be orbiting in 1991, would hold experimental or manufacturing equipment but would have no life-support systems. Astronauts would visit it periodically, entering through a temporary connection with the shuttle. NASA's large space station, scheduled for completion in 1997, would be able hold eight crew members and support a wide variety of experiments.



The New York Times/Jan. 9, 1988

Deciding Regionals' Data Role

Phone Companies' Future In Information Services Reviewed by Judge Greene

By John Burgess
Washington Post Staff Writer

Once again, Judge Harold Greene is poring over reams of technical data and conflicting advice to make decisions that will shape a multibillion-dollar sector of the American telecommunications system.

His subject of scrutiny this time is "information services," an industry term that covers just about every use for a telephone network beyond ordinary conversations: the electronic transfer of data and graphics; shopping, banking and library browsing by means of the home computer; electronic mail; recording and automatic transmission of voice messages, and simultaneous translation of the electronic languages in which computers talk to one another.

Such services are already available in varied forms in the United States. But now Greene is devising details on how to open the door to the business a bit for the seven titans of the telephone industry, the regional operating companies that were born of the 1984 breakup of American Telephone & Telegraph Co. They own most of the country's local phone networks.

His key idea is to let them operate "gateways," electronic points of entry through which users in home and offices would, with a single local call, be able to reach any service in the country easily and freely.

The regional companies are pressing Greene to go far beyond that, allowing them to operate recorded voice systems. Millions of American homes and businesses now have answering machines, but technology exists to build the same capability into the networks themselves. Using a touch-tone phones, a person stepping out would punch in a command to the network to intercept incoming calls with a recorded greeting, take messages and play the messages back when the person returned.

Other applications are possible for voice. An executive trying to reach a long-busy number could dictate a message to the network and instruct it to deliver it to the number when it was free. Or a Cub Scout leader might record a message about where the weekend picnic was going to be and order it forwarded to the phones of each of the 10 members of the den. Or a deep sleeper could request an automated wake-up call. Services like these are already available over the network in some foreign countries, including Japan.

The information business is now totally closed to the regional companies, with the exception of passive transmission of other people's data over their lines. The logic is that if they could provide data, they would have an incentive to try to monopolize the business because they own the local phone lines over which it must pass. The ban is part of the consent decree that broke up AT&T and is supervised by Greene, a judge at U.S. District Court for the District of Columbia.

Addressing delegates at an international telecommunications conference in Switzerland in October, Greene explained why he had decided to loosen the reins: "I believe that the American people can derive great benefits from modern, varied services of this type," he said. "And I hope that this action will provide the impetus for a broad advance in this field."

It is a key element of the information age, the much-heralded era when everyone will have a computer that can link up with any other in the country, or even the world, to draw out or put in all manner of things. Futurologists brim with predictions for heady social and economic changes this could wreak: fewer commuters on the highways as more people work at home; better education due to students' instant access to the best libraries in the world; a progressive withering away of paper mail and newspapers; a shift of retailing from shops to the computer screen.

Home hardware has indeed been proliferating at a rapid pace, with an estimated 25 million personal computers scattered across the country. There is a wide variety of information services available, by which users send electronic mail to each other and get stock quotes, video games, advanced computer software, health tips and myriad other services.

But usage is still considered small—perhaps only an eighth of the country's computers are involved and just one hundredth of its households. CompuServe Corp., the largest of the U.S. data service firms, has only about 375,000 subscribers.

Is this due to lack of demand, as some consumer groups say, or to the divestiture agreement restraining the industry's natural development, as the regional companies contend? To a degree, Greene has come to agree that the problem lies with the decree.

The way things now work, users must subscribe to services separately, submitting credit information. Bills are paid one-by-one. Users must hang up and redial to get from one service to another. For people who live outside the country's major cities, getting into a system at all may involve the extra charge of long-distance calls.

The regional companies, the Justice Department and the Federal Communications Commission have long advocated clearing away all legal restrictions on information services for the regional companies, saying their participation is the key to mass marketing. Under their plan, safeguards would be put in place to guard against monopolistic abuses.

"This is one issue where our interest and the public interest coincide," said Sidney Boren, corporate vice president for planning and budget at BellSouth Corp., the regional company based in Atlanta.

They were waiting anxiously last September, when Greene issued a 223-page opinion as part of a review of the breakup three years after it took place.

To their dismay, he reaffirmed the old principle that the phone companies could transport other people's information but not provide their own. But he offered some consolation prizes: They could put their white pages on computer and, more important, they could proceed with plans to offer to their customers electronic "gateways" through which all information services would be reached.

Fully implemented, gateways would mean that any user anywhere in the United States could dial a single local number and link up a computer to a phone company computer, which would generate a welcoming message on the user's screen and a "menu." This would list information services and explain billing. With a few strokes on the keyboard, the user would have ready access to any data base listed there, and the idea is that they would include most all that the country has. Services such as CompuServe and The Source currently provide gateways, but their selection is much smaller than is envisioned for the regionals.

New York Times 1/10/88

Spending Strategies Awaited

In AIDS Research, Money Is Just the Start

By ROBERT PEAR

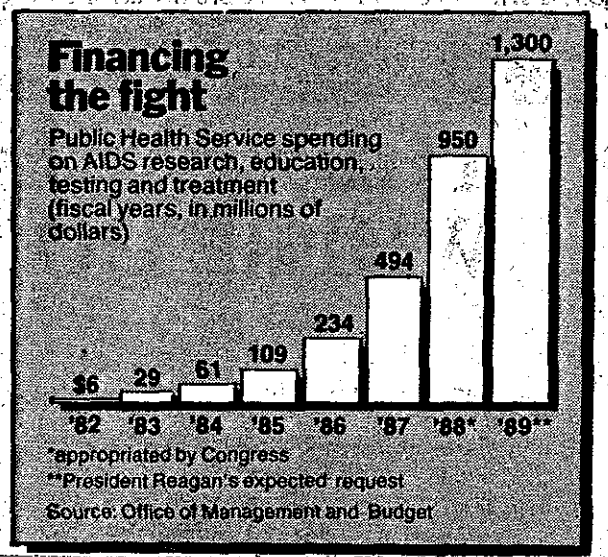
WASHINGTON

SEVEN years into an epidemic that is expected to kill more than 179,000 Americans by the end of 1991, Federal financing to fight AIDS is approaching the amount spent in the war on cancer. Budget documents show that President Reagan plans to ask Congress for $1.3 billion in the next fiscal year to help the Public Health Service combat the epidemic, an increase of 37 percent over appropriations for the current year. By way of comparison, the National Cancer Institute's 1988 budget is $1.5 billion.

As AIDS spending continues to grow dramatically, from $234 million in the fiscal year 1986 to $494 million in 1987 and $950 million this year, Federal officials are confronted with some difficult questions. How can the Government nudge research in desired directions while allowing individual investigators the freedom and creativity that often produce the most important scientific discoveries? How much of the money should be spent in Government laboratories? How much at universities, medical schools and hospitals?

"The best science comes from individual scientific creativity," said Dr. Anthony S. Fauci, coordinator of AIDS research at the National Institutes of Health. "We have to guide and coax in the right direction, but we cannot push too hard. We are against the idea of an AIDS czar or an approach like the Manhattan Project. That may be the way to get an atomic bomb, but that is not how you get the best science."

When the new figure for AIDS spending was disclosed last week, scientists said that Federal outlays appeared, after much delay, to be approaching the levels they regarded as necessary. A report by the National Academy of Sciences in 1986 said that by 1990 the Government should provide $1 billion a year for research on AIDS and should make significant contributions to the additional $1 billion a year required for education and public health measures. The President's 1989 budget request includes $323 million for research into the causes of AIDS, $325 million for development and evaluation of drugs and vaccines, $397 million for prevention activities and $24 million that will probably be used for a new laboratory for the Food and Drug Administration.



As the amount of money increases, competition becomes more intense. In the quest for financial support, scientists studying molecular biology and the structure of the AIDS virus are, in a sense, competing with epidemiologists who do field work to track the spread of the virus. Both types of work are essential to understand and disrupt the virus, which may become one of the most common causes of death, after heart disease and cancer, in the 1990's.

Unanswered Questions

Dr. Charles C. J. Carpenter of Brown University, chairman of a group of consultants who advised the N.I.H. on future directions for AIDS research, said scientists had made progress in both the molecular biology and the epidemiology of AIDS, identifying the genetic characteristics of the virus and the routes of transmission. But, he said, much work is needed to learn which cells become infected and what changes occur immediately after exposure to the virus. If scientists knew more about the mechanisms by which the virus causes disease, it would help them in trying to devise vaccines and therapeutic drugs.

Dr. Fauci said that only about 12 percent to 15 percent of the N.I.H. funds were spent for research by Federal scientists working in Government laboratories and clinics. The remainder, he said, goes to private researchers for projects initiated either by the investigators themselves or by the Government. The Government, for example, has signed contracts with university medical centers to perform clinical trials of experimental drugs in people infected with the AIDS virus.

Researchers who design their own projects usually receive grants, which are less restrictive than contracts. In evaluating applications for grants, the N.I.H. uses an elaborate system of peer review devised over the last 40 years. At the moment, officials said, the competition among scientists working on AIDS is not as great as that among scientists working in some other areas of biomedical research, such as metabolic causes of heart disease. But as AIDS researchers gain experience, their applications are receiving higher scores in the peer review process, indicating an increase in their technical and scientific merit, Dr. Fauci said. "We are funding most of the applications that are worthy of being funded," he said.

The report by the National Academy of Sciences warned that an overcommitment to centrally planned studies could have "extremely deleterious consequences" if it excluded "creative scientific input from researchers outside of the N.I.H." Federal officials said that investigator-initiated projects accounted for a growing share of the total because more and more experienced researchers were being attracted to the study of AIDS.

Dr. Carpenter's advisory panel warned that the Government must not shortchange other biomedical research to pay for work on AIDS. Some of the research that appears unrelated to the disease "may, in fact, provide important basic information in areas of immunology, virology and molecular biochemistry that will be critical to the resolution of the AIDS epidemic," the panel said.

It noted that the initial progress in AIDS research resulted, in large part, from money spent on basic research into viral causes of cancer over the last two decades.

An Official Program

Guide to China's Science and Technology Policy, 1986. State Science and Technology Commission of the People's Republic of China. China Academic Publishers, Beijing, 1987 (U.S. distributor, Pergamon, Elmsford, NY). viii, 434 pp., illus. $130. White Paper on Science and Technology, no. 1.

China's White Paper on Science and Technology, issued by the State Science and Technology Commission, is a broad overview of the role of science and technology in China's ongoing modernization program. As might be expected in a document of this type, the approach is very much top-down—an examination of science and technology policy from the point of view of China's national-level Party and government organs. A large share of the space in the volume is given over to explaining the 15-year development program for science and technology covering the years 1986 to 2000. That plan, in turn, is the successor to three earlier long-term science and technology development programs drawn up and approved by the Party in 1956, 1963, and 1978.

What is surprising, however, is the almost complete disjuncture between this top-down approach to planning for science and technology and the rather far-reaching decentralization of decision-making currently under way in many critical sectors of the economy. The science plan not only identifies high-priority fields such as microelectronics, information technology, biotechnology, and new materials technology (discussed in general terms in the volume under review) but in a separate internal 27-volume study identifies hundreds of specific scientific and technological projects that will be undertaken in these priority areas as well as in important traditional industries. In short, while economic reforms are altering the production sector of the economy in China far more profoundly than in any other reforming socialist system, science and technology planning appears to be blithely proceeding very much in the centrally planned style borrowed from the Soviet Union in the 1950s.

The volume also reflects little movement away from the traditional view that scientific and technological improvements in some sense can serve as a substitute for even more far-reaching institutional changes in the economy. Thus the burden placed on science and technology is enormous. Technology policy is assigned the responsibility for increasing productivity in manufacturing, for raising the production of primary energy sources, for increasing the energy utilization rate, for improving the efficiency of air, water, and surface transport, for upgrading the quality and efficiency of the communications networks, for raising farm yields, for increasing the efficiency of land use in urban areas, for preventing water and air pollution, and so forth. Though the replacement of inefficient industrial boilers, water pumps, fans, and electric motors may provide a one-time saving in energy, it may not be as effective a mechanism for stimulating conservation as raising the price paid by industrial users of energy to something approaching its real cost. Similarly, as long as urban land is very substantially underpriced and allocated bureaucratically the prospects for utilizing it more efficiently through more scientific urban planning seem dim.

In essence the White Paper advances policy for science and technology in something of an institutional vacuum. It considers neither how the top-down approach is no longer appropriate to a more decentralized production structure nor how further institutional changes, for example in the price formation process, in the long run may be essential to achieving some of the goals of the science and technology plan.

The White Paper explicitly acknowledges the shortcomings of traditional policies but also reveals how much remains to be done to reform the institutional arrangements and approaches borrowed from the Soviets in the 1950s. The effective utilization of scarce scientific and technical manpower, for example, continues to be constrained by limitations on the mobility of personnel. Scientists and engineers are assigned to research institutes when they complete their formal academic training and seldom change jobs subsequently. The research institutes regard these personnel as their own property, and in the absence of labor markets individual mobility is extremely limited. The White Paper discusses reforms that have been under way for several years to increase the opportunities for individuals to move to more appropriate or preferred jobs, but the results have been disappointing. Only 3 percent of scientific and engineering staff are now able to change jobs annually, a comparatively low rate. International experience suggests that labor mobility is one of the main means of diffusing new technology. Much technical knowledge is embodied in human capital, so the development of a labor market for scientific and engineering manpower would improve the diffusion of technology throughout the economy, an area where China is particularly weak.

Similarly the White Paper describes an elaborate new system of certificates and cash prizes that the state is now awarding to inventors and scientific innovators. But it is silent on the major crisis that threatens further to alienate China's intellectual community from the State and Party. That is not the persecution of individual scientists who have called for reform of the Chinese Communist Party but the steady erosion of real living standards that stems from the combination of a rigid fixed wage structure for scientists and engineers and the more inflationary environment of the mid-1980s. The decline in the incomes of scientists and engineers relative to that of workers in other sectors of the economy, where the opportunities for commercial and entrepreneurial activities have widened steadily and real incomes have grown explosively, has been particularly corrosive.

NICHOLAS LARDY
School of International Studies, University of Washington, Seattle, WA 98195

Institutions Transformed

The Care of Strangers. The Rise of America's Hospital System. CHARLES E. ROSENBERG. Basic Books, New York, 1987. x, 437 pp. + plates. $22.95.

The history of the American hospital was once portrayed as the story of a backward institution radically changed through medical and scientific advance. In recent years, this historiographic tradition has been augmented by histories that emphasize the role of communities, economics, politics, workers, and patients in the development of the institution. Charles E. Rosenberg has been instrumental in spawning the new history. His 1962 book *The Cholera Years* has served as a model of the social-history approach to medical subjects, and his subsequent articles on the American hospital have been critical in defining the issues that had to be addressed by historians of this central institution. Yet Rosenberg has always managed to integrate scientific change into his history, continuously illustrating the interrelationship of science and society, technology and social values, technical innovation and popular attitudes. *The Care of Strangers* continues in this vein.

Rosenberg begins by examining the internal order and administration of the antebel-

AIDS Testing Without Consent Reported

CHICAGO, Jan. 8 (AP) — Almost half the tests for the AIDS virus given at a major United States medical center over a 15-month period were administered without a sound medical reason or the patients' consent, researchers reported today.

An additional 44 percent of the tests were medically justified but were also administered without the patients' consent, the researchers said.

Dr. Keith Henry and his colleagues reported in the current issue of The Journal of the American Medical Association that their findings at the center, the St. Paul-Ramsey Medical Center in St. Paul, Minn., were probably typical of many hospitals.

The Minnesota group said no nationwide standard existed for when doctors should order tests for the virus that causes acquired immune deficiency syndrome. Yet mishandled test results can cause financial, social and psychological consequences that are "immediate, severe and irreversible," the researchers said in a commentary accompanying the report.

'Test Should Be Used Frequently'

"The test is very valuable and should be used frequently but should be used well," said Dr. Henry, a staff physician at the medical center and director of AIDS activities for the St. Paul Division of Public Health.

Dr. Henry recommended the approach St. Paul-Ramsey adopted after the study: assign a registered nurse full time to counsel staff and patients about the test for the virus causing the disease that cripples the body's immune system.

The Minnesota researchers reviewed all 275 AIDS virus tests given at St. Paul-Ramsey and its clinics from April 1985 through August 1986.

In 44 percent of the cases there was no reason for a doctor to think the patients might have been infected, and they were given the test without their consent, the researchers said.

In an additional 44 percent of the cases there was a medical reason for the test but no record that the patient had been counseled or had consented to the test, the researchers said.

Only 10 percent of the tests fulfilled all the criteria for an appropriate test, the researchers said. The remaining 2 percent of the tests were given to people who asked to be tested but who were not counseled.

Asked whether hysteria over AIDS might be influencing administration of the test, Dr. Henry said in a telephone interview, "I think that is one factor that probably exists."

A poll says the practice is probably typical of many hospitals.

But he said a more significant reason was probably that some doctors found it easier and less time-consuming to administer a test than to take down an accurate sexual history.

Few Would Warn Partners

CHICAGO, Jan. 8 (AP) — About one-fourth of a group of sexually active people taking tests for the AIDS virus told researchers that even if infection was confirmed, they would not warn casual sex partners, according to finding released today.

Of 132 people who answered a survey question on the subject, 34 said they would not disclose the results of their tests to casual sexual partners, said Susan Kegeles, who directed the study.

Questionnaires were filled out by 273 people who took AIDS virus tests at two centers in Alameda County, Calif., from July 1985 through May 1986. Of those, 33 women and 99 men answered the hypothetical question about informing casual sexual partners that the antibody was present.

"The findings underscore the need for sexually active individuals to protect their health by following safe sex practices, since not all sexual partners can be depended upon to be so forthright about their antibody status," Ms. Kegeles, a psychologist at the University of California at San Francisco, said today. Some results of the study were published in the letters section of the current issue of The Journal of the American Medical Association.

Those surveyed did not know what the AIDS test results would be, and Ms. Kegeles said that a greater number than indicated might inform casual sex partners about the virus after counseling provided at the centers for those who test positive.

Those testing positive for the virus are presumed to be able to spread it to others through sexual intercourse or through blood, although they might not have the symptoms of the disease.

Eagle Cripples Ethiopian Jet

KHARTOUM, the Sudan, Jan. 8 (AP) — An eagle crashed into the cockpit of an Ethiopian Airlines jetliner Tuesday, breaking the co-pilot's leg and forcing the plane to make an emergency landing in Khartoum, an airline spokesman

New Method Reported To Detect AIDS Virus

WASHINGTON, Jan. 8 (AP) — A new biological method that can detect tiny amounts of the AIDS virus may be a powerful tool for testing the effectiveness of experimental drugs against the disease, researchers say.

George Pavlakis and Barbara Felber, researchers at the National Cancer Institute, developed the test by genetically altering human cells to force them to secrete an enzyme when in the presence of the virus HIV, which causes AIDS.

Mr. Pavlakis said in an interview Thursday that the method had already been used successfully to test an experimental drug. He said the screening system proved so sensitive that it could detect 10 cells infected by the HIV virus within a sample of a million uninfected cells.

Considered Highly Accurate

"It is a speedier process for detecting the presence of functional HIV," he said, "and it is very accurate."

A report on the new test was published today in Science magazine.

Mr. Pavlakis and Ms. Felber developed the test by inserting a bacterial gene that produces an enzyme into a portion of the genetic pattern of the HIV virus. This recombined genetic pattern then was inserted into the genes of two types of human cells that are susceptible to HIV infection.

A result is that the genetically changed human cells now secrete the bacterial enzyme whenever the cells encounter an HIV infection.

Mr. Pavlakis said that by measuring the amount of enzyme secreted by the test cells, laboratory workers could tell if there had been an HIV infection and how active the virus had become.

The most widely used tests for AIDS virus infection depend on detection of antibodies that the body forms in response to the virus. Mr. Pavlakis said his test measured the presence of the virus directly.

But he said the new screening method was only now being tested experimentally and much more study was required before it was ready for wider use.

Antibody tests may continue to be used in screening programs for AIDS virus infection because antibodies continue to be present even when the virus is in a latent, inactive stage in the body. Direct virus tests such as the new one may prove most useful, experts said, in evaluating how well experimental drugs are suppressing the reproduction of the AIDS virus in active phases in the laboratory or in the body.

A CHANGING EAST EUROPE?
The Hazards of 'Perestroika'

Newsweek

THE INTERNATIONAL NEWSMAGAZINE

Soldiers of Fortune

The Corporate Raiders Are on The Prowl Again

Britain's Robert Maxwell

Austria	38 Sch	Luxembourg	85 LF
Belgium	85 BF	Netherlands	5.00 Fl
Denmark	16.00 Kr	Norway	16.00 Kr
Finland	11.00 Mk	Portugal	250 Esc
France	15.00 F	S. Africa	3.25 rand
Germany	4.60 DM	Spain	275 ptas
Gibraltar	1.20 £	Sweden	15.00 SKr
Greece	280 Drs	Switzerland	4.00 SF
Iceland (incl. tax)	80.00 IKr	United Kingdom	1.20 £
Ireland (incl. tax)	1.40 IE	Yugoslavia	1200 YD
Israel	3.50 NIS	Zimbabwe	2.00 $
Italy	3000 L	U.S. Forces	2.00 $

Number 48

PETER TURNLEY FOR NEWSWEEK

Printer, publisher, corporate financier—a quick-witted, perpetual-motion machine: *A tycoon takes aim at America*

A Raider on the Prowl

Britain's media magnate Robert Maxwell is looking for new conquests

It was not quite 7:30 a.m., and Paris was just waking up. A hulking figure in a blue cashmere overcoat strode briskly out of the elegant George V hotel and into his waiting car. He implored the driver to hurry. Picking up the car phone, he roused an aide at home in London, barking instructions for the day ahead. At Le Bourget airport, the businessman and his entourage whisked past the customs police—without having to show their passports—and boarded his private jet. Next stop: Sofia, Bulgaria, to meet with Todor Zhivkov, the country's de facto head of state.

For Robert Maxwell, printer, publisher, broadcaster, corporate raider and philanthropist, it was a typical week. The man British investigators once described as "unfit" to run a public company has become one of Europe's most ubiquitous and flamboyant magnates. In the span of just a few days the peripatetic empire builder met with the president and prime minister of France, the queen of Denmark and the prime minister of Britain. His mission to Bulgaria produced joint ventures in industry, television and video. He emerged as a major underwriter of the $10.5 billion Channel tunnel project, bought a majority stake in a soccer club from pop singer Elton John and readied a bid for Bell & Howell, the U.S. educational publisher and manufacturer of information-storage equipment.

Thanks to a lot of luck and no little foresight, Maxwell is well positioned to win the prize. October's stock-market crash sent big-time financiers around the world scrambling for cover—but Maxwell has since launched a $500 million shopping spree, snapping up a U.S. printing company and adding three British firms to his growing empire. Just weeks before the bust, he shifted most of his investments from stocks to bonds. Now, with a war chest of $1.3 billion, he is the first of a small band of European raiders hunting for corporate prey in America. With the dollar falling and stock prices still weak, U.S. companies are ripe for the picking. And raiders with cash now enjoy an enormous advantage over those relying on debt or equity to finance their acquisitions. "At a time when the markets have crashed," says Maxwell, "cash is king. And I have the cash."

Hawking the news: *The Daily Mirror*

Winner takes all: Maxwell is far too canny to signal the full scope of his offensive, but he's clearly intent on beefing up his still slender 2.3 percent stake in Bell & Howell. Two weeks ago Maxwell told Bell & Howell's directors that he wanted to take a majority interest in the company; that overture was rebuffed, but last week the directors an-

nounced that the company was definitely up for sale. The catch is that Maxwell must now contend with two potential rivals—Robert Bass, a wealthy Texan whose investment group already owns 16 percent of the company, and Macmillan, Inc., a U.S. publishing house owning 8 percent. The winner is expected to pay at least $650 million.

If Maxwell might have preferred an easy and uncomplicated buyout, he's not one to duck a fight. As tenacious as he is portly, he is, at 64, a quick-witted, perpetual-motion machine. When at home in England, he commutes from his Oxford mansion to his London headquarters by helicopter. When he's away, he takes his office with him. For a day-and-a-half stay in Paris last week, he was accompanied by two secretaries, a butler and a personal photographer and took a three-room suite at the George V equipped with eight telephones, two typewriters and a telefax machine.

Visions of empire: It's a tough job, overseeing an empire. The man who arrived in Britain 47 years ago as an impoverished refugee from Czechoslovakia now runs Maxwell Communication Corp., the largest commercial printing operation in Europe and the second largest one in the United States. In rapid succession, the U.S. company acquired 12 printing plants in North America last year—along with a host of printing contracts, including a $1 billion deal to print some 32 million weekly copies of Parade, the world's most widely circulated Sunday-newspaper supplement. One of Maxwell's companies, Pergamon Journals, is the world's second largest publisher of scientific and technical journals. He controls six British newspapers, including the Daily Mirror, a frothy mass-circulation British tabloid, and he plans to launch several more. He has a stake in TF1, France's most successful television channel, and a share of a printing plant in Kenya. He recently signed a deal to provide TV programs to China and plans to start an English-language European daily newspaper based in Paris. "In the past two years," says Maxwell, "we have begun to be taken seriously on a global scale."

It's tempting to label Maxwell a "workaholic," but that would be too tame. The man isn't addicted to his business; he lives and breathes it. "He doesn't know the difference between 12 noon and 12 midnight, between Wednesday and Sunday," says James Sullivan, who joined Maxwell a year ago as head of his American operations. Maxwell is also a bundle of contradictions. Despite only three years of formal schooling, he speaks nine languages (including Russian and German). A self-described socialist, he is known for his tough dealings with labor unions. An outspoken anticommunist, he has warm relations with leaders of Eastern Europe and China. And while he's a relentless publicity hound, Maxwell keeps the names of the beneficiaries of his private companies locked away in an impenetrable Liechtenstein trust.

Bell & Howell would add a jewel to Maxwell's corporate crown. By 1990 he wants his printing and publishing empire to rank among the world's 10 largest communications conglomerates. Gaining control of Bell & Howell would be a major step forward after several setbacks. Last July Maxwell's plans to expand in America were derailed when he dropped a $1.7 billion bid for Harcourt Brace Jovanovich, a leading American publishing house. HBJ chairman William Jova-

MAU[illegible] A-SIPA

Symbols of a globe-straddling communications empire: *TF1 French television*

ALLSPORT—DUOMO

A diverse set of holdings: *Watford soccer team*

Attracting a lot of interest: *A technician making tapes at Bell & Howell*

novich fended him off with a "poison pill" restructuring that left the publisher heavily in debt. But that wasn't a total defeat. Maxwell still has the $1.1 billion in cash he raised to finance the deal—a cache he can draw upon to buy Bell & Howell, if needed. "Perhaps we should thank Mr. Jovanovich for that," says Maxwell with a smile.

Just what is the scope of Maxwell's ambitions? By a "global communications company," Maxwell means a conglomerate that is involved in everything from publishing newspapers and printing department-store catalogs to broadcasting television programs by satellite and storing scientific information on compact discs. In a league of heavyweights, he aims to compete on equal footing with such international communications giants as Rupert Murdoch's News Corp. of Australia, Bertelsmann of West Germany, Dun & Bradstreet of the United States, International Thomson Organization of Canada and Reed International of Britain. To vault into the top 10, Maxwell Communication Corp. will, by its chairman's reckoning, have to increase its annual revenues to at least $5.3 billion, nearly three times what they are now.

Buy America: The key to that ambition is the United States, far and away the world's most important communications market—in printing and publishing as well as the electronic media. "The first Industrial Revolution emanated from Great Britain," Maxwell explains. "That was the revolution of steam and railways. The second revolution—mass production—emanated from the United States. And so did the third revolution, which we're in now. For the information and communications revolution, the United States is the largest market, and you cannot be a global communications business if you're not large in the United States."

Valor: *Receiving the Military Cross, 1945*

Maxwell's aspirations are a tall order in any business, let alone one as hotly competitive as communications, and the British tycoon has attracted no small number of detractors and doubters. "I don't know how he's going to get there," says Derek Terrington, a publishing analyst at Phillips & Drew, a London brokerage house. Maxwell's approach has so far been too scattershot and unfocused, Terrington believes. Yet it's hard to rule out anything from a man who has triumphed over adversity so many times that he is known as the Bouncing Czech. Maxwell's plan "is a clearly achievable goal," says Tony Willis, a publishing analyst at Shearson Lehman Brothers in London. "It's not pie in the sky."

It is, however, a long way from Maxwell's humble beginnings. Born as Jan Ludwig Hoch, the son of an unemployed Jewish farm worker, Maxwell joined the anti-Nazi underground, first in Czechoslovakia and then in France. Later, after the fall of France, he fled to Britain and enlisted in the British Army and was subsequently awarded the Military Cross for bravery in freeing captured comrades on the fields of Normandy. After the war, while attached to the British Army Control Commission in Berlin, Maxwell sensed his first business opportunity. Using money provided by his wife's family (wealthy French Huguenots), he helped rebuild Germany's battered academic-journal business. Those publications, which Maxwell later imported to Britain, formed the foundation of his first company, Pergamon Press. By 1964 Pergamon was thriving and Maxwell floated its shares on the London stock exchange. That same year he was elected to Parliament as a member of the Labor Party.

Never give in: Then Maxwell ran into a disaster that haunts him to this day. In 1969 he agreed to sell Pergamon to Saul Steinberg, a prominent New York financier. Steinberg tried to get out of the deal, allegedly after discovering irregularities in Pergamon's accounting. In the ensuing uproar, Maxwell was ousted from Pergamon's board and defeated in his bid for reelection to Parliament. A 1971 report issued by a panel of investigators from the British Department of Trade and Industry found the firm's accounts to be in utter chaos. No formal charges were ever issued, but the panel contended that Maxwell was unsuited for the stewardship of a publicly owned company—an assertion that Maxwell still protests. Just three years later, however, Maxwell managed to repurchase Pergamon and turn it back into a privately held company.

Maxwell's reputation did not fully recover from the scandal until the beginning of this decade. In 1980 he bought the nearly bankrupt British Printing Corp. (BPC), which later grew to become Maxwell Communication Corp. BPC was a textbook example of everything that was wrong with British industry. It suffered from overmanning, underinvestment and bad management. Threatening to shut down the company, Maxwell got BPC's unions to agree to 7,000 layoffs, nearly half of the 13,000-man work force. "It didn't take a stroke of genius to see that the operation was overmanned," says Willis, "but it took a very hardworking, determined

JULIAN CALDER

All the trappings of power: *Choppering onto the grounds of one his estates*

businessman to see the cuts through."

Maxwell took a similarly ruthless, hands-on approach at the Daily Mirror, bought through one of his private companies in 1984. With no previous experience as a newspaper publisher, he plunged headlong into writing headlines, choosing pictures and editing copy. He closed the paper's foreign bureaus, eliminated 2,000 jobs and steered the Mirror relentlessly downmarket, introducing, among other things, daily photos of pop stars and scantily clad young women. He unabashedly used the paper to tout his own adventures. Pictures and stories showed Maxwell meeting Deng Xiaoping, delivering food to famine-stricken Ethiopia, rescuing the financially troubled high-tech entrepreneur Sir Clive Sinclair (a commitment that Maxwell later jettisoned).

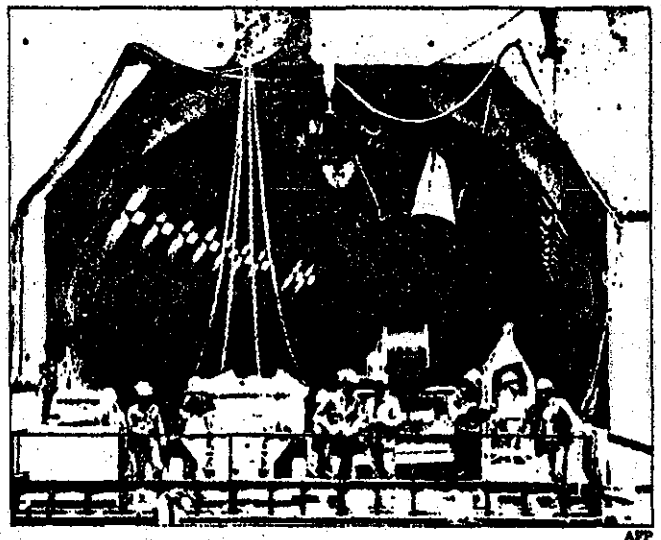
His brash brand of interventionism isn't always welcome. "He has the temperament of an old-time newspaperman, but he has very little idea of how journalism is actually practiced," says Anthony Delano, a former managing editor of the Daily Mirror and coauthor of a forthcoming Maxwell biography. With a circulation of 3.1 million and a healthy balance sheet, the Daily Mirror has grown to become a direct challenger to The Sun, controlled by Maxwell's archrival, Rupert Murdoch. But while Maxwell now meddles less in the day-to-day operations of the paper, his imperious manner invites criticism that his sprawling business empire is little more than an egotist's one-man band.

Not surprisingly, given his larger-than-life persona, Maxwell has been lampooned with enthusiastic abandon. Private Eye, the British satirical magazine, regularly features a madcap "Capt. Bob," a piratical figure at the helm of a never-quite-steady ship. Even Maxwell's supporters acknowledge that the publisher is prone to not-

Tunneling Through the Wreckage of '87

First came October's Wall Street crash and its global repercussions, then the narrowly averted disaster of the British government's sale of its stake in British Petroleum. Against that sober background, the Eurotunnel consortium still forged ahead to seek backers for its $1.4 billion stock offering. Any fears of a lackluster response proved unfounded. With nary a hitch, the British and French managers of the project to build a tunnel under the English Channel marshaled scores of institutions to underwrite the entire stock issue. Press magnate Robert Maxwell emerged as one of the leading British backers of the issue. That success, in turn, allowed Eurotunnel to confidently offer shares to the public last Monday in London, Paris and other international markets—and paved the way for the consortium to draw on another $8 billion in bank loans. Eurotunnel cochairman Alastair Morton proclaimed the financing as "an historic occasion." It may well be. Eurotunnel's success in gaining backers for its stock was a sign that enthusiasm for free-market capitalism in Europe remains intact after the Crash of '87.

Slick campaign: With financing secured, construction can proceed apace on Europe's largest civil-engineering project ever, which is estimated to cost $6.5 billion. The 31-mile Channel tunnel, dubbed the "chunnel," will contain a twin railway linking the Kentish coast at Cheriton to the French coast near Calais. Some 30 million passengers are expected to pass through the tube each year after it opens—if construction proceeds on schedule—in 1993. Since it will be six years until shareholders have any indication of how their gamble has paid off, the Eurotunnel consortium has spared no expense to court investors around the globe. The group spent $120 million to promote and underwrite the offering, making it one of the most expensive undertaken by a private company. Roughly two-thirds of those funds were used to pay financial advisers and intermediates; the rest was invested largely in a slick advertising campaign and a multilingual, tomelike prospectus on the share offer.



AFP

Good news for the moneymen: *'Chunnel' work near Calais*

Rallying support: The lavish campaign may have saved the day. Two weeks ago the consortium was still deeply worried that many investors, shaken by the recent turmoil in international stock markets, might steer clear of the issue. But several days before last week's stock offering began, British institutions had begun to show more than enough interest in Eurotunnel. Maxwell appeared among the 175-odd British backers. Through one of his companies, he sub-underwrote an estimated $65.5 million worth of the share issue.

The chunnel's underwriters, however, won't be able to rest easy until the offering, which is scheduled to close this Friday, is fully subscribed. Altogether, some 220 million units—each made up of one British and one French share—are now being offered to the public at over $6 each. Roughly half of Britain's portion of the offer has been reserved for institutional investors, and Eurotunnel managers are confident that the British public will quickly apply for all of the remaining shares. If the offer is oversubscribed, a drawing will determine which applicants become shareholders. In France, where shares are being sold primarily through banks on a first-come, first-serve basis, the offer is not going as well as expected. Nonetheless, French bankers believe that private investors will cast off their reservations and that the offer will be fully subscribed. Barring construction delays or cost overruns, Eurotunnel shareholders may eventually reap handsome rewards: the group's advisers predict that by 1997 shareholders' annual dividends will equal 20 percent of their initial investments. With Eurotunnel's checkbook in healthy shape, it appears the much-ballyhooed chunnel is a project whose time has finally come.

PAULA CHIN *with* BARBARA ROSEN *in London and* JENNIFER SCHENKER *in Paris*

always-justified fits of pique. "Maxwell is a bully," says Lord Spens, a longtime associate and former financial adviser. "He's impetuous. He's quite likely to call in his best friend and fire him on the spot." Derek Terrington at Phillips & Drew advises clients not to invest in Maxwell Communication at the moment: "It's too much of a risk. He's too unpredictable. You don't know what you're in for."

Maxwell's ill-fated London Daily News may be a case in point. Launched with great fanfare last winter, the newspaper was originally intended to be a direct challenger to the Standard, London's evening newspaper. When technical problems forced a delay in the start-up, however, Maxwell abruptly switched concepts and decided to bring out a newspaper that would have serial editions, regularly updated around the clock. For a variety of reasons, it bombed. After just five months, Maxwell shut the paper down—at an estimated loss of $75 million.

A sting: Maxwell jokes about his propensity for quick action, even when it trips him up at times. On one occasion, he was taking the elevator to his ninth-floor office when a fellow passenger, a young man of about 20, lit up a cigarette. "Can't you read?" growled Maxwell, pointing to the large "No Smoking" sign on the wall. "Yeah, so what?" replied the youth defiantly. "How much do you earn?" asked Maxwell. "A hundred pounds [$175] a week," he answered. Reaching into his pocket, Maxwell pulled out £100 and said: "Here's a week's severance pay. You're fired!" Stunned, the youth pocketed the cash, then said: "Thank you. By the way, I don't work for you."

More often than not, though, Maxwell's flash decisiveness has served him well. He is, by all accounts, an astute investor who earned an estimated $70 million earlier this year by playing the markets. "He has an astonishing mind," says Spens. "He can keep many balls in the air at once, and he doesn't miss many tricks."

Despite his seemingly inexhaustible energy, he readily concedes that he can no longer play all the parts in his own life drama. His management style, he says, "has evolved from doing everything myself to the point where we've grown so large that I have to delegate." Maxwell has therefore assembled a team of first-rate executives. Among them: James Sullivan, formerly a top manager at R.R. Donnelley & Sons, America's largest printing company, and Peter Jay, former British ambassador to the United States and now Maxwell's chief of staff. Four of Maxwell's seven children also work at his companies. Business associates see 28-year-old Kevin, chief executive of Pergamon Press, as the empire's heir apparent.

Maxwell views America as more than just a target of opportunity for business. "I love the United States," says Maxwell in a characteristic burst of effusive rhetoric. "Without the United States there would be no free world, no NATO, no *perestroika* [the Soviet Union's program of internal reform]. Without Reagan's rearmament program Mr. Gorbachev would not be coming to Washington." Pergamon Press has been publishing in America for nearly three decades, but it was only last year that Maxwell really began expanding his U.S. operations.

Ultimately, though, to really get ahead in the communications business Maxwell needs to acquire a major American publishing house. Without success, Maxwell has bid for Scientific American, CBS's magazine division and the book publisher Doubleday. The last went to Murdoch, the

PETER CARRETTE

'Maxwell's bête noire': *Archrival Murdoch*

Australian-American who always seems to be several steps ahead of his British rival in acquiring newspaper companies, book publishers and television stations. Murdoch has outbid Maxwell three times for newspaper properties in Britain, and his activities to date have clearly outpaced Maxwell's abroad. "Murdoch is Maxwell's bête noire," says Anthony Delano. "Everything Maxwell wants to do, Murdoch has done first." Well, not quite. Maxwell does not want to own television stations in the United States. "To do so," he says, "I would have to become an American citizen, like Mr. Murdoch did, and I have no such intent."

Maxwell hopes his company will surpass Murdoch's in revenues by 1990. In the postcrash era, the fact that he has little or no debt gives him an edge over his heavily leveraged rival. "I prefer my position to his," Maxwell says. Despite his ravenous desire to expand, however, Maxwell staunchly insists he will not buy a company if the price is wrong. In the case of Bell & Howell, Maxwell assumes that Robert Bass, who has operated more as an investor than as an owner, simply wants to bid up the price of the company's stock and then sell out at a profit. But, says Maxwell, "if he intends to drive up his price beyond what I consider reasonable, then *I* will leave" the field.

One problem that may surface in the Bell & Howell bid is the question of ownership. Take Pergamon Press, for instance, Maxwell's main private company. It holds a 51 percent interest in Maxwell Communication; a 77 percent interest in Hollis, Maxwell's engineering group, and a 100 percent interest in Mirror Group Newspapers. Pergamon Press is, in turn, owned by Pergamon Holdings Foundation, registered in Liechtenstein, where the corporate secrecy laws are watertight. The danger of these secret relationships, some analysts believe, is that they might potentially conceal liabilities not known to investors, making it difficult to gauge Maxwell's true financial strength. "You don't always know which pocket the money is coming from," says Terrington.

Maxwell thinks the ownership issue is unfounded. Even so, controversy surrounding the ownership of Maxwell's companies clearly worried investors who might otherwise have supported his 1984 bid for John Waddington, the British manufacturer of Monopoly and other board games. And during the fight for Harcourt Brace Jovanovich, an irate William Jovanovich claimed that Maxwell "ought to be sent packing to Liechtenstein."

Wherever Maxwell's money comes from, there seems to be no shortage of it—or the cachet that wealth confers. The peasant boy turned media magnate has a globe-spanning array of contacts in high places. His future is full of projects: a European daily modeled after USA Today, an English edition of Russia's Pravda, a Cantonese-language television station in Macao powerful enough to broadcast into China. Add to that the possibility of investing in pay TV in Belgium and privatized TV channels in Spain and Portugal (not to mention Maxwell's expansion drive in the United States), and the potential looks almost limitless. "Maxwell doesn't always get it right," says Lord Spens, "but he sure as hell tries." Asked to reflect on his career, the man who only stops working when he sleeps said there is one thing he craves above all: "More time."

RONALD HENKOFF *in London*

Intermedia

From Robert Maxwell, MC

Date: 31 December 1987
To: Bob Smith

Please respond to:
☐ London: Rm 900, Holborn, ext 2000
☐ Oxford: PPL, ext 3300

Fax: (203) 869 3731.

Please release the following press release in New York today (Bob, will you please fax me a copy once put out, thanks Deb):

Robert Maxwell announces that Maxwell Communication Corporation has reached agreement in principle to acquire University Technology Corporation. Mr Maxwell says: "University Technology Corporation is the first of a number of businesses planned for Maxwell operations. Our strategy is to create maximum value from intellectual property rights associated with the Research and Development in the world's best universities, government laboratories, and tertiary educational establishments."

Maxwell Communication is the US arm of its parent company of the same name in London. Its operations are global and far-flung as is its strategy to become the world's leader in global communications.

- END -

Scachano call Caren Bob Smith's Office

Norm Latker

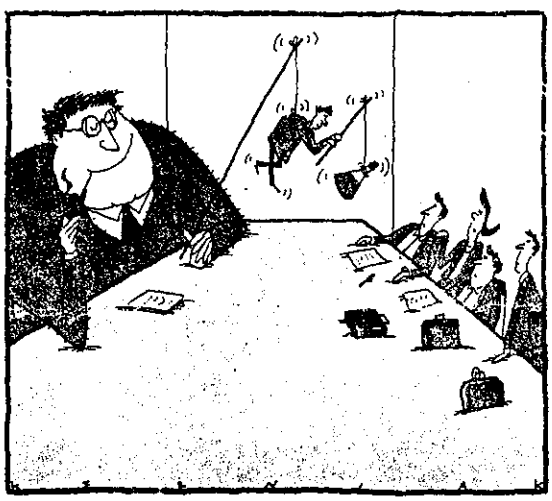
The Startup Insurance Trap

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.

MCI Mail Lets You Set Up a Post Office Operation on Your Desk-Top

By T.R. Reid
Washington Post Staff Writer

It was 20 years ago when a pair of businessmen named Bill McGowan and Jack Goken started a little company called Microwave Communications Inc. that was built around a certifiably crazy idea: Somebody could profitably compete in the long-distance telephone business against the world's mightiest telecommunications behemoth, AT&T.

At the time, AT&T seemed impregnable. The Bell System owned about 99 percent of the nation's telephone cable and more than 99 percent of the long-distance business. Shielded by the concept of "natural monopoly"—the idea that nature had designed the world so that there could only be one telephone company—the Bell System was legally protected from competition by government at every level.

Indeed, McGowan recalled not long ago, one of the first things Microwave Communications did was to set up field offices in more than two dozen states—not because it had the business to support those offices, but because presence in all those states made the company a constituent of more than half the members of the U.S. Senate. Over time, McGowan and his company prevailed in the political battles required to make the crazy idea work. Today, McGowan's company, its name shortened to MCI, is a major player in a fiercely competitive long-distance market, and the notion of a "natural monopoly" for long-distance calls has been tossed into history's trash bin.

When the personal computer revolution began to spread across the country a few years ago, McGowan and his engineers latched onto another visionary idea—a concept that might prove as powerful as their first one. They created an international instant-mail service—a sort of personalized post office—accessible at a bargain price to anybody who has a personal computer, a modem and a telephone.

"MCI Mail" lets you set up your own post office, Western Union, Telex and Federal Express operation on your desk-top. You can use it to send letters anywhere in the world at high speed and a reasonable cost. It is an enormous boon to the procrastinator in all of us.

MCI Mail will deliver a screen-to-screen message (text, data, graphics or a complete spreadsheet containing all of the above) to another computer anywhere in the world just about instantly. This "instant mail" service is cheap: In the United States, a note up to 500 characters (about two paragraphs) costs 45 cents. A document containing up to 7,500 characters (about three pages of typed text) costs $1, with a dollar added on for each additional 7,500 characters.

There are other electronic data bases that permit subscribers to exchange electronic messages with other subscribers. But the genius of MCI Mail is that it permits you to go beyond the MCI Mail subscriber base and send a fast letter to anybody in the world.

For one thing, MCI Mail ties in to Compuserve and some other electronic message services, so your MCI Mail letter can be routed to hundreds of thousands of computer users who haven't signed up with MCI. Beyond that, MCI Mail can reach any Telex address in the world.

Beyond that, the service also extends to those benighted folks who don't yet have access to a personal computer. MCI will turn your electronic message into that low-tech relic, the printed letter. You can have your letter delivered to anybody, either on MCI Mail's own stationery, which looks something like a telegram, or on a facsimile of your own letterhead, which MCI Mail will print up complete with a facsimile of your signature.

"MCI Mail" lets you set up your own post office, Western Union, Telex and Federal Express operation on your desk-top. You can use it to send letters anywhere in the world at high speed and a reasonable cost.

For $2 for the first three pages, your letter will be printed and delivered via U.S. mail; because it is printed somewhere near the recipient's local post office, this often means next-day delivery. For $9, MCI will guarantee overnight delivery. For $30, the letter will be printed and delivered by courier within four hours of your sending it.

MCI Mail is not the easiest system to use; unless you've read the manual fairly carefully, you could easily get lost in the chain of menus and commands that greets you when you sign on. And since the 100,000 subscribers mainly are businesses, you don't get much of the friendly personal chatter that shows up in electronic mailboxes on systems like CompuServe or the Source.

A year's membership in MCI Mail costs $18. You then pay extra for every electronic letter you send, except that your initial $18 is used to offset mailing fees for the first two months. The membership includes a free subscription to the Dow-Jones News Service, a useful electronic data base.

I know that some of you know about this service already because I get a good number of MCI Mail letters about this column. If the concept of "electronic mail" is new to you, however, you might want to give it a try. If nothing else, that would make it easier for you to send in those letters telling me this column is a bunch of baloney. ■

Norm Latker

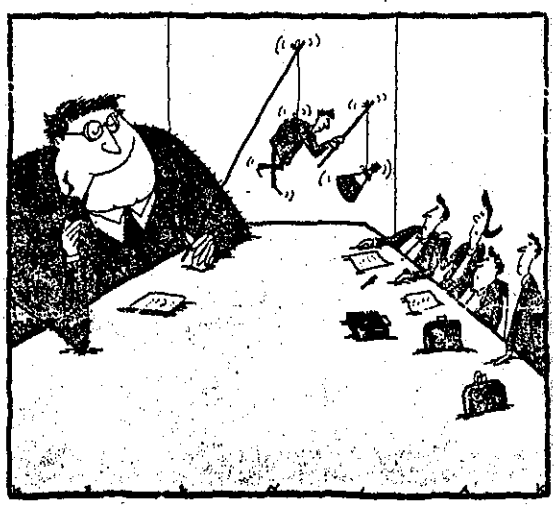
The Startup Insurance Trap

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 KSENAK

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.

PETE V. DOMENICI
NEW MEXICO

United States Senate

WASHINGTON, D. C.

3 December, 1987

Norm Latker
Director, Office of Federal Technology Management
U.S. Department of Commerce
Washington, D.C. 20230

Dear Norm,

I would like to take this opportunity to wish you success in your new venture and to thank you for all your assistance while you have been Director of the Office of Federal Technology Management at the Department of Commerce.

I know we share a lot of common goals for the commercialization of U.S. scientific and technical achievements. It is only through the combined efforts of all of us, whether we represent government, universities, or private industry, that we can meet the international challenge to compete effectively in product development. I appreciate the contribution you personally, have provided to this goal.

Good luck in all your future endeavors.

Warm personal regards,

Pete V. Domenici
United States Senator

PVD/fkf

File w/ Articles

MEET THE CAMPUS CAPITALISTS OF BIONIC VALLEY

THE UNIVERSITY OF UTAH NURTURES STARTUPS MAKING ARTIFICIAL HEARTS, ARMS, AND EARS

If there really were a Bionic Man, he probably would live in Salt Lake City. There he'd have ready access to an artificial heart as well as a broad range of spare parts, from prosthetic arms to artificial ears. In the past few years some 20 biomedical startups have set up shop in the shadow of Utah's Wasatch Mountains. The area is so awash with high-tech medical companies that locals have dubbed it Bionic Valley.

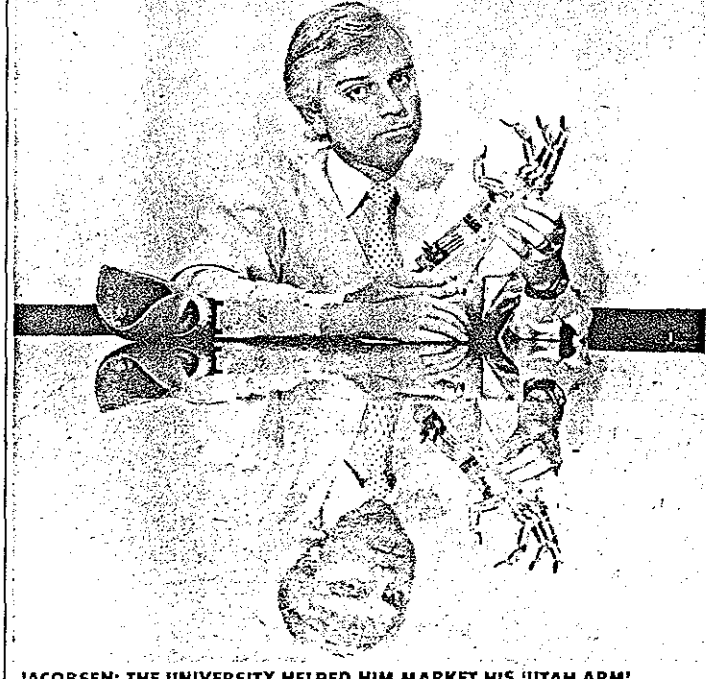
Just as major universities helped spawn the companies in California's Silicon Valley and along Boston's Route 128, the University of Utah is the driving force in Bionic Valley. But unlike Stanford University in the early days of Silicon Valley, Utah takes an equity position in the companies that commercialize its research. The school is setting up an office of technology transfer to expedite what it calls "academic capitalism."

'MINI-CAMELOT.' This push would not have gotten so far were it not for Willem J. Kolff, who retired in February as director of the school's Institute for Biomedical Engineering and Division of Artificial Organs. For nearly two decades, the Dutch-born Kolff, who in 1945 invented the first successful kidney-dialysis machine, has led the way in marrying medicine and engineering at Utah. He was lured to the university in 1967 by then-President James C. Fletcher, who is about to begin his second stint as head of the National Aeronautics & Space Administration. It was Fletcher's goal to build the school, the oldest university west of the Missouri River, into a major research center.

Kolff complied by turning it into a center for biomedical engineering. He created "a mini-Camelot," says Stephen C. Jacobsen, director of the university's Center for Engineering Design. Kolff attracted a number of outstanding graduate students—not the least of them Robert K. Jarvik, who developed the first mechanical heart to be implanted in a human. As Jarvik remembers, Kolff was more interested in Jarvik's Volvo—they each drove one—than in his undergraduate credentials. In 1971, Kolff hired Jarvik, who is now an assistant professor of surgery, at $100 a week and asked him to design an artificial heart.

More important, Kolff saw the need for early commercialization of the technology that he and his students were developing. After several of his ideas were rebuffed by large companies, Kolff realized that the best way to go commercial was to spin off small companies. In 1974, after failing to interest prosthetics makers in an artificial arm developed by Jacobsen, Kolff helped Jacobsen set up a company called Motion Control Inc. Its "Utah arm" was the first to be activated by electrodes attached to an amputee's remnant muscles. Unlike others available at the time, it was capable of smooth, natural motion.

PAINLESS INJECTIONS. Since then, Motion Control has sold some 250 arms, costing up to $30,000 each. It also manufactures an implantable insulin-delivery system for diabetics, and it is beginning to market a drug-delivery system that injects drugs through the skin without a needle. The device, called Phoresor, is a 3-in.-sq. plastic patch with a pocket the size of a quarter for liquid medication. An electrical current from a small battery pack runs through the medication, creating a positive charge. Because skin is negatively charged, the current pushes the drug through the pores. The process is



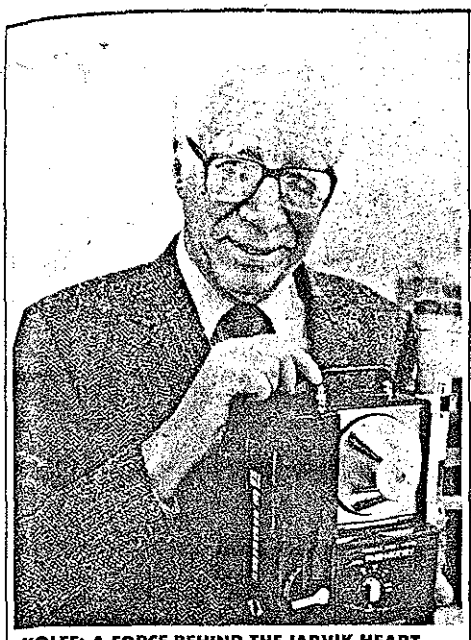
TIM KELLY

JACOBSEN: THE UNIVERSITY HELPED HIM MARKET HIS 'UTAH ARM'

UTAH'S BIOMEDICAL STARTUPS

Company	Date founded	Biomedical activities
BUNNELL INC.	1980	Manufactures a respirator engineered for infants.
DESERET RESEARCH INC.	1983	Biomedical engineering and testing, including cardiac research. Will soon produce a hearing-aid circuit that amplifies selected sounds.
LIFE EXTENDERS CORP.	1983	Developing an artificial bladder and an artificial sphincter.
MOTION CONTROL INC.	1974	Makes the "Utah arm" prosthesis as well as a controlled-delivery abdominal implant that administers insulin, and an electronic system to deliver drugs through the skin.
SYMBION INC.	1976	Manufactures an artificial heart and an artificial ear.
VASCULAR INTERNATIONAL INC.	1983	Makes synthetic blood vessels.

DATA: BW



KOLFF: A FORCE BEHIND THE JARVIK HEART

painless and takes about 20 minutes to complete.

Phoresor is already being used to deliver such drugs as cortisone, which reduces inflammation in joints and tissue, and the product may also be important for treating acne and skin cancer. This year the privately held company expects revenues of about $2.2 million, and President Thomas A. Wiita believes the new drug-delivery system may push sales to $50 million in five years.

Kolff's best-known spinoff is Symbion Inc., which he formed with Jarvik in 1976 to make artificial hearts. "Heart doctors and other research labs wanted to buy them, and it's against the rules for a university to market them," explains Donald B. Olsen, an early Symbion investor who heads the university's Institute for Biomedical Engineering.

HELPING THE DEAF. Symbion still has extremely close ties to the university. In fact, it rents space in the building where the university conducts research on artificial hearts. So far, 12 of Symbion's Jarvik-7 hearts have been implanted in humans, seven of them as a "bridge to transplant" in patients waiting for heart donors. The company, which lost $2.9 million last year on sales of $4.3 million, is also working on a partial artificial heart to assist the hearts of patients recovering from heart surgery. And it recently began marketing a device that restores some hearing to the profoundly deaf. Called a cochlear implant, it relays sound to the brain through electrodes implanted in the patient's inner ear.

Other startups are at work on a broad range of spare parts, including artificial blood vessels, heart valves, and even urinary sphincters and fallopian tubes (table). State officials hope the influx of new companies continues, because these startups are providing jobs at a time when employment in agriculture and mining is declining. Bionic Valley also has the tacit approval of the Church of Jesus Christ of Latter-day Saints, whose members make up 70% of Utah's population. The church not only applauds the new jobs but also has traditionally encouraged entrepreneurship.

The University of Utah licenses the technology developed in its laboratories in return for royalties of 1% to 4% of gross sales in the startups. In addition, the school takes up to 10% equity in the companies. "If somebody's going to make $10 million, I want our million," says James J. Brophy, the school's vice-president for research. He is determined not to repeat a mistake made in 1968, when the university licensed computer technology to a professor who started Evans & Sutherland Computer Corp. Last year the computer-graphics company reported sales of $80 million, but the university never got a penny from its licenses. Its technology became obsolete, so it was not used when the company brought its product to market.

A PENNY A SHARE. The relationship with more recent startups is already enriching the university. So far it has accumulated stock in the ventures valued at $2 million—and Brophy estimates that the value of these shares will multiply tenfold in 10 years. The stock is held by a university foundation that receives dividends and royalties—some $100,000 last year. Several professors are doing quite well, too. Jarvik's stock in Symbion, for instance, is worth $550,000. Olson, who thought he was throwing away $100 when he purchased Symbion at 1¢ a share a decade ago, gave some of the stock to his children. Three of them used it to cover college expenses; two more sold it for downpayments on houses.

Not everyone on the campus is comfortable with academic capitalism, however. Faculty members with corporate interests could face conflicts of interest, says Raymond L. White, co-chairman of the Human Genetics Dept. He also worries that graduate students could "become low-paid lackeys of the company. The student has the pleasure of seeing his work become public domain, but the faculty member has the pleasure of taking it to the bank."

Still, Olsen and others are confident that academia and the profit motive are compatible. Motion Control's Wiita maintains that the lure of Bionic Valley to researchers is not money but the opportunity to conduct cutting-edge research and see their "ideas have a chance to try their wings." Researchers at the university say they have so many good biomedical ideas waiting to take flight that Bionic Valley will be Utah's hottest growth industry for years to come.

By Sandra D. Atchison in Salt Lake City

PORTER/SALT LAKE TRIBUNE

HOW MUCH MONEY IS YOUR LIFE WORTH?

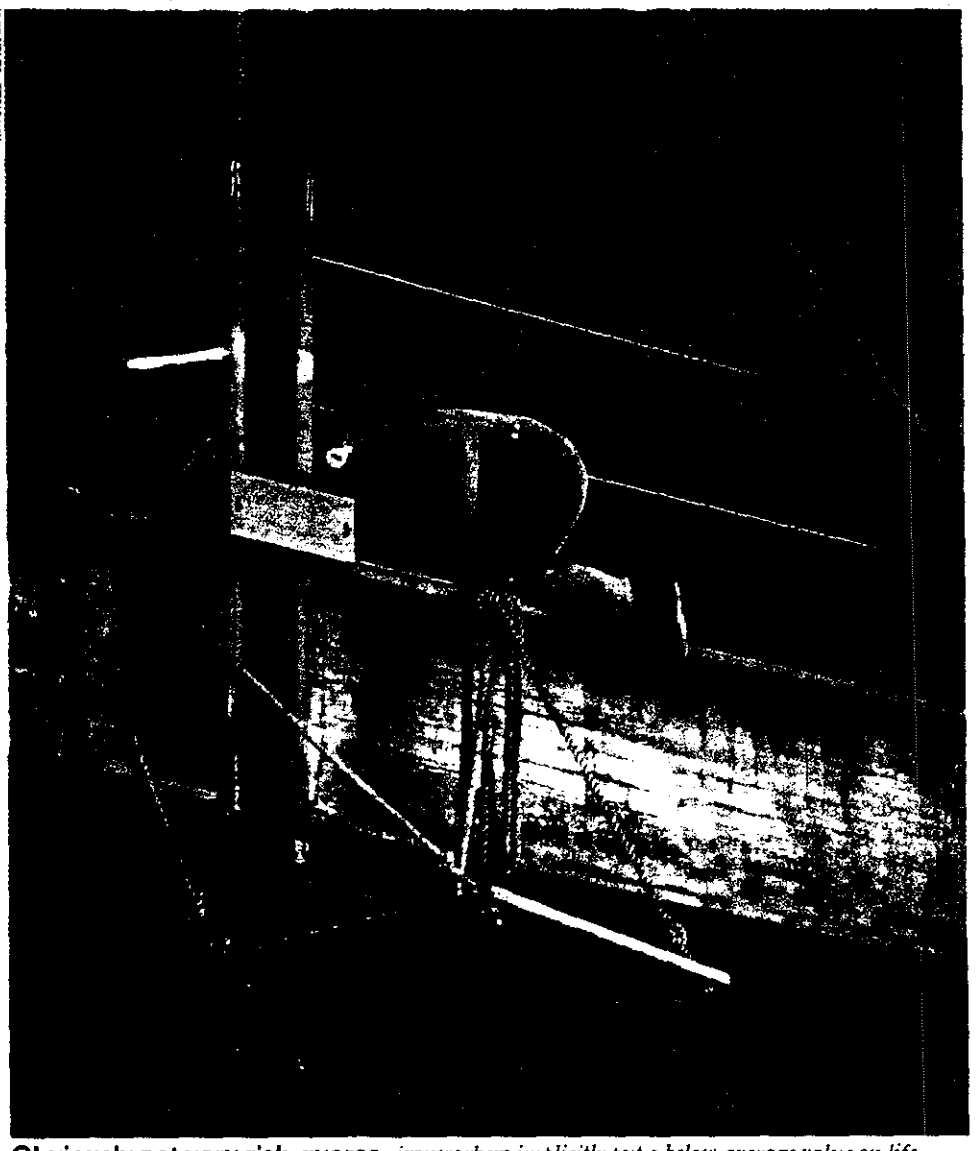
A lot of people are offended by the question, but it actually seems to be answerable, and some perfectly serious people in Washington are delivering answers these days. Their answers make more sense than the big numbers some juries have been serving up. ■ *by Daniel Seligman*

THE LITIGATION set loose by that massive gas leak at Union Carbide's Bhopal plant in 1984 has produced many arguments about the facts and the law, but on one critical detail the parties seem in total agreement. They agree that lives are cheaper in India than in the United States. The plaintiffs, many of them relatives of the 2,000 or so who died at Bhopal, want the case tried in the U.S., where jury awards for "wrongful death" run to six or seven figures, sometimes even eight. Union Carbide wants a trial in India, where several hundred dollars per death would be typical.

The spectacle of jurors placing dollar values on human lives is by now utterly familiar to American business. Still, a presumption remains that such valuations are special events. The jury is generating those numbers because something has gone tragically wrong: products have been ruled defective, or an aircraft has crashed, or something about the workplace turns out to cause cancer. What business is not yet used to, but what are surely coming, are valuations performed by executives themselves and in many industries by government regulators.

A natural first thought about such valuations is that they are repellent if not absurd, and that it's a kind of putdown of the human experience to even imply that you can capture it in monetary terms. A plausible second thought would be that in many contexts the valuations are inescapable. After all, someone has to decide whether it's worthwhile to invest in expensive medical technology, or to spend heavily on highway designs that prom-

KIM STEELE—BLACK STAR



Obviously not very risk-averse, *ironworkers implicitly put a below-average value on life.*

workers . . . who perceive their jobs as hazardous and their industry's . . . injury rate . . . There is a strong element of rationality in the underlying risk judgments."

The first labor-market studies produced life values not much different from those generated in other ways. A National Bureau of Economic Research study by Richard Thaler and Sherwin Rosen, published in 1975, concentrated on workers in very high-risk jobs and derived values that come to around $650,000 in today's prices. However, that figure may have been held down by the nature of the sample; people who have elected to do especially dangerous work presumably cannot be thought of as typical when it comes to trading off risk and reward. In any case, Viscusi and other scholars found that when they looked at more representative groups of workers, they got much higher life values. In general, the labor-market studies driving policy in Washington today are estimating the values at around $3 million.

Although now solidly entrenched in numerous federal bureaucracies, the practice of valuing lives is still a source of unhappiness in some of them. "I don't like to make a judgment based on putting a value on somebody's life," says Patrick Tyson, the acting assistant secretary of OSHA. "I just find that repugnant. We only do it because the executive order tells us to."

As Tyson's tag line indicates, Ronald Reagan has applied pressure for systematic life valuation. That may sound a bit counterintuitive, but in fact it is entirely logical for a conservative administration to be exerting such pressures. Valuing lives is something you are driven to do by cost-benefit analysis. And conservatives in Washington tend to like cost-benefit analysis: they figure, correctly, that it gives them some leverage in resisting expensive government programs. When those programs are concerned with saving lives—as many are in OSHA, the Environmental Protection Agency, the Federal Aviation Administration, the Department of Health and Human Services, the Consumer Product Safety Commission, and elsewhere—you need to have some thoughts about the value of the lives being saved before deciding whether the programs are cost effective.

Under the Carter Administration, agencies in the executive branch were instructed by Executive Order 12044 to do cost-benefit analysis in considering new programs. However, 12044 was an essentially toothless tiger since it didn't specify what was supposed to happen after the analysis. The Reagan Administration replaced it with Executive Order 12291, which decisively changed matters. The order said that no program could go ahead unless benefits exceeded costs. (An exception was provided for some laws that prohibit cost-benefit analysis.) Second, 12291 said that the Office of Management and Budget had to review the agency's numbers before the program was approved. In practice, OMB has often told federal regulators that it doesn't like their analyses and sent them back for more work.

Under present arrangements, OMB still lets each agency develop its own life valuations, and a fair amount of disparity exists.

A fair amount of disparity exists in life valuations. OSHA assumes $2 million to $5 million, EPA $1 million to $7,500,000. The FAA uses a relatively low $650,000 or so.

OSHA proposals generally assume a range of $2 million to $5 million. EPA has a wider range: $1 million to $7,500,000. The FAA has used a relatively low $650,000 or so.

To some extent these discrepancies can be justified. You could argue—and Northwestern's Viscusi is among those who have done so—that different kinds of people, with different priorities and risk preferences, are being protected by all those federal agencies, and so it would be senseless to impose a single number on all of them. Still, some OMB officials worry that the disparate life values reflect a certain amount of sloppiness. "Ultimately," says Robert Bedell, who runs OMB's regulatory-affairs office, "we will evolve a more uniform way of evaluating benefits and risks and also come up with a much tighter range than now exists between agencies and even within agencies."

An intriguing political argument now raging around life valuation in Washington has to do with programs designed to save *future* lives—for example, environmental and occupational health programs meant to fight slow-developing diseases. Point at issue: in calculating the benefits of saving a $3-million life 30 years from now, do you have to discount that future value? Some congressional liberals, led by the formidable John Dingell of Michigan (he heads the House Subcommittee on Oversight and Investigations), have been crusading against the discounting of benefits, arguing that it results in absurdly low present values and always leaves you with a case for just doing nothing. At a 10% discount rate, for example, $3 million in 30 years is worth only $172,000 today—a benefit that seems paltry in relation to the immediate costs required of some programs.

The alternative view, which OMB insists on, is that discounting is inescapable and that the laws of financial economics do not change because your future payoff comes in the form of a life saved rather than a bond that has matured. Portney of Resources for the Future is among the many economists firmly supporting OMB in the argument. He observes that even aside from the arithmetic of discounting, we should prefer to save lives today rather than in the future. "The life we're thinking of saving in the future may be saved in other ways, as we come up with new lifesaving techniques," he argues.

In their role as "regulatees," private-sector managers have already had some exposure to Washington's ideas about valuing lives. In their role as defendants—against product-liability suits, accident suits, workplace safety suits, and more—they have been exposed to juries' ideas about the worth of a human life. Thus far the two roles seem unrelated. But in the long run, it seems clear, jury awards will be affected by the government's deepening involvement in life valuation. Which ought to mean an end to some of the more extravagant awards, although it would not necessarily mean lower awards overall. The scholarly studies make it clear that, when all is said and done, Americans do value life highly.

THE NOTION that life values are specific to particular societies, and that willingness to pay varies considerably from one to another, is obviously hard for a lot of people to accept. The issue is now very much onstage in the arguments about Bhopal. A brief filed on behalf of the plaintiffs by the National Council of Churches and other groups expresses indignation at the idea that lives might be valued differently in the U.S. and India. "A double legal standard for the value of a human life is . . . morally unacceptable," says the brief. But the logic of willingness to pay is that a single standard makes no sense.

In the long run the work being done on the value of a human life will bear on a broad range of management decisions, obviously including some of the toughest ones. The work's greatest value may be in the guidelines it can offer managers obliged to wrestle with vexatious questions about, say, how much they should spend to make products and the workplace safer. In a world where some level of risk is inevitable, but some higher level of risk is unacceptable, the studies are pointing to the level that Americans view as reasonable. ■

IBM-compatible computers

They're often considerably less expensive than the IBM-PC.

Leading Edge Model D

If you do professional work at home, work that requires large amounts of typing, filing, or financial analysis, you need a computer with a large memory and at least two disk drives. For many buyers, the choice of a professional computer for home boils down to an *IBM-PC* or a computer compatible with it, simply because they use IBM-compatible programs and data files at the office.

If you're in that situation, an IBM-compatible usually makes more economic sense than the *IBM-PC* does. *IBM*-brand equipment tends to be expensive. An *IBM-PC* configured with two disk drives, 256K of memory, and a monochrome monitor would cost about $2100 at discount. A number of compatibles are available for $600 to $700 less than that, often with useful software and extra ports that would further increase the cost of the *IBM-PC*.

Last October we reported on six IBM-compatible computers (the *Compaq Portable*, the *Kaypro 16*, the *Panasonic Sr. Partner*, the *Sanyo MBC-775*, the *Tandy 1000*, and the *Leading Edge Model D*). We recommended the *Leading Edge Model D* for four reasons. It had the most versatile display, the best keyboard, the most available expansion slots, and an attractive price ($1495 list). Since then, Leading Edge has added a very good word-processing program at no increase in price, making what we then considered a Best Buy a still better buy.

This month we report on three more IBM-compatibles, all desktop models: The *Epson Equity I*, the *Zenith Z-148*, and the *Kaypro PC*.

User memory

Computer memory has been likened to bookshelf space: You can never have too much. These days, 256K of temporary memory is routine for *IBM-PCs* and compatibles. You need that much to use such popular programs as *Lotus 1-2-3*—a combined spread sheet, graphing, and filing program—or to work conveniently with the large word-processing programs available for the IBM family.

Our *Zenith Z-148*, *Epson Equity I*, and *Kaypro PC* all came with 256K of memory, like the compatibles we tested last fall. The *Kaypro* and the *Zenith* can be expanded to 640K by having a dealer add memory chips to their "motherboard." The cost of these expanded memories is only about $200 or so, an unheard-of bargain by the standards prevailing only a few years ago. The *Epson* can go to 512K by using a special *Epson* memory-expansion slot or to 640K by using one of its IBM-type expansion slots.

Bundled programs

A number of IBM-compatibles bundle programs for word processing, spread sheets, and other applications into the price. IBM typically bundles nothing with the *PC*. Even the operating-system disk is an extra-cost "option."

If the free software is close to what you need, it can make the price of the package very attractive, since the better programs typically cost $200 to $400 apiece when

bought separately. But as often as not the bundled programs are not all one could hope for.

The three machines in this group all came with an *MS-DOS* operating-system disk. The *Epson* and the *Kaypro* came with a version of the Microsoft BASIC programming language as well. Only the *Kaypro* bundled in any applications programs. Those included a full-featured word processor, *WordStar*, a desk-accessory program called *Kdesk*, and *Kaypro's* telecommunications program, *Mite*. *WordStar* is a widely used and very versatile program, if not among the easiest word processors to learn and use.

The *Leading Edge Model D* now comes bundled with Leading Edge's aptly named *Leading Edge Word Processor*, in addition to MS-DOS and BASIC. It is, like *WordStar*, a full-featured program, though it is less formidable than that old workhorse. There is a tutorial disk included to help you get started.

The look you like

Technically, an *IBM-PC* comes without any provision for displaying things on the screen. Instead, IBM offers display choices on extra-cost, plug-in circuit boards.

The *Monochrome Display and Printer Adapter* board ($250) displays sharp monochrome text, but not color or graphics. That's fine for word processing, but it leaves you in the lurch if you want to draw bar graphs or play games. To do those things, IBM tilts you toward the *Color/Graphics Monitor Adapter* board ($244). It displays both text and graphics, in color if desired. But art comes at the expense of clarity: Text and pictures displayed using the graphics board are only medium-resolution, which means that they have a rather dotty appearance. You could buy both boards, but that forces you to buy two monitors as well—a monochrome monitor for sharp text, a color monitor for graphics and games.

Enter the aftermarket. You can buy an *IBM-PC* (or some compatibles) with neither board and add a third-party combination board. Several are on the market. One we have looked at is the $499 *Hercules*, which provides high-resolution text and high-resolution graphics—better than the medium-resolution graphics produced by IBM's color/graphics board. That way, you can display graphics, albeit in monochrome, on a high-resolution monochrome monitor. (Not all programs can be set up to recognize the *Hercules*—check before buying a program.)

We also tried an aftermarket board called *STB Chauffeur* ($395). It combines high-resolution text with medium-resolution graphics—rather like buying both IBM boards. You can access either mode from the keyboard, and any program usable on the *PC* will recognize the board, without special instructions being programmed in.

In a sense, IBM jumped into its own aftermarket by introducing its *Enhanced Graphics Adapter* board ($524). That board presumably provides high-resolution color graphics and text, but requires both a high-priced color monitor and programs written specially for it.

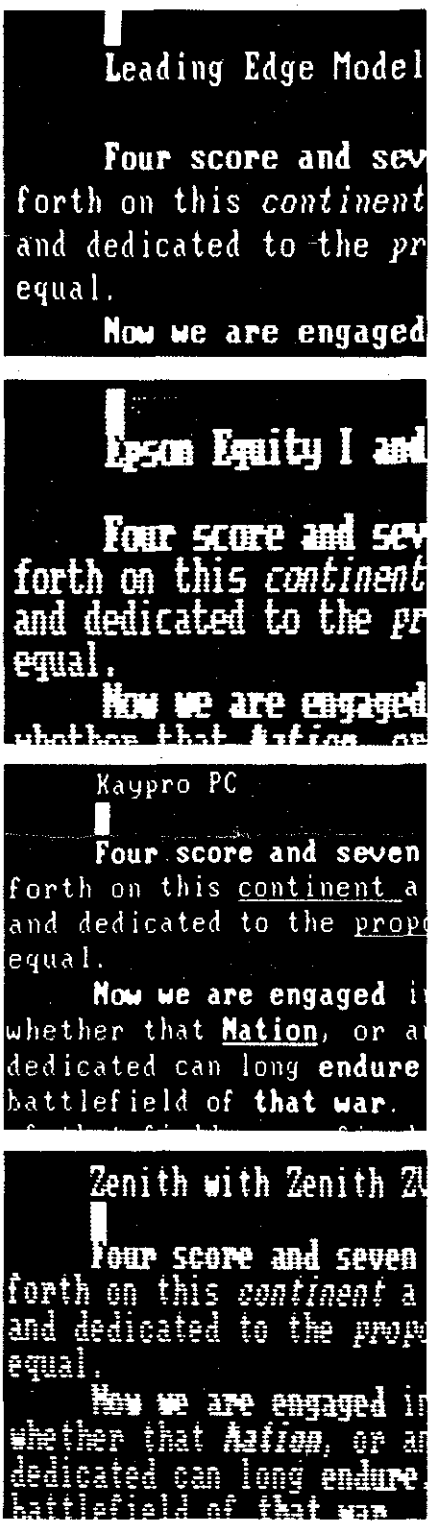
IBM-compatibles take a variety of approaches to these display choices. The *Zenith Z-148* is essentially a medium-resolution computer. It comes with circuitry that emulates the *IBM Color/Graphics Monitor Adapter* and is set up to drive *Zenith* monochrome monitors. (According to Zenith, other brands of monochrome monitor may require modifications to the display circuit board.)

The *Kaypro PC* comes with a high-resolution monochrome monitor driven by a combination graphics and text board. Text display was excellent. However, the *Kaypro* is not equipped to display graphics on the monitor included with the machine. You'd need a second monitor (a composite or an RGB color monitor), and you'd get only medium resolution. If you want some other video option, such as the *Hercules* board, check with your dealer about substituting it.

The *Epson Equity I* puts you in the same boat that the *IBM-PC* does. It is nominally sold without any display circuitry. Our sample came bundled with an optional *Epson Color Video* board ($149) that emulates the *IBM Color/Graphics Monitor Adapter* board, delivering medium-resolution graphics and text. For sharp text you would need to substitute or add a monochrome board such as the *Epson Monochrome* ($129) or one of the aftermarket devices, such as the *Hercules*, *STB Chauffeur*, or the like. The *Equity I* is sold without a monitor, since you would match your choice of monitor to the display circuitry you want, just as with the *IBM-PC*.

How compatible?

One of the great appeals of the *IBM-PC* and its clones is the huge library of software, particularly business programs, that already exists for them. However, no one actually uses more than a handful of programs. Three good ones—for word processing, filing, and spread sheets—are enough to run a small business, and one or two such "productivity" programs may be all that's actually necessary in an office at home. The significance of the library of IBM programs is as a barometer of interest in the machine. Presumably, as new programs evolve, they will be directed



Some word-processing programs can produce such graphics devices as boldface or italic text, but not all displays reproduce them equally well. From top to bottom: The Leading Edge Model D, the Epson Equity I, the Kaypro PC, and the Zenith Z-148. (The Epson is shown using a Zenith monitor with a medium-resolution display card. The Kaypro's high-resolution text board doesn't display graphics.)

Interested in the Leading Edge?

Since our last report on IBM-compatibles in October, Leading Edge has been advertising a single laudatory paragraph drawn from a fairly lengthy discussion. The company has done so despite our protests and despite careful explanations of our no-commercialization policy.

The information and opinions we publish are for the exclusive use of our readers and members of Consumers Union. Commercial enterprises that adapt our reports to their purposes compromise our reputation for impartiality. Consumers Union prefers to stand apart from the commercial world on which we comment; that's why we accept no advertising and never give permission for the use of our material for promotional purposes.

Many of you, we know, are not merely readers of CONSUMER REPORTS but partisans of Consumers Union. You may therefore wish to consider the ethics of a company's advertising policies in any purchasing decision you make. You may also wish to express yourself directly to:

Leading Edge Hardware Products Inc.
21 Highland Circle
Needham, Mass. 02194
President: Michael Shane
Product: Leading Edge Model D personal computer

first at the legions of *IBM* owners. If you buy an IBM-compatible, you want reasonable certainty that it can run present and future programs without a hitch.

To test for compatibility, we ran each computer with IBM versions of popular applications programs and games. Our library included two word processors, *Microsoft Word Version 2* and *WordStar*; two good spread sheets, *Lotus 1-2-3* and *SuperCalc 3*; the heavyweight database manager, *dBase III*; an outlining program called *Thinktank*; a touch-typing drill called *Mastertype*; two versions of the simulation game *Flight Simulator*; and a home accounting program called *Managing Your Money*. All ran without problems, but *Microsoft Word Version 2* required a "patch" program from Leading Edge to get it started on the *Leading Edge Model D*.

Disk drives

Two disk drives have become the standard for serious computer applications. Floppy disks are used to store both the programs and the data—work records—created with those programs. Without two drives, you have to swap the program and data disks in and out to manipulate the large quantities of information used by heavyweight productivity programs and big data files.

We bought each compatible equipped with two 360K-capacity floppy disk drives—the same capacity as the *IBM-PC* drives. All the drives worked well. The *Epson's* drives were quietest.

Keyboards

Key placement on the *IBM-PC* has irked many people, particularly those who were used to the superior layout of the *IBM Selectric* typewriter. On the *PC*, the Return and Shift keys are the same size as other keys, and they're marked with arrows instead of words—a design that can lead to errors. It's easy to hit the Alternate or Control keys on the left, rather than the Shift. The cursor-control keys share space with numerals on the numeric keypad. That's an inconvenience when entering numbers on a spread sheet, since you must "shift up" to enter numbers, then "shift down" to move the cursor to another cell.

Some manufacturers sell keyboards that avoid some or all the *PC* keyboard's shortcomings, but many compatibles copy the *IBM* right down to its last defect.

The three computers in this group redress some of the *PC's* keyboard problems. All three have placed the left Shift key where you intuitively look for it. They all use an oversized Return key, labeled as such.

In this group, the *Zenith* walks the extra mile. It has lights on its "Caps Lock" and "Numeral Lock" keys. It has a large, labeled Backspace key, and a separate Enter key in the numeric keypad area.

The *Kaypro* has lights just above the keyboard for Capital-, Number-, and Scroll-lock. But *Kaypro* also has an extra key, a Reset key, that could cause more trouble than it's worth. Resetting a computer is the same as turning it off and on. When you do so, everything in the computer's memory is lost for all practical purposes unless you've saved it on a disk beforehand. With the *IBM-PC* and most compatibles, you must hit three keys to reset. The *Kaypro's* Reset reduces that to two keys, making the disaster of an accidental Reset much easier.

The *Epson* and *Zenith* have the best keyboard feel, about on a par with the best compatibles we've tried. The *Kaypro* is less crisp, rather similar to the *Compaq*.

Ports and expansion slots

Peripheral equipment such as printers, modems, and sometimes disk drives and monitors must be connected to the computer through what are called ports. One of the great attractions of the *Apple II*, later adopted by the *IBM-PC*, was the ability to add extra ports to the computer. Inside the central processing unit are slots—empty sockets—that can accommodate the accessory circuit boards needed for peripherals or more memory.

The *Zenith* has no expansion slots as such, but may be expanded with a "daughter board" ($149), which will give it one slot; that slot could be used to add a high-resolution monochrome board. The *Epson* has three standard, long expansion slots, but one of them is used by the display card. The *Kaypro* has six long slots, of which three are available; it also has three short slots.

All three provide a standard *Centronics* parallel port for running a parallel printer, and an *RS-232* serial port for running a serial printer or modem. The *Zenith* has a front-panel switch to increase its clock frequency to eight megahertz, which can speed up processor operations by about 30 percent; that's a nice feature.

Recommendations

The easiest professional computer to learn and use is the *Apple Macintosh*. We recommend it to those willing to pay a premium price for the pleasure of doing serious computing with a minimum of study or help. Equipped for serious work, with two disk drives and 512K of memory, the *Macintosh* costs about $2300 at discount, a price that includes a good word-processing program. The main problem with the *Macintosh*, aside from the relatively high price, is that it is incompatible with the *IBM-PC* and its peripherals.

Among the nine IBM-compatibles we've tested, our favorite remains the *Leading Edge Model D*. In price and dis-

Other reports to read

If you're in the market for a professional computer to use at home, we suggest you also look at the following recent reports:

The Apple Macintosh	January 1985
Computer printers	June 1985
Computer monitors	July 1985
If not IBM, what?	August 1985
Which software?	September 1985
IBM-compatible computers	October 1985

play ability, it's streets ahead. The system comes with circuitry that emulates the *Hercules* graphics card, a $500 option for the other machines. It also comes with a good-quality monochrome monitor and a fine word processor. It often sells for about $1000 less than a similarly equipped *IBM-PC*.

As we note in the box opposite, however, Leading Edge is among a handful of sellers that insist on using selected quotes from CONSUMER REPORTS in their advertising. Some readers may consider this insistence on taking commercial advantage of our good name reason enough to look elsewhere.

A good place to look would be the *Epson Equity I*. It doesn't take up much room, has a couple of full-sized expansion slots available for later upgrades, and has notably quiet disk drives. Its list price of $1424 doesn't include a monitor, however. Figure another $150 for a good monochrome monitor.

The *Zenith Z-148* performed very well. But since it lacks expansion slots, it can't readily be adapted to produce sharp text unless you buy a $149 daughter board. The *Kaypro PC* had many expansion slots and came with a good-quality monochrome monitor, as well as a software bundle. It was rather a bulky unit, though, and had a noisy exhaust fan. ■

IBM-compatible computers

Listed alphabetically. Prices are for system with 256K of user memory, two disk drives with 360K capacity, and other hardware and software components shown. Prices for *Epson* and *Zenith* do not include monitor (about $150).

Computer	Epson Equity I	Kaypro PC	Leading Edge Model D	Zenith Z-148
Type	3-piece desktop	3-piece desktop	3-piece desktop	3-piece desktop
Dimensions, H x W x D				
System unit	5¾x14½x16 in.	5⅝x19⅜x17½ in.	5⅝x14x17½ in.	4⅞x15¾x18½ in.
Keyboard	2x18½x7	2x17¾x7½	2⅛x19x7½	1⅞x19¼x8
Monitor	—	11½x12¾x13⅛	11¾x12¼x13	—
User memory	256K	256K	256K	256K
Expandable to	512K (Epson slot) 640K (IBM slot)	640K (on existing card)	640K (on motherboard)	640K (on motherboard)
List price	$1444 (color version) $1424 (monochrome version)	$1595	$1495	$1799
Included software	MS-DOS BASIC	MS-DOS BASIC	MS-DOS BASIC	MS-DOS —
Word processing	—	WordStar [1]	Leading Edge W.P.	—
Desk accessory	—	Kdesk	—	—
Communications	—	Mite	—	—
Monitor	Not included	11-in. TTL monochrome included	11-in. TTL monochrome included	Not included
Display provision				
High-resolution text	✓ (monochrome)	✓	✓	[2]
Color/graphics	✓ (color)	✓	✓	✓
Hercules emulation	Not included	Not included	✓	Not included
Text legibility	◉ (monochrome) ○ (color)	◉	◉	○
Keyboard				
Number of keys	83	84	83	84
Keyboard feel	◓	○	◓	◓
Convenience	◓	◒	◓	◓
Connectors				
Parallel printer	✓	✓	✓	✓
RS-232 Serial	✓	✓	✓	✓
TTL monochrome monitor	✓ (monochrome)	✓	✓	—
Composite video monitor	✓ (color)	✓	✓	✓
RGB monitor	✓ (color)	✓	✓	✓
IBM-type expansion slots				
Long	3 (1 needed for display)	6 (3 are occupied)	4	0 (1 with daughter board)
Short	—	3	—	—
Proprietary expansion connectors	1 Epson slot	—	—	—
Hardware reset	✓	✓	✓	—
Documentation	◓	◓	◓	◓
Warranty	1 yr.	90 day	15 mo.	90 day

[1] *With* **Mailmerge** *and spelling checker.* [2] *Needs daughter board and display board.*

AN EDUCATOR'S OPINION

When Bureaucracies Rule, Learning Loses

By Mary Hatwood Futrell, President NEA National Education Association

The bell rings. The class enters—25 students, a kaleidoscope of personalities, all unique, each a bundle of idiosyncracies, different strengths, different attitudes and aptitudes, different *needs*.

You begin the day's lesson—and a day-long dialogue with yourself: Am I moving too quickly for Jonathan? Too slowly for Janice? Does Daniel need some remedial work? Would tougher homework assignments catch Alan's attention? Or is it time to ease up? Would Anna flourish in an Advanced Placement course?

For America's teachers, these are the sorts of questions that never stop. But there's another question that we as a society need to ask: Who is most likely to have the answers to the daily questions every teacher faces?

The obvious answer is, of course, the teacher—the person on the scene, in the classroom, in *touch*. I'm firmly convinced that, in this case, the obvious answer is also the right answer. Teachers have the experience, the insight, the training to know what works in the classroom—and when.

Unfortunately, our contemporary school systems seldom recognize this obvious truth. One of the baffling ironies of modern times is, in fact, the extent to which control over classroom decisions has been wrenched from the hands of teachers and principals. Teaching methods and materials, assessment tools, disciplinary codes, and even entire curricula are frequently dictated by officials sitting in district offices comfortably at a distance from the classroom and its challenges. Decisions drop down from on high. Teachers and principals lose autonomy. Learning is the casualty. Jonathan and his classmates are the victims.

The result: a tyranny of inefficiency that's been noted—and denounced—by virtually every major education reform report over the last two years. Ted Sizer, for instance, charges that "hierarchical bureaucracy" is "paralyzing American education." And when, in the concluding chapter of *Horace's Compromise*, Sizer lists five imperatives for better schools, his primary recommendation is that we "allow teachers and principals to adapt their schools to the needs, learning styles, and learning rates of their particular students. . . . *The decentralization of substantial authority to the persons closest to the students is essential.*"

Ernest Boyer echoes Sizer's view: Heavy doses of bureaucracy, he argues in *High School*, stifle creativity and block teachers and principals from exercising their best professional judgment on matters that should be decided at the school building level.

Boyer and Sizer's critiques reflect more than a decade of research on effective schools. Derrick A. Bell, dean of the University of Oregon Law School, succinctly summarized this research when he observed that teachers at effective schools are "mavericks." They become forces for educational excellence precisely because they—like their principals—are "willing to give priority to a vision of education *even over policy decisions coming from a central board.*" They're rebels—with a cause. And the cause is an instructional program and school climate tailored to the needs of students—*not* to the demands of bureaucrats.

Surely teachers and principals should not have to risk insubordination in order to advance the cause of educational excellence. And the change that would render such rebellion unnecessary is in no way radical. Returning decision-making power to the local school is, in fact, consonant with the prescription for success put forth in Thomas Peters and Robert Waterman's *In Search of Excellence: Lessons from America's Best Run Companies.*

America's corporate leaders are learning the *decentralization* lesson that management analysts like Peters and Waterman strive to teach. They're beginning to understand that common sense demands treating employees as adults deserving of respect and capable of making intelligent judgments.

It's time centralized school district bureaucracies learned that lesson, too.

NEA • 1201 Sixteenth Street, N.W. • Washington, D.C. 20036 • (202) 822-7200

AMERICAN CAN: TSAI GETS THE TOP JOB FOR GETTING THE JOB DONE

When he was younger, Gerald Tsai Jr. tore down and rebuilt five homes. "I liked to see the two-by-fours go up and finally the furnishings put in place," he says. On Apr. 30, in recognition of the solid financial house he's constructed for American Can Co., Tsai was named chief executive, succeeding Chairman William S. Woodside.

American Can's transformation has been remarkable. In 1981, Woodside, who will retire next January, began to shift the company away from can manufacturing and paper operations into less capital-intensive and faster-growing businesses. In only a few years, American Can's financial services business grew to produce 1985 earnings of $200 million on revenues of $1.3 billion. In the same period, the company divested its paper operations, cut back on can manufacturing, trimmed employment, and decentralized management. Return on equity rose from 7% in 1981 to 11% last year. "The challenge now," says Tsai, "is to make sure the company will grow at a faster-than-average rate."

BIGGEST COUP. For the 57-year-old Tsai, who remains vice-chairman for now, the promotion caps a four-year effort. A few years ago, Woodside formed an office of the chairman, putting Tsai in competition for the chief executive spot with President Francis J. Connor. Connor, 56, a 30-year veteran with packaging and retailing expertise, is expected to stay on.

The promotion also marks a comeback for Tsai, who first set Wall Street afire in the 1960s as a "go-go" mutual fund manager. He reappeared in 1982 when he sold Associated Madison Cos., a life insurer, to American Can for $140 million. Associated Madison became the focus of Woodside's financial services strategy, and the chairman gave Tsai the charter to build it. Largely through acquisition, Tsai added specialized insurance, mortgage banking, and real estate syndications. In 1984, financial services contributed 25% of the company's total revenue and 45% of operating income. Last year, financial services accounted for 54% of total profits. And in the quarter ended Mar. 31, while overall aftertax income rose by 20%, financial services' operating income rose by 47%.

American Can's biggest coup came in March, when it sold 15% of its American Capital Management & Research mutual fund subsidiary to the public for $69 million. The Houston-based fund had been acquired less than three years earlier for $38 million, and it produced a special $25 million dividend for American Can before it was sold. Tsai estimates the offering added nearly $10 to American Can's stock price, which hit a new high of 79¾ and closed at 70 on Apr. 30. Other such offerings are under consideration. A likely candidate is Fingerhut Corp., a profitable direct-mail merchandiser.

Other projects include the sale and leaseback of the company's Greenwich (Conn.) headquarters and further reductions of its vast timberlands. American Can is also likely to concentrate on beverage cans and shut its other can plants. Tsai has ambitious plans for the company: He wants to double earnings per share by 1990 and boost return on equity to 18%. He also plans to expand his portfolio of service businesses, probably by buying a health care company. Being a master builder seems to suit Tsai—and American Can.

By Marilyn A. Harris in Greenwich, Conn.

RESEARCH

MONSANTO'S SCHNEIDERMAN AND WASHINGTON UNIVERSITY'S MACCORDY: "FASTER SCIENCE"

MONSANTO'S COLLEGE ALLIANCE IS GETTING HIGH MARKS

While tight research dollars are cramping scientists' style at many universities, researchers at one school are sitting pretty. At Washington University, they can apply to tap into a $52 million research fund bankrolled by Monsanto Co.

Four years ago, the St. Louis university and the chemical giant signed an extensive collaborative industry-university joint research agreement. Monsanto anted up $26 million over four years to fund university research in return for first crack at licenses on any resulting patents. The effort proved so successful that on May 2, Monsanto kicked in another $26 million and extended the partnership until 1990.

Monsanto is convinced that it is getting its money's worth. Indeed, Howard A. Schneiderman, senior vice-president and chief scientist for corporate research and development, says the 1985 acquisition of drugmaker G. D. Searle & Co. might not have happened otherwise. "Through the program we made enough discoveries of potentially interesting pharmaceutical products to justify buying Searle," he says.

The first drug Schneiderman is counting on is a hormone produced by heart cells that plays a key role in regulating blood pressure and kidney function. Several other drugmakers, including Merck & Co., are pursuing the same substance, called atrial natriuretic factor. But Mon-

T. MIKE FLETCHER

santo believes the Washington University group is on the cutting edge of the research: The university won the first U. S. patents for the potential drug, which will enter human clinical tests this summer.

Another dozen or so patents are pending. Monsanto has targeted a group of drugs that dissolve blood clots in heart-attack victims and immune-system regulators that may be useful to treat such diseases as arthritis. To help get those drugs to market, Monsanto has beefed up its internal R&D spending. This year the company expects to spend $520 million on R&D, 57% of it in life sciences, up almost 11% from last year. With that push, "we will deliver to Searle one or two very exciting product candidates in 1986 or 1987," vows Schneiderman. New drugs should be welcome at Searle, which faces hundreds of millions of dollars in liability claims over its Copper 7 intrauterine device.

Initially, the agreement with Monsanto was controversial. Critics, including Representative Albert Gore Jr. (D-Tenn.), feared it would compromise the independence of the university and skew research toward commercial goals. But both parties argued they had developed a committee of Monsanto and university scientists that acted as an on-campus granting agency to prevent conflicts.

'ATYPICAL.' The relationship is getting high marks on campus. Last fall, an independent committee of academic leaders gave it a clean bill of health. "Our overall conclusion was that the venture had been extremely successful," says Leroy E. Hood, a committee member and professor of biology at the California Institute of Technology. And academic scientists are finding that the collaborative effort is speeding up their research. "With the collaboration we did faster science than might have been done otherwise," says Philip Needleman, a professor of pharmacology who heads the work on atrial peptides at Washington University Medical School.

Despite the good reviews, the Washington University-Monsanto deal has not become a model. There are fewer than two dozen industry-university collaborations with more than $1 million in funding. Some believe the situation in St. Louis is unique: Monsanto was in the throes of reorienting itself out of commodity-chemical businesses and needed the university for help. "Monsanto was ripe, and the situation was quite atypical," says Edward L. MacCordy, the university's associate vice-chancellor for research. But with cutbacks in federal funds, more universities may try to tie up with corporate backers.

By Emily T. Smith in New York

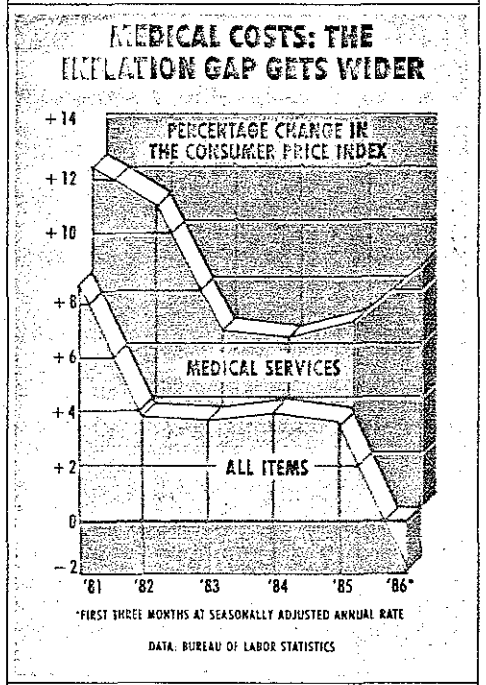
PATRICE CAIRE

SAFETY & HEALTH

WHY HEALTH CARE COSTS ARE HAVING A RELAPSE

Medical inflation has cooled so dramatically since 1983 that many economists no longer study it as a barometer of rising prices. But if they missed the mid-April release of the consumer price index, they are in for a shock. During the first three months of 1986, the medical component of the CPI rose at an annual rate of 8.7%, while the overall index dropped by 1.9% (chart). With companies and the government battling to contain medical inflation, such price rises "shouldn't be possible," declares Uwe E. Reinhardt, an economist at Princeton University.

What's behind the cost runup? Health care experts suggest the very cost-containment efforts that helped bring increases down to 6.1% in 1984 from a high of 12.5% in 1981 may actually have contributed to the upward spike. Reducing the volume of in-hospital care raised costs per patient. Now, hospital officials contend, significantly higher prices are necessary just to cover costs—which in health care have long outpaced the overall rate of inflation.



HUGE PREMIUMS. The government's program to slash medicare expenditures also may have played a role. Medicare payments to hospitals, which account for 40% of their revenues, have increased by only 4% since 1983, and medicare payments to doctors have been frozen. These actions may have forced rates for private patients to balloon, and they clearly haven't helped doctors facing huge malpractice premiums. "Fees may be rising more rapidly than people like, but that doesn't mean physicians are taking home more net income," says Dr. James S. Todd, senior deputy vice-president of the American Medical Assn.

In the first quarter, hospital-room charges swelled by an annual rate of nearly 10%, prescription-drug prices jumped by more than 12%, and physician fees rose by about 7%. The 8.7% quarterly spurt for the CPI medical component is well above the 6.3% figure for the same period a year earlier.

With oil and commodity prices tumbling, renewed medical inflation poses little immediate threat to the economy. But increases in health prices already are translating into higher health-insurance premiums. Hewlett-Packard Co. has received a handful of proposed contracts calling for increases of about 9%. Arthur J. Young, HP's benefits manager, warns that more hikes of that size would be "cause for significant concern."

'OUT OF THE CLOSET.' Employers clearly will resist. Many already have negotiated discounts for group health plans, and higher rates will prompt more to follow suit. "Employers were getting used to health costs going up only 5% to 7% a year," notes Jeffrey C. Goldsmith, a health care expert for the accounting firm of Ernst & Whinney. "If premiums start increasing by 10% or 12% a year, the club will come out of the closet."

The club already is out in some areas. In Southern California, hospitals in the last year nominally raised room rates from 6% to 10%, estimates Thomas M. Priselac, chief operating officer of Cedars-Sinai Medical Center in Los Angeles. But companies won much lower prices. "The difference between quoted rates and the actual amount paid is growing," Priselac notes. This may mean the CPI itself is a bit inflated.

Because of its deregulatory philosophy, the Reagan Administration is unlikely to try to halt the steep price rise in medical costs. "We've pretty much gotten our own costs under control," says a Health & Human Services Dept. official. "You have to wonder what's going on out there in the private sector."

By Michael A. Pollock, with Vicky Cahan in Washington

BIOENGINEERING

MEET THE CAMPUS CAPITALISTS OF BIONIC VALLEY

THE UNIVERSITY OF UTAH NURTURES STARTUPS MAKING ARTIFICIAL HEARTS, ARMS, AND EARS

If there really were a Bionic Man, he probably would live in Salt Lake City. There he'd have ready access to an artificial heart as well as a broad range of spare parts, from prosthetic arms to artificial ears. In the past few years some 20 biomedical startups have set up shop in the shadow of Utah's Wasatch Mountains. The area is so awash with high-tech medical companies that locals have dubbed it Bionic Valley.

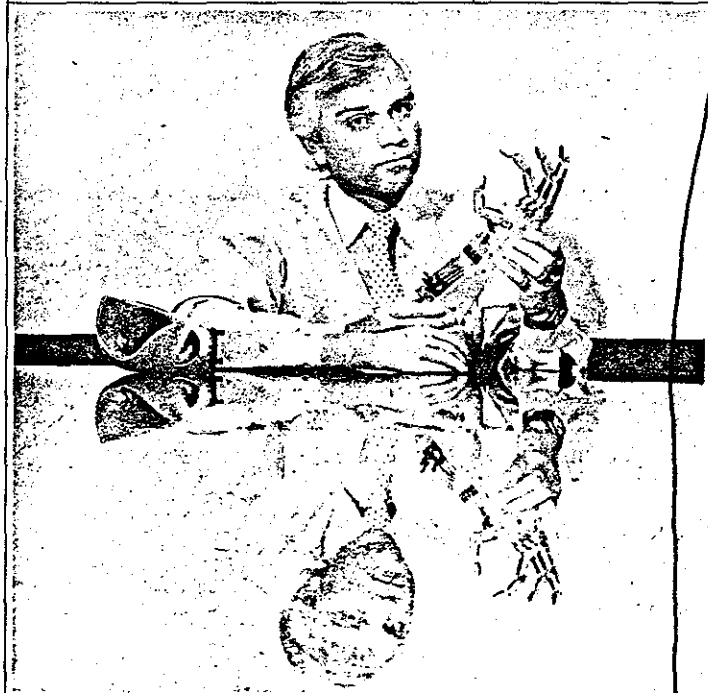
Just as major universities helped spawn the companies in California's Silicon Valley and along Boston's Route 128, the University of Utah is the driving force in Bionic Valley. But unlike Stanford University in the early days of Silicon Valley, Utah takes an equity position in the companies that commercialize its research. The school is setting up an office of technology transfer to expedite what it calls "academic capitalism."

'MINI-CAMELOT.' This push would not have gotten so far were it not for Willem J. Kolff, who retired in February as director of the school's Institute for Biomedical Engineering and Division of Artificial Organs. For nearly two decades, the Dutch-born Kolff, who in 1945 invented the first successful kidney-dialysis machine, has led the way in marrying medicine and engineering at Utah. He was lured to the university in 1967 by then-President James C. Fletcher, who is about to begin his second stint as head of the National Aeronautics & Space Administration. It was Fletcher's goal to build the school, the oldest university west of the Missouri River, into a major research center.

Kolff complied by turning it into a center for biomedical engineering. He created "a mini-Camelot," says Stephen C. Jacobsen, director of the university's Center for Engineering Design. Kolff attracted a number of outstanding graduate students—not the least of them Robert K. Jarvik, who developed the first mechanical heart to be implanted in a human. As Jarvik remembers, Kolff was more interested in Jarvik's Volvo—they each drove one—than in his undergraduate credentials. In 1971, Kolff hired Jarvik, who is now an assistant professor of surgery, at $100 a week and asked him to design an artificial heart.

More important, Kolff saw the need for early commercialization of the technology that he and his students were developing. After several of his ideas were rebuffed by large companies, Kolff realized that the best way to go commercial was to spin off small companies. In 1974, after failing to interest prosthetics makers in an artificial arm developed by Jacobsen, Kolff helped Jacobsen set up a company called Motion Control Inc. Its "Utah arm" was the first to be activated by electrodes attached to an amputee's remnant muscles. Unlike others available at the time, it was capable of smooth, natural motion.

PAINLESS INJECTIONS. Since then, Motion Control has sold some 250 arms, costing up to $30,000 each. It also manufactures an implantable insulin-delivery system for diabetics, and it is beginning to market a drug-delivery system that injects drugs through the skin without a needle. The device, called Phoresor, is a 3-in.-sq. plastic patch with a pocket the size of a quarter for liquid medication. An electrical current from a small battery pack runs through the medication, creating a positive charge. Because skin is negatively charged, the current pushes the drug through the pores. The process is



TIM KELLY

JACOBSEN: THE UNIVERSITY HELPED HIM MARKET HIS 'UTAH ARM'

UTAH'S BIOMEDICAL STARTUPS

Company	Date founded	Biomedical activities
BUNNELL INC.	1980	Manufactures a respirator engineered for infants.
DESERET RESEARCH INC.	1983	Biomedical engineering and testing, including cardiac research. Will soon produce a hearing-aid circuit that amplifies selected sounds.
LIFE EXTENDERS CORP.	1983	Developing an artificial bladder and an artificial sphincter.
MOTION CONTROL INC.	1974	Makes the "Utah arm" prosthesis as well as a controlled-delivery abdominal implant that administers insulin, and an electronic system to deliver drugs through the skin.
SYMBION INC.	1976	Manufactures an artificial heart and an artificial ear.
VASCULAR INTERNATIONAL INC.	1983	Makes synthetic blood vessels.

DATA: BW

KOLFF: A FORCE BEHIND THE JARVIK HEART

painless and takes about 20 minutes to complete.

Phoresor is already being used to deliver such drugs as cortisone, which reduces inflammation in joints and tissue, and the product may also be important for treating acne and skin cancer. This year the privately held company expects revenues of about $2.2 million, and President Thomas A. Wiita believes the new drug-delivery system may push sales to $50 million in five years.

Kolff's best-known spinoff is Symbion Inc., which he formed with Jarvik in 1976 to make artificial hearts. "Heart doctors and other research labs wanted to buy them, and it's against the rules for a university to market them," explains Donald B. Olsen, an early Symbion investor who heads the university's Institute for Biomedical Engineering.

HELPING THE DEAF. Symbion still has extremely close ties to the university. In fact, it rents space in the building where the university conducts research on artificial hearts. So far, 12 of Symbion's Jarvik-7 hearts have been implanted in humans, seven of them as a "bridge to transplant" in patients waiting for heart donors. The company, which lost $2.9 million last year on sales of $4.3 million, is also working on a partial artificial heart to assist the hearts of patients recovering from heart surgery. And it recently began marketing a device that restores some hearing to the profoundly deaf. Called a cochlear implant, it relays sound to the brain through electrodes implanted in the patient's inner ear.

Other startups are at work on a broad range of spare parts, including artificial blood vessels, heart valves, and even urinary sphincters and fallopian tubes (table). State officials hope the influx of new companies continues, because these startups are providing jobs at a time when employment in agriculture and mining is declining. Bionic Valley also has the tacit approval of the Church of Jesus Christ of Latter-day Saints, whose members make up 70% of Utah's population. The church not only applauds the new jobs but also has traditionally encouraged entrepreneurship.

The University of Utah licenses the technology developed in its laboratories in return for royalties of 1% to 4% of gross sales in the startups. In addition, the school takes up to 10% equity in the companies. "If somebody's going to make $10 million, I want our million," says James J. Brophy, the school's vice-president for research. He is determined not to repeat a mistake made in 1968, when the university licensed computer technology to a professor who started Evans & Sutherland Computer Corp. Last year the computer-graphics company reported sales of $80 million, but the university never got a penny from its licenses. Its technology became obsolete, so it was not used when the company brought its product to market.

A PENNY A SHARE. The relationship with more recent startups is already enriching the university. So far it has accumulated stock in the ventures valued at $2 million—and Brophy estimates that the value of these shares will multiply tenfold in 10 years. The stock is held by a university foundation that receives dividends and royalties—some $100,000 last year. Several professors are doing quite well, too. Jarvik's stock in Symbion, for instance, is worth $550,000. Olson, who thought he was throwing away $100 when he purchased Symbion at 1¢ a share a decade ago, gave some of the stock to his children. Three of them used it to cover college expenses; two more sold it for downpayments on houses.

Not everyone on the campus is comfortable with academic capitalism, however. Faculty members with corporate interests could face conflicts of interest, says Raymond L. White, co-chairman of the Human Genetics Dept. He also worries that graduate students could "become low-paid lackeys of the company. The student has the pleasure of seeing his work become public domain, but the faculty member has the pleasure of taking it to the bank."

Still, Olsen and others are confident that academia and the profit motive are compatible. Motion Control's Wiita maintains that the lure of Bionic Valley to researchers is not money but the opportunity to conduct cutting-edge research and see their "ideas have a chance to try their wings." Researchers at the university say they have so many good biomedical ideas waiting to take flight that Bionic Valley will be Utah's hottest growth industry for years to come.

By Sandra D. Atchison in Salt Lake City

TOM HILL/SALT LAKE TRIBUNE

ington Times WEDNESDAY, MAY 28, 1986 PAGE 3A

Many Dixy Lee Ray backers shocked she may not get post

By Ed Rogers
THE WASHINGTON TIMES

Prestigious scientists and scholars who support President Reagan's policies expressed shock yesterday that Dixy Lee Ray, former Atomic Energy Commission chairman, may not be chosen the president's science adviser.

The scientists said they had learned that Miss Ray, 71, who has served on the National Science Foundation and as governor of the state of Washington, was being edged out by Dr. Robert O. Hunter Jr., 36, a San Diego research executive.

"He probably is a worthy young man, but I do not believe that he is in the same league with Dr. Dixy Lee Ray," Frederick Seitz, president of the National Academy of Sciences from 1962 to 1969, said in an interview.

"I was a little suprised when I read [illegible] pushing his candidacy over Ray," Mr. Seitz said. "This led me to a profound suspicion that perhaps he is being pushed on political grounds rather than on scientific grounds."

Robert Tuttle, White House personnel director, when asked about the scientist's suspicion that a political deal was underway, had a one-word comment: "Preposterous!"

"No decision has been made; I expect one will be made shortly," Mr. Tuttle said in a telephone interview. He would not discuss the matter further.

The White House announced yesterday that astrophysicist Richard Johnson will serve as interim director of the White House science office until a new permanent science adviser is chosen. Mr. Johnson, 58, is currently assistant director for space science and technology in the White House science office.

Mr. Seitz said he, Edward Teller, known as the father of the H-bomb, and Miro Todorovich, executive director of Scientists and Engineers for Secure Energy, had recommended Miss Ray for the science adviser post months ago.

Commenting on speculation that Mr. Hunter is being favored for the job, Mr. Seitz said, "I would certainly like to be further enlightened as to what quality he possesses, besides perhaps friendship among Republican politicians, that would make him a superior candidate to a woman of such recognized scientific achievement, who has had experience in government."

Mr. Teller was in the Mideast and could not be reached for comment.

"I guess what we are afraid of is having another unknown who spends three years learning the post," Mr. Seitz said. "He might be a splendid person, but there's a chance he might be new to the Washington scene and new to the scientific community as a whole."

There was some criticism of George A. Keyworth, who resigned as the president's science adviser Dec. 31, because of his inexperience. Critics said he used the appointment to get on-the-job training for his private career. He has formed a consulting firm that will advise businesses on how to establish intelligence-gathering systems.

New York University professor emeritus Sidney Hook, who gave the prestigious Jefferson Lecture before the National Endowment for the Humanities two years ago, also expressed concern about Miss Ray being bypassed.

"My astonishment is due to the fact that Dr. Ray is being passed over without any public evidence that the person who seems to have the inside track to this post has scientific and administrative merits," Mr. Hook said.

"Is Mr. Tuttle a Republican trying help another Republican from San Diego?" he asked. "The interest of the country transcends the interest of San Diego Republicans. I'm surprised. I don't think the president is aware of this situation."

Mr. Hook, widely known in the scientific community, although his field is philosophy, was asked if any scientists oppose the selection of Miss Ray for the job.

"Any scientist might on political grounds. People who don't like this administration don't like Republicans and don't like atomic energy," Mr. Hook said.

Ernest W. Lefever, president of the Ethics and Public Policy Center and a friend of Miss Ray, said she recently told him that the position of presidential science adviser is the only one that would bring her back to Washington.

"She's proud to announce that she's 71 years old and says, 'I'm too old to change my honest, plain American ways,' " Mr. Lefever said.

"She thinks the president would be well served by having a fearless, courageous honest person, and loyal person, next to him, and that's why she's interested in this position," he said.

Mr. Lefever said he personally believes the job requires maturity and a broad range of experience.

"That's my answer to putting in these youngsters," Mr. Lefever said.

Lt. Gen. Daniel O. Graham, director of High Frontier — a private organization that promotes President Reagan's proposed Strategic Defense Initiative — said either Miss Ray or Mr. Hunter would be acceptable to him.

"Dixy Lee is an old friend," he said. "She is a great supporter of SDI. But I know that Hunter has his head screwed on right, too. Robert Hunter is also a supporter of SDI, so from my point of view they're still getting a good guy.

"What I was worried about was getting a non-supporter of SDI in there."

Triggering Technology Transfer

By Thomas P. Evans

Adapted from a paper presented at Dr. Dvorkovitz & Associates University/Industry Forum, Chicago, Illinois, February 3-7, 1975.

ABSTRACT

Technology transfer — the movement of new product and process ideas from seller (usually an inventor, a university or a research institute) to buyer (an industrial organization or company) — is a potentially important instrument of commerce which needs cultivation and encouragement. Many problems, some real and some imagined, prevent wide acceptance of the concept today.

The triggering of technology transfer requires buyer and seller attitudes which are more closely attuned to each other; mutual understanding of and respect for each other's problems can provide the necessary spark to initiate beneficial interchanges.

* * *

A display of its identifiable products usually gives an accurate image of any particular company; the products largely reflect the corporate philosophy, the personality of the marketing department and the manufacturing tools and skills available in its production plants. The products or processes which "fit the company" are the ones which find their way from conception stages through research and development and prototypes to production and marketing and general use.

Corporate organizations are formidable fortresses, and relatively little transfer of technology takes place between companies or to or from other outside institutions. When transfer does take place, it is usually in the form of a finished product to strengthen product lines or a proven process intended to reduce production costs or meet competition. Perhaps surprisingly, a corporation rarely seeks or accepts outside technology merely because it is the least expensive way to acquire certain new product/process concepts and research and development.

The movement of technical ideas and know-how from a conceiving organization (the seller) to a user organization (the buyer) is TECHNOLOGY TRANSFER . . . at any stage of research or development. While TECHNOLOGY TRANSFER is a rather unusual experience for the buyer, it is also often confusing, mystifying and uncommon for the seller and, more broadly, can have wide social and economic effects which extend to world trade and standards of living.

The case can clearly be made for acceleration of technology transfer, but the means by which the buyers and the sellers can be encouraged and emboldened are not obvious. The synergism of technology transfer which has actually taken place — where the transfer has brought product or process results which are substantially more valuable than would have been possible in the buyer's or seller's domain alone — suggests the prerequisite for success and an underlying triggering mechanism; somehow, in some way, the two parties in every successful technology transaction have developed an understanding and a sympathy and a respect, one for the other.

By first examining separately the attitudes, the hopes, the expectations, the frames of reference and the different environments of potential buyers and sellers of technology, it is possible to begin the process of fostering more and better transfer of technology, secure in the knowledge that the mutual respect and understanding which stem from such examination and which are vital to that process will provide the trigger for successful results.

The two parties to transfer: buyer and seller

The buyer of technology is usually a corporation. As such, he will likely have a split personality — that is, several different views of new technology will surface from within the same organization. The Board of Directors, as any one of its members will quickly tell you, is ALWAYS interested in new products and processes; unfortunately, no Board member has ever found one suitable for the company, for no proposed new product or process has yet met all of the model specifications of the Board:

- It must be a completely new product which no other company has.
- It must be protectable against imitation or substitution by competitors, in the U.S. and abroad, by strong patents and know-how. It must be absolutely exclusive.
- The product must be cheap to make, habit-forming for the buyer, non-durable (it must wear out).
- The product/process must be producible with no capital investment.
- Firm orders should be in hand before products are sold (no inventory).
- There must be no research or development risks, no marketing risks, etc.

A second view of acceptable new technology is held by the President: his outlook is usually somewhat more moderate than that of his Board, for he has the practical problem of getting results — demonstrating accomplishments. The President of a corporation which may be seeking new technology from outside his company is generally looking for products/processes not too different from those which his company already sells, or which "fit" well with his various departments (promise a minimum of upheaval everywhere) — so as to minimize the risks of time and money and prestige for the company. At least, he is not expecting that new technology can be injected into his company with ZERO risk!

The various departments within the corporation have their own slants on outside technology, and all of them are prejudiced against triggering any transfer. The Marketing Division has very definite ideas as to what products/processes may be salable (and with the least effort), what sort of appearance and color the product should have, what the customer wants, the type and intensity of advertising and promotions which it likes to run and which will surely be successful with a new product, and so forth. Such thinking leaves very little room for new technology from outside the company, for all of the thinking is geared to existing products and product lines.

The Production Division is ever more inclined to resist any change whatsoever in its operation, unless it is to discontinue a few products and processes with which it has always had trouble. Engineering has scarcely recovered from its flurry of tooling and methodizing for the last "new product" (which, they will hasten to tell you, was a flop — even though it has just gone on the market), so THAT Division doesn't want to have anything to do with ANY new product — particularly one from outside the company — unless it is just like one now being produced.

The Research & Development Division of the potential buyer's organization is often the group with whom the seller of technology makes contact and expects to react. Examination of the motivations of and the management expectations for an industrial R&D operation, however, yields the same negative likelihood of of the triggering of technology transfer from any source external to the company. The rejection of "not invented here" (N.I.H.) is no less real because it stems from complex motivations, pride and corporate expectations rather than from simple pigheadedness. R&D might consider a new product/process idea from an external source IF the division could get corporate credit for a masterful job, and IF the risk to its prestige and its budgets were close to zero. Nobody wants to be responsible for a failure!

To summarize the characteristics of the would-be buyer of technology: he is many-headed — and each head has different reasons for saying NO. Basically, the buyer is seeking minimum exposure, minimum risk and maximum return. Perhaps to such a degree that he is overlooking tremendous opportunity.

The technology seller may be too shortsighted, also. We shall proceed on the assumption that he has a good idea to transfer to a company which can use it; the seller nevertheless often vastly underestimates the difficulties and the costs in time and dollars to bring his technologically advanced product/process to the point where it can be marketed or otherwise usefully employed. Even with a working prototype and, perhaps, a product design concept for mass production, the seller is not likely to have any realistic feel for the agonizing laborious product development, evolution, marketing test stages, appearance models, engineering designs, production drawings, tooling arguments and agreements and procurements, quality control standards development, marketing program creation — and finally, production start up and sales introduction involved in just getting the seller's baby launched into a hostile world!

The technology seller with a good item for which he, himself, has no particular use (the usual case) and in which he does not intend to invest his own development, production and marketing dollars has definite feelings about the worth of his technology to others who may be in a position to use it. Since he doesn't recognize

(Continued on Page 20)

ABOUT THE AUTHOR:

Thomas P. Evans has been Director of Research at Michigan Technological University since 1967. He received his B.S. degree from Swarthmore College in 1942, then spent 3 years in the Navy during WWII. A two-year stint of study-teaching at Yale earned him an M. Eng. degree in 1948. Evans did nuclear plant design at Westinghouse Atomic Power Div. and at AMF, Inc., followed by broad military and industrial R&D supervision at AMF. For the 5-year period just prior to his move to Michigan Tech, he had been Vice President for Research and Development at W. A. Sheaffer Pen Co. He is a member of American Management Association, Society of Plastics Engineers, Institute of Electrical and Electronic Engineers, American Physical Society, American Defense Preparedness Association, American Forestry Association and Yale Science and Engineering Association. He belongs to Sigma Xi and Tau Beta Pi honorary scientific and engineering societies, and is a registered professional engineer.

Triggering Technology Transfer

(Continued from Page 3)

either the complexity of the job or the risks which the buyer assumes when he makes the decision to proceed with development of an item of new technology, the seller practically always has a highly-inflated idea as to the value of his technology to others. He drastically discounts the risks inherent in new product/process development and marketing — risks which are invariably financial and which often involve unavailable technical skills or undeveloped production methods as well.

The would-be seller of technology, then, can be satirically characterized as the owner of a sure-fire item which anyone in his right mind KNOWS will be successful, and which is worth a fortune because it can be produced for a nickel and sold for a dollar and can be put into production next week (after special new machines are purchased and installed by the Manufacturing Department of your company, of course!).

The transfer gap

If there were few differences between the thinking of buyers and sellers of technology, there would be little need for concern about triggering technology transfer. But the buyer is a very different animal from the seller; one is over-reluctant to take risks and the other is over-confident of the value of his technology. The width of the gap can be described in a series of contrasts between the thinking of buyer and seller:

1) The gap between IDEA and PROTOTYPE; the seller maintains that an idea is all that is necessary — that the buyer is a fool if he can't readily envision the benefits which will flow from the new technology which is represented by the concept he is expected to be eager to embrace. The buyer, on the other hand, is anxious to make the best possible investment of his funds and his manpower and facilities resources; he must minimize his risks, and therefore seeks only those ideas which have been translated into prototype products or pilot-plant processes. The seller generally cannot afford to develop his idea into one or more prototypes, and he likely does not have the expertise to do this in any event. Thus occurs a very wide gap between the two parties — one which must be bridged in some manner before transfer can be accomplished.

2) The simple communications gap between organizations: "Who to talk to" in a company or in a university is always a dilemma. When potential seller wishes to explore items of technology transfer with potential buyer, who gets together with whom? The seller is not going to get anywhere with the buyer's R&D Department, for N.I.H. will quickly squelch any idea-transfer conversations. Moreover, the resources-planning decisions of the buyer must all be made at a high corporate level, so it is practically essential that the seller communicate first with such decision makers. The buyer, for his part, may be dealing with an inventor, a consultant, a research laboratory, a university or another company; he must be able to recognize a seller-communicator who can speak authoritatively about the item or items of technology for sale, and who is going to follow through on inquiries and decisions. In most universities it is exceedingly difficult to find a seller-communicator who is willing to concede that he has the necessary authority and who is willing to use it! Transfer simply cannot occur until or unless "the right people" are in communication with each other.

3) The disparity between the buyer's concept of WORTH of new technology and the seller's opinion of its VALUE has been discussed; the gap is almost invariably a wide one. It probably causes as many transfer failures as the N.I.H. factor. Bridging this gap requires a great deal of patience and open-minded give and take on the part of each party to any negotiation, and, of course, is crucial to transfer. The basic secret for triggering technology transfer is mutual respect and understanding; that respect and understanding begins with the discussions between buyer and seller on WORTH vs. VALUE.

4) The would-be buyers and sellers of technology either never begin serious discussions about new items or abruptly interrupt such talks with great gnashing of teeth on both sides because buyers refuse to recognize that outside technology can be valuable to them. Often, the buyer could profit immeasurably from infusion of techniques, design concepts and products from outside the normal view of his business. The problem which makes technology transfer difficult is the well-known "N.I.H.," NOT INVENTED HERE; it affects, in varying degrees, practically every organization of every type — the unwillingness to admit that someone from outside the business might have some creative and ingenious ideas about the business which we had not thought of ourselves. Such idea-interjection attempts are inclined to be summarily rejected without rational consideration.

5) A gap common to most negotiations between buyers and sellers of new items is a biased interpretation of the RISK vs. RETURN axiom. Naturally, the buyer stresses the tremendous risk and the need for handsome return (to him), while the seller sees the new product risk of his new technology to be minimal. The seller seeks sub-

(Continued on Page 22)

Triggering Technology Transfer

(Continued from Page 20)

stantial compensation (to him) for his low-risk idea which he believes will soon put the buyer at the top of the FORTUNE 500 list. Both parties need some education on the matter of new products — the cumulative investment curve as market introduction approaches (which would be an eye-opener for the seller, no doubt) and the history of companies which are too inflexible to change products and lines or are too conservative to risk resources on new technology which can drastically affect the nature of their products or services.

6) Most buyers of technology will find it difficult to believe that the sellers oftentimes have a peculiar, curious, problem. A university or a company or a federal agency may generate new technology as a regular thing, though as a by-product of its basic functions and/or outside of its normal interests and needs; such an organization is likely to have many individuals in its employ who are not convinced of the value and importance of selling its technology to those who can put it to use. In some instances the sale or licensing of new ideas is even discouraged by official policy. Until this attitude can be changed, there will be many, many items of new technology languishing in graduate theses, in professors' desks and heads and on university and government laboratory benches. Though the result is the same, a large number of companies have a somewhat different internal problem to resolve: do we want to sell some of our technology, and if so, how and to whom? Incredulous as it may sound, the first step in triggering technology transfer must frequently be one of convincing the owner of such technology that everyone's best interests may be served by transfer of his new, unutilized products/processes to those who can put them to good use!

To bridge the differences between buyer and seller, it is necessary to recognize that differences exist, then consciously seek to minimize them one-by-one. If a few of the highest hurdles can be cleared away, those remaining inevitably appear to be less formidable. As a start, the tremendous IDEA to PROTOTYPE barrier between buyer and seller can be tackled if each party will shift his position slightly; the seller could assume some of the development risk (and learn a bit about the buyer's problems at the same time) by investing time and energy and modest funds in designing and producing a prototype or two. Even though the seller's prototypes might not be most appropriate for the buyer's purposes, the evidence of seller's willingness to meet the buyer further down the road will have accomplished much.

At the same time, the buyer could assign the responsibility in his organization for the risk-taking of investment in new products/processes to a special group having the introduction of new products and new lines of products as its major responsibility and loyalty. Such assignment would immediately reconcile the buyer/seller gap caused by the infamous NOT INVENTED HERE syndrome and would also help to alleviate the WORTH vs. VALUE, RISK vs. RETURN and the communications problems which beset the potential transfer of technology from seller to buyer. A buyer who can uncouple his risk-taking on new technology from his marketing and production and R&D department has gone a long way toward meeting the seller on more mutually understandable terms.

If the seller would consider developing prototypes and the buyer would isolate an "outside investments in technology" person or group, two useful steps could be taken toward bridging the transfer gap. These steps can cock the trigger for technology transfer; they are two steps toward the prerequisite mutual respect and understanding between buyer and seller.

Advice to the buyer

It should be quite clear to all concerned that the triggering of technology transfer on a regular basis will require substantial changes in buyers' and sellers' attitudes — changes which are entirely feasible, but which may be hard to implement because habit and outlook are often difficult to alter. If only a part of the advice is heeded, the words of admonition will have been worthwhile.

From the sweet and bitter experiences of one who has been both a buyer and a seller of new technology, the words of advice which can help to trigger technology transfer for the buyer include the following suggestions:

a) Take a hard look at the absolute cost, the ongoing commitment and the cost effectiveness of your RESEARCH (not your DEVELOPMENT) operation. Try to estimate the research cost of each new product/process (if any) which has evolved from this operation. Do not include "warmed-over" products. Has your research operation produced <u>new</u> new products/processes at some sort of reasonable intervals and at an acceptable cost?

b) Turn on your imagination and your ingenuity! Open your eyes and ears to outside new product/process IDEAS and to new components which may become useful in new products. Don't wait for working models and prototypes before making assessments of the impact of new technology items on your business.

c) Develop a plan and a budget for risk-taking on new products/processes in your company. Establish some financial objectives and some numerical new product objectives. Don't be afraid to buy outside ideas when they sound promising.

d) Keep your R&D Department and your Production Department away from new outside technology item evaluations. Don't let your New Product Evaluation Committee near them, either — a sure way to develop instant resistance to anything from outside the company is to ask any of these groups to determine the suitability of outside technology for you! The NOT INVENTED HERE psychology is hard to overcome.

e) Assign the responsibility for looking at outside new product/process ideas to the President or to an imaginative Vice President — someone in the organization who knows the corporate philosophy and who can make decisions stick.

f) There are hundreds of people who, when confronted with any new idea, can explain why it won't (can't) work; try asking yourself and others around you HOW IT <u>CAN</u> BE MADE TO WORK.

g) Challenge yourself to imagine what you would do, and how, with a new product/process for which you have no use, but which should be of value to another industry. Put yourself in a seller's place.

h) If your company hasn't already done it (or hasn't done it well), try to decide objectively what your company is in business for (don't say "to make money" — if that were so, you could do much better by investing in AAA bonds, at much less risk).

Advice to the seller

If the buyer takes some of the advice which has been freely offered, he will have moved positively toward respect for and understanding of the seller and his way of thinking. To push the seller in the general direction of the buyer, with the expectation that the two will reach a common understanding and the transfer of technology will result, the following suggestions are offered:

a) DO try to make a working model of your product or test out your process on a small scale. The buyer usually won't have a very good imagination, and needs reassurance that your item of technology is practical.

b) Don't be coy with a prospective buyer — explain what you have. Don't withhold vital information or detail.

c) Recognize that a reputable company has far more to lose by stealing your idea than have you; if you have a good item of technology, have faith and trust in the integrity of well-known potential buyers. There are simple ways to protect your interests.

d) Try to estimate the cumulative cost to a buyer of product development, testing, market tests, production tooling, and so forth, necessary to bring your product to market. Ask the potential buyer for his figures, and use various references which are available for typical product development. Then multiply this cost by the accepted number of failures per successful new product introduction to obtain a quantitative ideas to the financial risk which the buyer will be assuming if he takes on your product/process.

e) Share the buyer's risk by investing whatever you can in proof of product/process performance and effectiveness and economy before you present your item for transfer to others. Your investment will be evidence of your own confidence in the technology you are selling.

f) Let potential buyers know what you have to offer — what it will do, what it replaces, why it is better — in simple, non-technical language. Leave the technical detail for in-depth explanations when requested.

g) Do not hesitate to seek foreign buyers when domestic companies will not listen to your technology item description; in many countries, imported technology is common and companies openly seek new ideas from abroad.

(Continued on Page 23)

TRIGGERING TECHNOLOGY TRANSFER

(Continued from Page 22)

h) Make a list of all of the steps which you think a buyer of your technology would be likely to go through before he would be able to start collecting income from the item. Check it out with one or more prospective buyers.

i) Challenge yourself to imagine what you would do, and how, if you were the president of a company doing very well at the business of making glass jars and bottles, and a seller of a new biodegradable plastic jar and bottle material offered you a non-exclusive license for a $500,000 fee plus 10% royalty on your selling price for all containers sold. If you don't like that example, set one up for yourself — but DO try to imagine yourself in a potential buyer position.

Corollary: what would your reaction be if the seller offered you the plastic material but was unable to tell you whether it would make good bottles and jars?

The final word: the secret ingredient

The summary of "Triggering Technology Transfer" is relatively succinct:

- Technology transfer is worthwhile, a) to the buyer (industry, generally) and b) to the seller (an individual, university or another company); it needs to be encouraged and broadened.
- The triggering of technology transfer is difficult, to understate the situation. The problems in broadening such transfer to the point where it will become common practice are substantial, for most of them involve changing the attitudes of would-be buyers and sellers of technology.
- The secret ingredient of a successful technology transfer, the trigger, is mutual respect and better understanding between those having technology for sale and those who can use it. The transfer gap — sharp differences in the backgrounds and points of reference of potential buyers and would-be sellers — can be bridged, though the parties must devote serious attention to the problems, and they must want to succeed with technology transfer.
- A raft of specific points of counsel for the buyer and another, separate list for the seller have been formulated to give the technology transfer participants some insight into each other's framework of reference for buying and selling. This counsel can, indeed, lead to the triggering of technology transfer by supplying the secret ingredient.

* * *

...of 'Inventions'

...ENTIONS, From C1

...agazine. A year later I formed my own company for packaging these things."

It all came together with her book of inventions. First published four years ago in France, it became an instant hit on the order of the Guinness Book of World Records. Annual editions were put out. The staff grew to 60. And now, as the World Almanac Book of Inventions, it has come to America.

"We deleted a few of the modern French things, like electrostatically heated underwear," she said, "but we also added some American sports like baseball and football. It changes with every edition, new pictures and everything."

Thus, though Rudolf Laban, the inventor of labanotation for recording ballet steps, does not appear in the U.S. version, he has been in earlier editions, and his name appears on a master index for the seriously curious. The point of the book, however, is not to substitute for an encyclopedia—"which is read by people who already know what they're looking for"—but to stimulate interest in people, especially young people, who had perhaps only vaguely wondered who invented the zipper (Whitecomb Judson) or matches (Robert Boyle) or the microwave oven (Percy Spencer, who discovered the waves when they melted candy in his pocket as he stood in his lab at Raytheon).

"It's very tempting to get into the larger meaning of these inventions," said the author, "into the conceptual insights that caused the real changes. But there is no space for that here." As it is, the book covers in considerable detail such complex sequences as the gradual development of the steam engine and the airplane. It glories in the stories behind individual inventions and the poignant failures that seem to precede so many famous successes.

"Rudolf Diesel committed suicide, you know. He sold his patents, the ones that weren't stolen. He gambled his money away, died in despair. But then you have the lucky ones. John Pemberton invented a sweet syrup, but it wasn't until someone spilled soda water into it that Coca-Cola came into being. And then there was the Earl of Sandwich, who couldn't bear to leave the gaming table so had his lunch brought to him between slices of bread."

A surprising number of the inventors turn out to be French—surprising, that is, to Americans brought up on the notion that the Industrial Revolution happened exclusively in England. In fact, France and Germany were at least as active as the British during the 17th and 18th centuries in producing new processes and devices that would change the way everyone lived.

And they are still at it. It was a Swiss engineer, Georges de Mestral, who invented Velcro in 1948 when he took a closer look at the thistles caught in his hunting clothes. And it was the Frenchmen Charles Crosset and Ernest Bevan who first created rayon in 1895. The list goes on. The new book has 362 pages, three columns per page, with plenty of illustrations.

Next year the Book of Inventions will go into 10 languages. It has spawned a TV quiz show in France, and Giscard d'Estaing's firm sponsors an annual award for inventors and a foundation to aid young idea people. With 160,000 copies sold in France, the company is looking for an even bigger score in this country.

The 32-year-old entrepreneur has two younger brothers and a sister. Only one brother is in politics. Her father doesn't mind.

"He is proud of me," she said. "And I am proud of him."

PERFORMING ARTS

National Symphony Orchestra

If symphonies had personalities, ...ethoven's Fourth would possess ...extraordinary humility. Long ...dowed by its next of kin, his ...ory "Eroica" and the im...ular Symphony No. 5, ...exemplary perform... ...ov Rostropovich ...hony Orches... ...he Ken... ...wed metallic showers of sound. As one heard the largo's gradual crescendo, ever so taut, relentless, the ears became a gateway to the heart, where myriad shades of pathos intermingled before subsiding into a note of hushed resignation. The orchestra then sprang into a savagely intense allegro non troppo.

Beethoven's Fourth was marked by balanced parts and thoughtful phrasing throughout. Rostropovich's hands were imbued with eloquence, shapi...

stage at the Bayou until midnight Sunday, but the wait was worth it, if only to see how well Mike Scott, the leader of this Scottish band, puts across his heroic-scale rock in concert.

A singer, songwriter and guitarist, Scott is partial to songs that combine a sweeping, often poetic vision with an intensely rhythmic urgency. On the raging, three-chord rant "Be My Enemy," there was no mistaking Bob Dylan's influence, and later Scott acknowledged the debt directly with a compelling version of D...

THE TAKE AT THE TOP

PAY FOR PROFITS

How the most competitive companies around are "incentivizing" their compensation systems.

BY BRUCE G. POSNER

BACK IN THE LATE 1960s, SHANNON & Luchs Co. was just one of a dozen or so small real estate brokerage businesses in Washington, D.C. Its managers were all paid in accordance with the norms of the industry, and they received the standard merit raises and bonuses at the end of each year. Then, around 1970, the company overhauled its executive compensation system. In addition to their regular salaries, division heads were given the opportunity to earn a percentage (10% to 25%) of the net profits of their respective divisions, adjusted for overhead and other expenses. The result: sales and profits took off. Today, Shannon & Luchs is one of the largest and most profitable real estate companies in the United States. Company president Foster Shannon gives full credit to the compensation system.

Such tales may sound too good to be true, but they are becoming increasingly common as more and more companies turn to incentive pay as a means of achieving strategic objectives. The trend is easily the hottest one to hit the compensation field since the cost-of-living raise. It involves a whole different approach to compensation, one that is geared toward achieving future objectives, rather than rewarding past performance. To date, thousands of businesses have adopted such systems, and those that try it swear by it. Most practitioners will tell you that—in addition to fostering phenomenal results—incentive compensation allows them to recognize the movers and shakers in their organizations, the people who make things happen, and to inject a new sense of vitality and purpose into the company as a whole.

Testimonials aside, the trend reflects important changes in the business environment. As inflation has declined, companies have found it harder to justify the big raises that were common in the 1970s and early '80s, and so they have begun searching for new ways to keep employees motivated. Even more important has been the pressure of increased competition, forcing companies to become ever more efficient and profitable.

Among the first to move in the direction of incentive compensation were the *Fortune* 500 companies. A study by Hewitt Associates, in Lincolnshire, Ill., shows that more than 90% of the nation's largest companies had short-term incentive plans as early as 1980. These plans made it possible for participating managers to earn bonuses totaling 16% to 55% of their base salaries, given the achievement of certain operating or financial targets. Since then, thousands of smaller businesses have set up incentive plans of their own.

On the surface, at least, [illegible] centive-pay program [illegible] difficult at all— [illegible] where you [illegible] want [illegible]

[illegible] to [illegible] one [illegible] respe [illegible] hand, [illegible] Gear In [illegible] million m [illegible] ear systems, who [illegible] on its ability to deliver q [illegible] cts on time at competitive price [illegible] ce every employee plays a role in achieving the company's productivity goals, all 90 of them receive a quarterly bonus check when targets are met.

Of course, you also have to choose the performance criteria by which you'll hold people accountable. Here, your decision is almost entirely a function of your goals. Indeed, two identical companies might deliberately choose different performance criteria. One, for example, might decide to reward nothing but sales growth as a way to spur aggressive selling, while the other might target profits or quality control. The latter business would, in effect, be telling people to say no to some business opportunities. But each company, in its own way, would be encouraging the kind of behavior it wanted.

Then again, some companies might want their employees to pay attention to more than one goal at a time. For several years, Nicolet Instrument Corp., a Madison, Wis., manufacturer of medical and chemical testing equipment, calculated its management bonuses using a formula that took into account both sales growth and return on assets. With two important goals to balance, says chief executive officer and president John Krauss, there were no rewards for leaning too far in one direction. Other companies accomplish the same thing by establishing separate incentive pools tied to the achievement of different objectives.

[illegible]atever measures you choose, they [illegible]e readily comprehensible to the em- [illegible] they affect. If employees don't [illegible]at kind of performance you are [illegible] encourage—or why it's impor- [illegible]aren't likely to respond as you [illegible]ither have to explain what you [illegible]ccomplish, or choose other [illegible]he same token, the perfor- [illegible]ust involve aspects of the [illegible] affected employees can [illegible]or. That means providing [illegible]he data—monthly sales figures, [illegible]ction reports, profit statements—[illegible]hat will show them how they are doing.

Within these parameters, however, you have a lot of flexibility, not to mention influence. You can, indeed, attach incentives to almost anything—and thereby determine how managers and employees spend their time and where they focus their attention.

Now, none of this seems particularly difficult. You choose your goals, your people, your performance criteria. What could be simpler? Well, not so fast. The problem is that, at every stage, you have decisions and judgments to make, and any one of them can undermine your plan.

Consider, for example, the choice of performance criteria. Should you establish custom-made targets for individuals, or is it better to tie their incentives to the performance of the company as a whole? Dynamark Security Centers Inc., a $5.5-million franchisor of home security centers and distributor of security equipment, gives

THE INDIVIDUAL INCENTIVE
Tailoring the bonus to the job

ROSEMARIE CERTO

Michael Zisman
President of Soft-Switch Inc.

Establishing incentives for individuals takes time, and many jobs are difficult to measure. But Michael Zisman, chairman and chief executive officer of Soft-Switch Inc., in King of Prussia, Pa., thinks that individual incentives are critical to the success of any compensation program. Last year, his company, an $8-million maker of computer networking software, embarked on a program that provides special rewards for about one-third of Soft-Switch's 70 employees.

The idea, says Zisman, was to encourage key employees to focus on individual objectives that are important to the overall success of the business. To provide the necessary rewards, Soft-Switch established a bonus pool based on its achievement of certain sales and profit targets. If the targets are met in fiscal 1987, for instance, the company will kick in 20% of the combined base salaries of affected employees. How that money gets divided depends partly on each individual's contribution to the company's collective success. Last year, for example, half of the potential bonus for the vice-president of operations was tied to such things as improving customer satisfaction ratings and reducing the time required to install products. (The other half was tied to the overall performance of the business.) Similar criteria are applied to many nonline positions as well. A large chunk of the controller's bonus, for instance, is linked to getting monthly reports in on time.

Zisman admits that it's not always easy to define the right objectives for jobs, but he argues that, without individual goals, some critical tasks will never become priorities. What's more, you'll always have a hard time differentiating between levels of performance, and everyone will wind up with roughly similar rewards.

THE GROUP INCENTIVE
Rewarding a company as a team

PHIL MATT

Tom Lowry
President of Riley Gear Inc.

Suppose you had a company in which each and every employee had the power to undermine your competitive position. That was the problem at Riley Gear Inc., a maker of precision gears, in North Tonawanda, N.Y. The solution was to create a compensation system that gives all 75 manufacturing people and the 15 other employees a significant financial stake in the overall success of the company.

The system is known as gain-sharing, and it is built around monthly productivity targets. Every order that comes in to the $6-million business is broken down into a series of production steps, which are assigned hourly rates related to the capabilities of the equipment and the complexity of the work. These rates are then used to create a "blended" productivity target for the company. The amount that Riley puts into the bonus pool each month depends entirely on the achievement of the companywide target, which in turn depends on the workers meeting, or exceeding, their goals.

In the two years the system has been in effect, Riley's hourly workers have earned 3% to 4% a year in extra compensation—over and above the annual increases of 3.3% provided in their three-year union contract. President Tom Lowry thinks that bonuses of 8% to 10% a year are well within reach "as long as the productivity is there." He's also talking about adding nonfinancial rewards, such as extra vacation time.

Of course, there are trade-offs involved in paying plantwide bonuses. "If you have superb performers, you can't really recognize them," Lowry notes. Nevertheless, he believes the benefits of the system outweigh its liabilities. "There's a lot of peer pressure. People know that if we get the cost reductions, everyone gets something. And they understand it's a competitive market, and we're all in this together."

each of its nine key managers and supervisors a different set of performance targets. The marketing and training manager, for instance, gets a small slice (about 1%) of sales up to a given level, and a smaller percentage after that. The head of franchise development, on the other hand, gets a cut of the franchise fees and the inventory ordered by new franchisees. "The structure of the deals is basically the same," says chairman Ed Cusick, "but everyone gets his own report card."

Some businesses go even further, linking an individual's reward to the accomplishment of specific tasks. Thus, at Morris Decision Systems Inc., a computer dealership and maintenance company in New York City, the vice-president of finance has to get a new general-ledger system up and running in order to earn a part of his bonus for 1986.

But there can be problems with this approach. First, it takes time and effort to select the right goals. Then there is the administrative burden of monitoring the performance of many individuals. But perhaps most worrisome is the possibility that what's good for a particular individual, or group of individuals, may be awful for the business as a whole.

In the early '70s, for instance, Nypro Inc., now a $65-million plastic injection molding company in Clinton, Mass., began to reward employees for their own individual output. Some enterprising workers found ways to speed up production equipment during their shifts. They refused to share their secrets with their colleagues, however, and the high-speed work undermined quality. So Nypro was forced to switched from individual to group incentives.

Fearing similar problems, many companies require a certain level of overall results before individual bonuses are paid. "You can say, if we earn so many dollars, or if we get into the World Series, you'll get a reward," notes Peter T. Chingos, who heads the compensation consulting practice at Peat, Marwick, Mitchell & Co. But finding the right balance is not easy.

Nor is it easy to establish performance standards for every job. True, you can set quotas for salespeople and determine efficiency ratios for plant managers. You can even measure performance in such areas as quality control: at Soft-Switch Inc., a King of Prussia, Pa., software company, the quality-control manager is rewarded in part on the basis of results from customer-satisfaction surveys. But what do you do with a human-resources manager? Should you measure employee turnover? In many cases, turnover is totally beyond a manager's control. What's more, if you *do* target turnover, you run the risk of winding up with unambitious employees whose main virtue is that they don't like to change jobs.

To avoid these sorts of decisions, many CEOs prefer to maintain a certain amount of discretion over bonuses. In rewarding vice-presidents and project managers, Joseph Viar takes into account the "degree of difficulty" of the projects they manage. He could pay strictly on the basis of volume of business under management, "but different jobs rely on different mixes of inside people, consultants, and subcontractors," says Viar, president of Viar & Co., an Alexandria, Va.-based consulting company in the data-processing area. Thus they require different amounts of management, and he compensates accordingly.

Then again, you can't use too much

THE PHANTOM STOCK INCENTIVE
Eating your cake and having it, too

TOM SIMON

Al Weatherhead
Weatherchem's founder and CEO

How does a private company get key employees to lose sleep over the business without giving up equity? That was the question confronting Weatherchem Inc., a $6.5-million maker of plastic caps and closures located in Twinsburg, Ohio. Its solution: "phantom stock," an increasingly common technique by which a company rewards employees for building the business's value, while keeping the stock in the original owner's hands.

As founder and chief executive officer of the family-owned company, Al Weatherhead knew he wanted to institute some kind of long-term reward system to get his half-dozen key managers focused on "profitable growth." Real equity made him nervous, however. Among other things, he didn't know how long the key people would stay around the 65-employee company, and he didn't look forward to endless battles over stock valuation. Under the phantom program, adopted in May 1982, selected managers will receive a share of the amount by which Weatherchem's value appreciates over a five-year period. The value is calculated according to a formula that takes into account the company's return on assets and return on equity, both adjusted for its cost of capital.

The plan has encouraged managers to focus on Weatherchem's long- and short-term objectives, but Weatherhead is dissatisfied with the formula. "It's too damn complicated, and it isn't something you can pound the table over." So the company is formulating a new, simpler phantom plan to take effect when the first one expires next May. The new formula, he says, will probably be based on cumulative profits over a three-year period. Why three years this time, instead of the five years in the original plan? "Five years," Weatherhead offers, "just seemed a bit too long."

THE REAL EQUITY INCENTIVE
When nothing else will do

RICHARD HOWARD

G. B. Lankton
Nypro's CEO and president

Few owners of small companies relish the idea of taking on their employees as partners and minority shareholders, but that was not the case with Gordon B. Lankton, president and chief executive officer of Nypro Inc., a highly successful plastic injection-molding company in Clinton, Mass. He inaugurated the company's unusual stock bonus program 17 years ago, and he has never regretted the decision.

Created in 1969, when Nypro was a struggling $4-million business, the plan was designed to encourage employee commitment and achievement by making equity available to people throughout the company. Eligibility is based on a formula that takes into account three factors: length of service, salary level, and job performance. Every year, employees receive points in each category. If an individual scores 20 points or better, he or she can receive a special equity bonus.

The equity takes the form of real stock. The program is not an employee stock ownership plan and uses none of the tax advantages associated with ESOPs. Nor does Lankton view phantom equity as a viable alternative in a company like his. "I want [the stock] to feel real," he says. "You can explain phantom stock to people who are financially sophisticated, but it can be incredibly confusing to everyone else."

As Nypro has grown—today, it is a $65-million company with 1,200 employees—some 90 employees, about half of them nonmanagers, have become shareholders. Meanwhile, the value of the stock (measured by book value) has shot from $3.50 a share in 1969 to $25 last year. To discourage employees from leaving, Nypro requires departing shareholders to sell their stock back to the company over a period of 5 to 10 years—thereby minimizing the impact on Nypro's cash flow.

discretion in awarding bonuses without undermining your incentive program. If the principal basis for compensation is the boss's whim, the only real incentive is to stay on his good side.

At this point, you still have to decide how much money you should dish out in the form of incentives. It can't be so much as to imperil the business—by getting in the way of meeting debt service payments, for example—yet it has to be enough to attract employees' attention. As a rule of thumb, most compensation experts advise that you make available incentive bonuses of at least 10% to 15% over base salaries. Employees will tend to regard smaller bonuses as "tips," which may motivate them to work a little harder and "smarter," but not enough to justify the effort and expense of establishing an elaborate incentive system.

Then there's the related issue of selecting the right performance levels—a critical part of the process. If the targets are too high, people may give up. If they're too low, you may encourage people to take it easy. What happens, for example, if you surpass the target midway through the year?

And what if you set target levels that inadvertently wind up *penalizing* your best employees? That's more or less what happened at The Myers Group Inc., a freight forwarder with 65 offices around the country. For several years, the company paid out bonuses according to a formula that rewarded people annually for profit improvements at their individual branches. The formula was designed to motivate those who worked at the least efficient locations, and that it did. But it provided little incentive for employees assigned to the most profitable branches. Moreover, the system became less and less effective over time. The better an office did one year, the harder it was to receive a bonus the next. People grumbled, and so the company, based in Rouses Point, N.Y., eventually scrapped the formula. Now incentives are tied to the overall profitability of each office and of the company.

Once you have settled on performance levels and criteria, you still have to decide how often people will be rewarded—an aspect of incentive compensation that is often overlooked. After all, the real test of any incentive program is its ability to keep people focused on company objectives. Annual bonuses are traditional, and relatively easy to administer, but can employees stay focused on targets for a whole year? Gordon Lankton of Nypro, the plastic molding company, doesn't think so. His company pays its productivity bonuses on a quarterly basis because "a year can feel like a long time," he says. To make sure that everyone notices, Nypro even uses special profit-sharing checks with a picture of George Washington in the center and "profit-sharing" printed across the top.

On the other hand, quarterly bonuses can be extremely impractical from a company's perspective. Not only does it take administrative effort, but it demands an ability to forecast with precision and to anticipate cash-flow needs. Recently, an air-freight company paid out substantial incentive bonuses at the end of one quarter, only to hit a dry period the next. It hastily revamped its quarterly incentive program. Now nonmanagers get bonus checks after each profitable quarter, but managers don't receive theirs until annual results are in.

So, if you look hard enough, there are solutions to all these potential problems. The bad news is that, once you've come up with a viable short-term incentive plan, you

STRATEGIES FOR INCENTIVE COMPENSATION

You can look outside for help and inspiration, but the answers are all close to home.

There are no real shortcuts to creating an effective incentive compensation system. No matter how you approach it, you still have to ask, and answer, dozens of difficult questions about your goals, your people, and your business. It helps, however, to have a strategy for dealing with these questions. There are essentially three to choose from:

THE COPYCAT METHOD

One strategy is to adapt somebody else's plan to your own circumstances and needs. It's particularly appealing if the other company is similar to yours, and if its system has worked well.

That was the case with Nicolet Instrument Corp., which developed its plan back in 1981 after chief executive officer John Krauss saw an article in the *Harvard Business Review* about the incentive compensation program at Analog Devices Inc. As it happened, Analog had management and operating structures strikingly similar to Nicolet's. So Krauss copied Analog's incentive compensation program, and it worked effectively for several years.

There are pitfalls in the copycat approach, however. To begin with, no two companies have identical cost structures: if your costs are higher than those of the company you're copying, you may be stimulating behavior that you can't afford. Nor can you assume that the other company's market position or goals are the same as yours. If they aren't, the performance criteria are liable to be off as well. "Copying another incentive plan," says one consultant, "is like trying to learn Jimmy Connors's backhand when you don't have his serve." It may work; then again, it may throw everything out of whack.

THE CONSULTANT ROUTE

Another strategy is to hire a specialist to design your compensation program for you. That's a natural impulse, and consultants do have much to offer in the way of advice and experience. But many have worked only with large companies, which does not help them in understanding and solving the compensation problems of smaller companies.

James Bernstein learned that lesson the hard way when he brought in a well-known consulting firm to design an incentive plan for his $4.5-million health risk–management firm, General Health Inc., based in Washington, D.C. He wanted a compensation system that would encourage employees to focus on sales volume and building market share. With that mandate, the consultant produced an elaborate plan under which all 80 employees could earn handsome bonuses by meeting individual and company objectives. "The consultant gave me his best advice," says Bernstein. "It sounded just terrific." Unfortunately, it wasn't. Not only did the system demand hours upon hours of management time to review each employee's objectives, but it also completely overlooked the company's need to change direction and shift people around on short notice. Objectives that made perfect sense one week were outdated the next.

Within a year, General Health scrapped the consultant's incentive program and installed a simpler one designed by Bernstein himself. Dispensing with individual goals for everyone but salespeople, the new system rewards employees for meeting quarterly profit objectives. It takes a lot less time to administer, notes Bernstein, and yet it's enough to send the message that "everyone needs to put their shoulder to the wheel."

THE TAKE-YOUR-LUMPS APPROACH

Bernstein's experience illustrates a fundamental fact of incentive compensation: sooner or later, you have to develop your own system. There are no blueprints, and there are no outside cures. You may discover some interesting features in other companies' programs. You may also find consultants who can help you think through your company's needs. But don't expect anyone to understand your company as well as you do.

"There's no substitute for sitting down, locking yourself in a room, and thinking about what's really important to your business," says Bernstein. "Otherwise you'll end up with a cookie-cutter approach that was designed for the company next door." So, in the end, most companies wind up developing their compensation programs the old-fashioned way—by doing it themselves.

---

still have to confront the issue of *long-term* incentives—the kinds of rewards that ensure employees stay focused on a company's objectives over the long haul. Those kinds of incentives can be just as important as the quarterly and annual ones, maybe more so, and the issues involved are no less thorny. Should you give people real stock, or stock options, or some sort of substitute, such as "phantom equity"? In a private company, how much information should you reveal? How should the value be determined? Who should you include in the plan? How often should you make awards, and at what level? Should you pay dividends? How can people cash out? The list goes on and on. In effect, you have to start all over again, deciding what kind of behavior you want to encourage, and why.

And, as they say on late-night television, THAT'S NOT ALL! You also have to be prepared to change your plan (or plans) at least every couple of years. Why? Because companies change, markets change, people change, objectives change. Even the best plans aren't good forever. Some need to be rejiggered every year—adjusting the performance criteria, including other people, and so on. From time to time, moreover, you may have to scrap the whole system and start again.

Consider Nicolet Instruments, which recently has been forced to restructure its program in response to a slowdown in its market. The original system rewarded managers according to the performance of individual product groups. It worked fine, says CEO Krauss, when the company was smaller, and growing at 25% to 30% a year. But now the growth has leveled off, and the old rules don't apply.

Incentive compensation takes an enormous amount of time and effort. It also requires that you think strategically about your business, that you provide significant rewards for performance, and that you be willing to share a lot of information with your employees. The systems that work best are the ones with clear objectives that people can understand and clear incentives that they can follow. If you can't provide those things, or don't want to, you might as well save yourself the trouble. Incentive compensation is not for you.

There's only one problem with that attitude. The evidence is overwhelming that a well-designed incentive system can have a major impact on a company's performance, giving it a new competitive edge. So if you don't set one up, you run the risk that your competitors will.

In fact, it could be that the company passing you on the right already has one. □

Reviving the spirit of enterprise: Role of the Federal labs

Since a 1983 report of the White House Science Council recommended strengthening the role of Federal laboratories in America's R&D, progress in transferring technology has ranged from impressive to modest. Congress is accelerating the action.

Paul A. Blanchard and Frank B. McDonald

About 400 research facilities officially classified as Federal laboratories[1] employ nearly 185 000 of the nation's scientists and engineers and account for roughly $18 billion per year—a third of all Federal R&D funding in fiscal 1985. Most of this support went to a relatively few large centers devoted to energy and weapons research, high-energy physics experiments, medical programs and space science and exploration. Besides the multipurpose national labs such as Sandia, Argonne, Los Alamos and the National Bureau of Standards, which perform a broad range of R&D activities, the full roster includes a diversity of installations, including the Boll Weevil Research Laboratory; the National Radio Astronomy Observatory; the Insect Attractant, Behavior and Basic Biology Center; the FBI Laboratory; and even the National Zoo. Despite the contributions of the Federal labs, how they can enrich the nation's R&D enterprise with "public technology" has been a subject of concern in Washington for decades.

One recent study of the problem was conducted by a panel of the White House Science Council. After a year-long review, the panel, headed by David Packard, chairman of Hewlett-Packard Co and former deputy secretary of the Defense Department, issued a slender report[2] in 1983 that spoke to issues relating to the management of the laboratories—their missions, funding and personnel systems. But of greater importance, the report called for increased interaction between the laboratories and commercial firms to make the labs "more responsive to national needs." The Packard report accused some of the labs of working without clear purpose and contributing inadequately to the nation's good. The Packard panel recommended that the size of each lab be "allowed to increase or decrease (to zero if necessary) depending on mission requirements," arguing that "preservation of the laboratory is not a mission." What the labs needed to do was develop more alliances with universities and corporations and simplify government procurement procedures, the report stated.

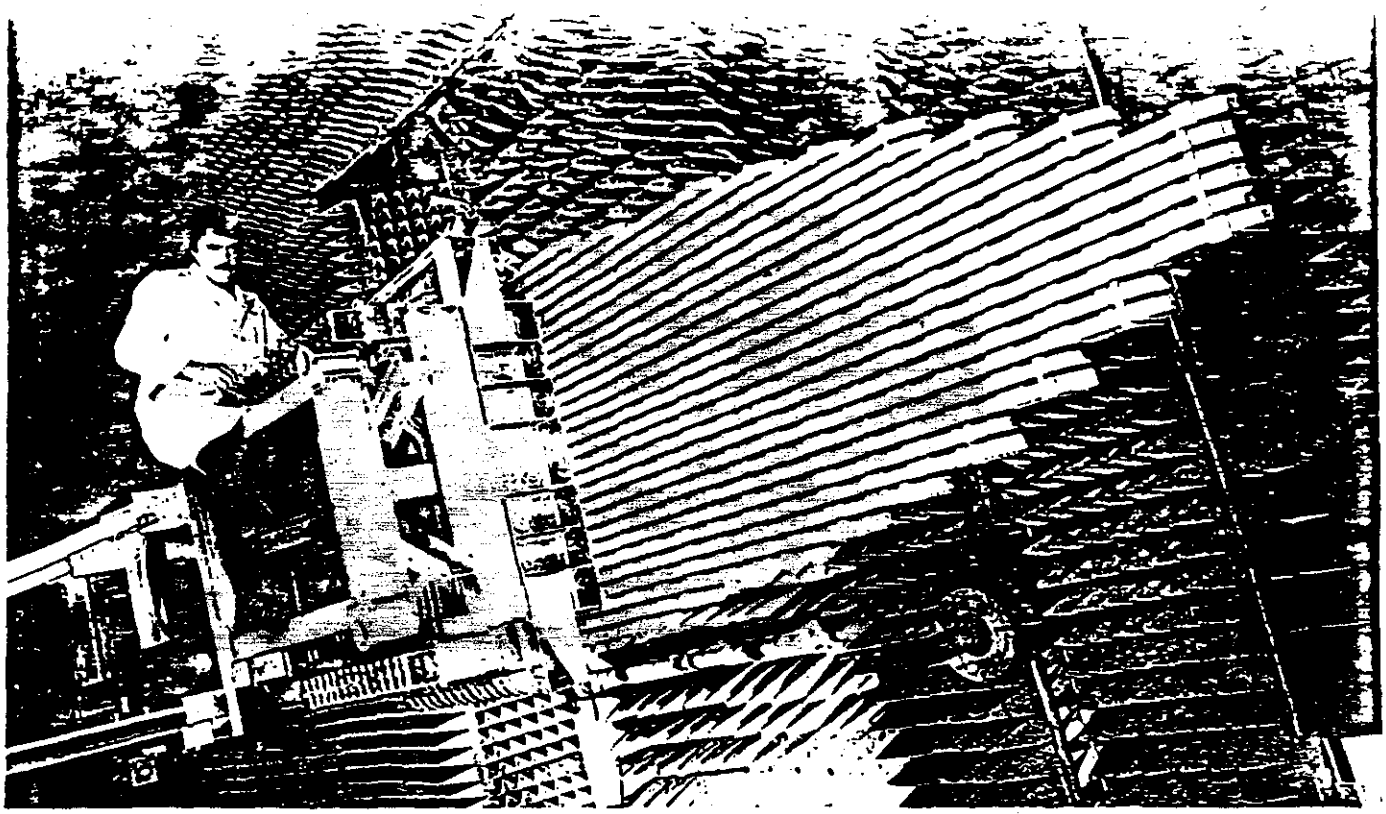
Such recommendations were not surprising because the panel had been instructed at the outset by George A. Keyworth II, who was then the President's science adviser and director of the White House Office of Science and Technology Policy, to ask whether the nation gets an adequate return on the taxpayer's investment in the Federal labs and whether the labs are helping to stimulate the country's industrial competitiveness.

White House concern with these issues was also expressed in President Reagan's suggestion of a Department of International Trade and Industry and his appointment of the Commission on Industrial Competitiveness in 1983 (see box, page 45). Congress, for its part, is also taking increasing notice of the way government-funded R&D is translated into the commercial enterprise—most pointedly, the conditions under which Federal labs contribute best to new goods and services that are likely to benefit the country's world trade. In the current session of Congress no fewer than four bills have been introduced, in the nature of amendments to or substitutes for the 1980 Stevenson-Wydler Technology Innovation Act (P.L. 96-480), to improve the transfer of technology from Federal labs and to promote commercialization.

Prior to the Stevenson-Wydler Act, Federal agencies were not explicitly required to engage in technology-transfer activities, with the sole exception of NASA. The Stevenson-Wydler Act directs the agencies "to ensure the full use of the results of the nation's Federal investment in research and development." To do this, the law creates an elaborate procedure: It calls for each Federal lab to set up an Office of Research and Technology Application to identify ideas and technologies with commercial potential. Once found, information about those concepts is to be sent to a newly organized Center for the Utilization of Federal Technology at the Commerce Department's National Technical Information Service. NTIS is responsible for collecting and disseminating information about Federally funded R&D to possible users. However, NTIS has little experience or interest in technology-transfer matters, particularly as these involve licensing and royalties, and Congress has

Paul A. Blanchard served as Executive Study Manager of the OSTP Working Group on External Interactions, which reviewed how Federal laboratories are carrying out the White House Science Council's 1983 recommendations. Frank B. McDonald, who was chairman of the working group, is Chief Scientist of NASA.

0031-9228 / 86 / 0100 42-06 / $01.00



Microwave antenna, constructed indoors at the National Bureau of Standards in Boulder, Colorado, provides calibration of far-field satellite antennas and phased-array radar stations. NBS provided the design for computer programs for this technology to 18 different US corporations and government agencies.

not provided funding to the agencies for establishing or operating research and technology applications offices at the labs.

The bills introduced in the current, 99th Congress are intended to correct the Stevenson-Wydler Act and stimulate more technology transfer. Hearings on the proposed legislation were held in the House last May and the Senate in August. As recently as 18 November, another bill, H.R. 3773, championed by the House Committee on Science and Technology, was dropped into the hopper with bipartisan blessings. The measure is working its way through Congress with unaccustomed support and speed (see box, page 47).

Obviously, a sea change of sweeping significance has occurred since the Packard report. So much has happened, in fact, that even the conclusions of the working groups established by OSTP to assess the response by Federal agencies to the Packard report may be so much flotsam and jetsam amid the new currents. The findings of those working groups were released in the summer of 1984 as a progress report.[3] This article originally was intended to discuss the conclusions of the Working Group on External Interactions, which examined the relationships of the Federal laboratories with universities and industry. It now includes later developments.

Lab research, Federal style

The Federal laboratories are essentially a post-World War II phenomenon, though the Agriculture Department's extension service was founded in the 19th century. The agricultural extension service has provided a wide variety of educational, research and technical programs that have helped make America's farmers the world's most productive. Agriculture's labs and those organized by other agencies were originally founded to carry out well-defined missions or to take on specific sets of tasks and responsibilities. Over the years, however, research programs have changed substantially at many of these installations.

As the labs have grown in size, cost and function, their significance to science and technology has increased apace. Since World War II they have been the recipients of a sizable proportion of Federal R&D funds. For the record, annual Federal outlays for R&D programs, which stood at about $100 million in the late 1930s, increased to $10 billion by 1962 and reached about $52 billion in 1985. The Federal laboratories account for about one-third of current government outlays for R&D.

Consider the returns to the nation of just one of them—the Naval Research Laboratory, founded in 1923 at the suggestion of Thomas Alva Edison. From it have issued an array of achievements, including radar, sonar and Teflon as well as synthetic lubricants for aircraft engines, rocket probes of Earth's atmosphere and magnetosphere, and several cardiac instruments. Last year NRL registered its 3000th patent, and last October one of its 1700 scientists, Jerome Karle, won the Nobel Prize for chemistry.[4]

Another Nobel laureate working in a Federal laboratory is Rosalyn Yalow. For her work on human hormone chemistry, performed at the Veterans Administration research center in Brooklyn, she shared the prize in medicine in 1977. The National Institutes of Health boasts four Nobel laureates—Marshall W. Nirenberg (1968), Julius Axelrod (1970), Christian Anfinsen (1972) and D. Carleton Gajdusek (1976). The Department of Energy and, before it, the Atomic Energy Commission have had a peculiar relationship with scientists. Most of them have been engaged at the labs through their respective universities; thus, they are not considered Federal employees. But as members of DOE-supported research centers, Ernest O. Lawrence, Edward McMillan, Luis Alvarez, Burton Richter, Glenn Seaborg and other Nobel Prize winners add to the luster of Federal labs.

Efforts by the government to ensure that the nation is receiving an optimal return on its investment reach back more than two decades. In 1962 President Kennedy, concerned about the growth of spending for Federal R&D, asked David Bell, then director of the Bureau of the Budget, to lead a cabinet-level study of the laboratories in the

mission agencies. The Bell report[3] called for reforms that were to become familiar themes in later years. The agencies needed to support world-class, cutting-edge research in their labs; laboratory directors needed to have more discretionary authority, along with relief from the burdens of excessive review and supervision by the agencies; and salaries for key laboratory scientists, engineers and technicians needed to be raised to attract the ablest people.

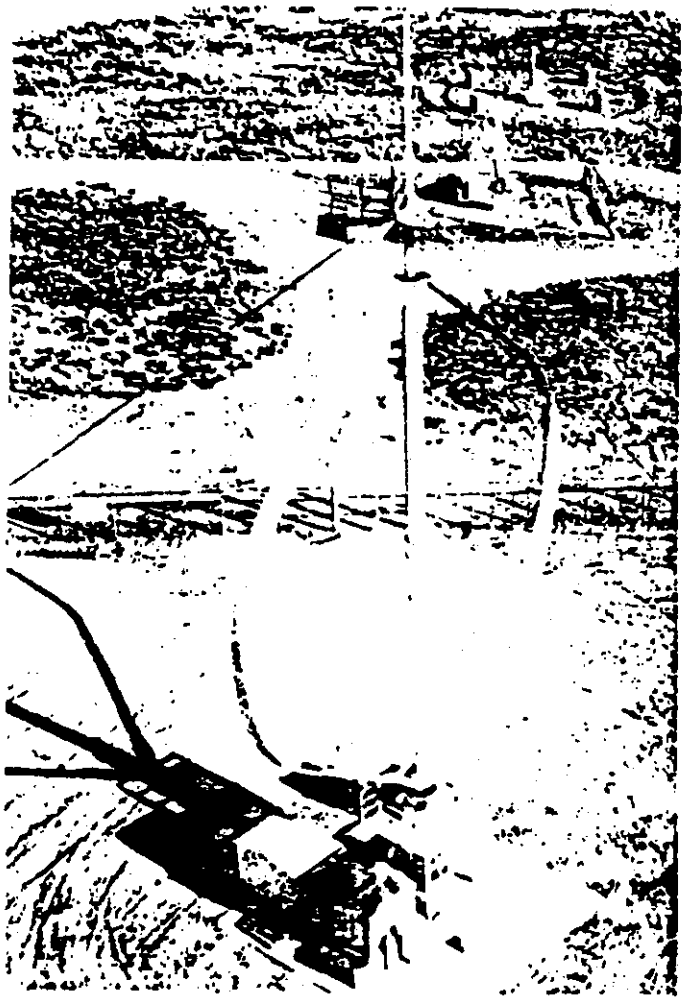
Several other advisory bodies endorsed these recommendations in a series of reports during the 1970s. The reports bore such stirring titles as *Power to the States: Mobilizing Public Technology*, *Intergovernmental Uses of Federal R&D Centers and Laboratories*, *Public Technology: A Tool for Solving National Problems* and *Action Now: Partnerships—Putting Technology to Work*. Among the options proposed in these reports were technology transfer from the Federal laboratories to state and local jurisdictions and to various public and private cooperative ventures, with the aim of speeding up the introduction of commercial products and techniques.

This theme had important adherents. In an address to Congress on science and technology in March 1972, President Nixon announced a new effort to improve the nation's economic well-being and quality of life. He called for partnerships among Federal labs, state and local governments, industries, universities, and other research organizations to apply Federally sponsored R&D to civilian needs. In his statement, Nixon said, "Federal research and development activities generate a great deal of new technology which could be applied in ways that go well beyond the immediate mission of the supporting agency."

Cooperative programs

Partly in response to Nixon's speech, the National Science Foundation established RANN (the Research Applicable to National Needs program), as well as the Intergovernmental Science and Public Technology and Community Technology Incentives programs. None of these has withstood the test of time.

One of the more promising programs promoting the use of government-backed R&D for product development in the commercial world is the Federal Laboratory Consortium for Technology Transfer. The consortium was organized in 1971 by 11 Defense Department laboratories to help move technology developed specifically for DOD to local governments and commercial companies. By 1974 it had expanded to include labs from other agencies, and since the enactment of the Stevenson–Wydler Act the consortium has consisted of almost 300 Federal labs from 11 different agencies. Part of the consortium's success is attributable to its unique structure. The act requires the lab directors to name research and technology application officers, who, as members of the consortium, seek to encourage transfers. In testimony before the House Science Research and Technology Subcommittee last May, the efforts of these lab technology-transfer officers were characterized as often limited, tentative and uneven. Witnesses said a smoothly operating, systematic technology-transfer process requires greater resources and commitment than the *ad hoc* consortium and the lab people have been able to muster. For this reason alone, supporters of pending bills in Congress sought to place the consortium in NSF, thereby giving it legal authority, funding stability and management structure.



Vertical-axis wind turbine, neglected for nearly 50 years, based on a design called a troposkien (from the Greek word meaning "turning rope") first proposed by a French inventor, D. J. M. Darrieus, is under development at Sandia Laboratories as an alternative energy source. Though laughed at as "egg beaters," the turbines offer advantages over standard horizontal-axis technology because they operate at ground level, adjust to wind shifts and can be built more cheaply.

The latest reexamination of the Federal laboratories dates from the appointment of Keyworth as the President's science adviser in May 1981. As a former leader of the Physics Division at Los Alamos National Laboratory, Keyworth had encountered firsthand many of the problems and issues facing the laboratories. When Keyworth arrived in Washington, a major review of nine Department of Energy multiprogram laboratories was already taking place. The ensuing report[4] by the Energy Research Advisory Board in 1982 clarified the roles of the DOE facilities and recommended steps to increase interactions with external groups to promote technology transfer to the private sector.

Packard panel sets the stage

Early that same year Keyworth commissioned a more broadly conceived review of the Federal laboratories and selected Packard to head it. The Packard report did not advocate the wholesale transfer of Federal laboratory programs to private industry, as some observers had expected it would, in keeping with the Reagan Administration's philosophy. Instead, the Packard panel took pains to define the R&D roles appropriate to the laboratories, going on to make recommendations consistent with the missions and functions of Federal research centers.

A Presidential panel argues for R&D partnerships

Only weeks after the Packard report reached the White House, President Reagan appointed a 30-member Commission on Industrial Competitiveness under the chairmanship of John A. Young, president of Hewlett-Packard. Its purpose was to identify how corporate America might more quickly and easily translate scientific research and technological innovation into commercial products, services and manufacturing processes and to recommend government policies to improve the nation's competitive position in world markets. The commission's report, *Global Competition: The New Reality*, recognized, among its many observations and conclusions, that US industry must make optimal use of the research capabilities and research results within Federal laboratories.

"One way is to increase R&D cooperation between Federal laboratories and specific industries," states the report, released last February by the Commerce Department. "As a result of discussions in this committee, the Office of Science and Technology Policy is leading an effort that has brought together national laboratories with expertise in materials science and the steel industry to generate leapfrog technology applicable to steel production." Steel is an industry that has been particularly plagued by the absence of innovation. Not coincidentally, the only government member of the Young commission was George A. Keyworth II, OSTP's director, who instigated the "steel initiative." "It is hoped this pilot effort will stimulate additional cooperative research between Federal laboratories and other industries that might benefit from Federal research," the report states.

The trouble, as the Young commission sees it, is that "government-funded mission-oriented R&D," as practiced in the Federal labs, "is not a major contributor to industry's ability to innovate and produce." For almost two decades after World War II, says the Young report, government agencies and laboratories abetted the commercial development of such prime innovations as computers, semiconductors and jet aircraft. "Today, however, industry has long surpassed the government as the main source of technological innovation, and the government has increasingly become a net user, not a provider, of industrial technology," the report argues.

Indeed, among its recommendations the Young report urges that nondefense Federal agencies require the labs to foster industrial competitiveness through their R&D and that a cabinet-rank Department of Science and Technology be created to "transform the current, fragmented formulation of policies for science and technology . . . and improve the management of Federal R&D in laboratories and agencies" under its jurisdiction.

—IRWIN GOODWIN

Among seven basic laboratory roles, the panel concluded, are the obligations to "build and manage large multiuser technical facilities and encourage industry and universities to use them," to "contribute . . . to the education of scientists and engineers in applied research" and to develop commercial products "only when that work has industry cooperation and is directly related to the laboratory's unique capability." Noting that these roles are intermediate between those of universities and industry, the Packard report went on to urge the laboratories, universities and industry to "fulfill their proper roles and complement one another, so that the research contributes to US leadership in technologies and products."

Nothing in the report's recommendations startled those familiar with policy issues relating to the labs. Apart from proposals to create a separate personnel system for the laboratories and to provide multiyear funding, there was nothing even controversial in the recommendations. Some critics maintained that the report added little new or useful to the national debate about the future of the laboratories. Indeed, the recommendations of the Packard report are similar to those made in the Bell report more than 20 years before. Both sets of conclusions, then, tend to reinforce the verdict that the Federal labs offer an exceptional source of R&D for commercial technologies.

Keyworth saw to it that the Packard study was followed immediately by a second inquiry designed to emphasize the report's recommendations and to gauge the responses to those recommendations by Federal agencies. Thus in August 1983, only a month after he had been briefed on the Packard recommendations, President Reagan directed OSTP and the Office of Management and Budget "to lead an interagency effort to respond to the central thrust of the report." During the spring of 1984 four working groups examined what progress the agencies and their labs had made in implementing the Packard recommendations. The groups compiled detailed status reports of the actions taken by all major Federal agencies. Accordingly, the sections of the overall progress report treating laboratory missions, personnel, funding and management deal largely with issues internal to the Federal government.

The issues considered by our Working Group on External Interactions, by contrast, involve universities and industry and may in that sense be considered of wider public-policy interest. The working group's assignment was not without its challenges. First of all, the Packard report is brief—only 12 pages long, apart from the summary and appendices—and consequently offers little or no detailed guidance in carrying out its recommendations. The working group also needed to interpret the recommendations in the light of the differences observed between the ways the laboratories interact with the universities on the one hand and with industry on the other. A third challenge arose from the disclosure, following the completion of the Packard report, of several irregularities in military procurement, such as $670 toilet seats for the Navy and $7000 coffeepots for the Air Force. Such cases threatened to affect Federal procurements generally.

Finally, the working group had to confront the great diversity of the Federal laboratory system itself. As a practical matter, the working group sought first to understand the fundamental features of external interactions of the most successful and productive laboratories, with a view toward framing recommendations applicable to the larger number of Federal laboratories. Although the working group consulted other reports dealing with external laboratory interactions, it found that the goals and recommendations enunciated in the Packard report were themselves the most useful points of departure for the task at hand.

Access to Federal labs

The Packard report recommended that Federal laboratories "should encourage much more access to their facilities by universities and industry." While industrial R&D firms perform some basic research and also develop military hardware, their main functions are to create, provide and sell useful products and services. It follows that the main reason to make laboratory facilities available to industry is to promote commercial development.

By contrast, access to the Federal laboratories by universities is likely to contribute fundamentally to strengthening a complementary relationship. Both laboratories and universities are committed to the search for an understanding of basic physical phenomena. They share needs for improved state-of-the-art research instrumentation, for instance. Moreover, laboratories are almost entirely dependent upon universities for the training of their management, administrative, scientific and technical staffs. Assistance to universities—and, more broadly, a strong interaction with educational institutions generally—therefore is in the self-interest of the laboratories, as well as in the national interest.

The working group found that implementation of the Packard recommendation for greater access to laboratory facilities has been widespread. Some Federal laboratories, such as the National Bureau of Standards, are renowned for their long tradition of providing access to external groups. Indeed, the record of achievement is impressive. Take the case of NBS's Automated Manufacturing Research Facility, which has been helping to develop the factory of the future with dozens of major industrial firms. NBS provides a test bed for both hardware and software systems—among these, robot vision devices that direct robot arms electronically, laser position-measuring devices that enable computers to direct tooling operations, instruments for detecting changes in sonic signatures that can anticipate drill failures, and near-field microwave antennas that simplify measuring and calibrating far-field radiating characteristics for satellite antennas and phased-array facilities.

Another instance of laboratory–industry partnership is taking place at Keyworth's suggestion: Argonne National Laboratory is forming an R&D venture with US Steel, Armco, Bethlehem, LTV and National Steel. The plan is for steel-company scientists and engineers to work alongside lab researchers developing new technologies to replace obsolete coke ovens and blast furnaces. Electromagnetic casting may be one way of improving products while cutting costs. The Argonne project is fundamental to Keyworth's "steel initiative," whose goal is to develop "leapfrog technology" that will not only help restore the industry's badly eroded position in world markets but also place it well ahead of foreign competitors. The idea is to develop generic technologies that the entire industry will share.

Soon after the steel project was proposed, Keyworth asked the national laboratories to identify ongoing or planned research that might benefit other ailing industries. Argonne suggested that its development of an adiabatic engine could help the farm-machinery industry. Soon afterward Caterpillar and John Deere Co spoke to laboratory officials about setting up some sort of research project in advanced engines, electronic controls and continuously variable transmissions. Unlike the steel initiative, the off-road equipment project will attempt to develop specific products rather than basic technology.

Increasingly, Federal labs are spawning grounds for new-technology ventures. In the 35 peacetime years of the Oak Ridge National Laboratory from its origin in the Manhattan Project of World War II until 1980, some 20 companies were launched with technologies developed by the lab. In the next four years, between 1980 and 1984, more than 30 spinoffs led to the formation of new companies.

Several venture-capital companies have been founded on R&D produced in Federal labs. For example, viruses and bacteria have been identified in minutes, rather than the days or weeks needed with existing methods, by a technique involving laser beams developed at Los Alamos in a project funded by the National Institutes of Health. Just as the lab set out to find companies that might want to acquire the new process, a Chicago venture capitalist happened to visit Los Alamos, seized upon the concept and raised enough money to develop a commercial prototype. He then organized a company, Mesa Diagnostics, with an exclusive license to market the technology.

The Solar Energy Research Institute has developed two prototypes of insulated glass—one using coatings that reflect heat and cold, the other using a vacuum rather than an inert gas between panes. Vacuum-insulated double-glazed windows, according to SERI, improve thermal insulation by a factor of 10 over conventional double-panel windows. SERI is now working with several companies interested in such technologies. SERI has also developed a technique for producing continuous ribbons of silicon for making photovoltaic cells. Exclusive license for the process has been granted to Arthur D. Little Enterprises, which is about to announce a fabricator for the ribbons.

The primary reason for such progress is easy to identify: Provision of access to facilities lies almost entirely within the jurisdictions and the means of the laboratories themselves. Given the freedom to act without the need for agency reviews, authorizations and approvals, laboratory directors and managers can rapidly and effectively provide the access envisioned by the Packard panel. There is still room for improvement, however. Many Federal laboratories have programs to promote personnel exchange, but the flow of laboratory scientists and engineers into educational settings remains weak. Some career laboratory staff members may spend 30 years or more within the same walls, never to refresh or upgrade their education or training at external institutions. In addition, much more could be done to bring students and faculty into the laboratories, where they would perform research in the national interest while simultaneously furthering their education and experience.

Many laboratories have attempted to hire more students and faculty but have been thwarted by the current system of quotas on "full-time-equivalent" employees. These personnel ceilings are intended to control the growth of Federal agencies. In practice, however, the full-time-equivalent quotas force laboratory managers to choose between temporary student and faculty hires, on the one hand, and retention of permanent laboratory staff on the other. At the least, the working group concluded, student and faculty hirings should be exempt from such quotas. Additional interchanges of personnel between laboratories and universities are also desirable at the senior level. Even if other circumstances are favorable, however, differences in pension benefits can work against such appointments. These impediments should be removed, the working group agreed. The foregoing conclusions led the working group to offer recommendations of its own:

- ▶ Collaborative relationships with educational institutions should be incorporated into the laboratory mission.
- ▶ Programs to provide students and faculty with opportunities to work in Federal laboratories should be expanded.
- ▶ Student and faculty job positions at government-operated laboratories should be exempt from full-time-equivalent personnel quotas.
- ▶ Programs to increase interchanges between university and laboratory personnel should be strengthened, particularly those that bring permanent laboratory staff to university and other educational settings.
- ▶ Legislation should be sought to permit retention of pension benefits for scientists and engineers who move between Federal laboratories and universities.

R&D interactions with industry

The Packard report recommended that R&D interactions between Federal laboratories and industry "should be greatly expanded by more exchange of knowledge and personnel, collaborative projects, and industry funding of laboratory work, provided an oversight mechanism is established to prevent unfair competition." The R&D interactions referred to, of course, are two-way

A bill for Federal labs gains speedy action

Few legislative bills have won so much political support as quickly as H.R. 3773. Introduced in the House of Representatives on 18 November by more than a dozen members, including Don Fuqua, the Florida Democrat who heads the Committee on Science and Technology, and Robert Michel, the Illinois Republican who is House minority leader, and incorporating parts of three other bills, it would amend the Stevenson–Wydler Technology Innovation Act of 1980 by authorizing government-operated laboratories to enter into joint R&D agreements with states and localities or corporations and universities. On 9 December, the measure was approved unanimously in the House and went to the Senate, where it is championed by the majority leader, Robert Dole, a Republican from Kansas.

Among its provisions, the bill requires the agencies to establish cash-award programs as incentives for Federal labs and their workers to produce discoveries and inventions that may be commercialized. The bill omits the most controversial issue of other proposed legislation: It does not require that government inventors get "at least 15%" of the royalties on any development licensed for commercial use—a reward formula that some, both inside and outside of government, fear may change the nature of much Federal laboratory work from basic studies to short-term research with potential commercial value. H.R. 3773 gives lab directors great flexibility to use the royalties or other income derived from inventions at their labs to reward their staff people as well as to spend such money for a variety of purposes, including advancing scientific exchanges among government-operated labs and educating and training workers.

H.R. 3773 would also institutionalize the Federal Consortium for Technology Transfer, placing it in the National Science Foundation. If the bill becomes law, the consortium, which now operates *ad hoc* within some 300 Federal labs to help move R&D into the wider world, would develop guidebooks, conduct seminars and serve as a clearinghouse for requests from states, businesses, universities and other private parties to foster technology transfer.

—IRWIN GOODWIN

in nature. Industrial experience, research results and management techniques might profitably be transferred in many instances to Federal laboratories. At the very least, industrial scientists and managers need to participate more fully in the initial planning of laboratory research programs.

The primary thrust of the Packard panel's recommendation, however, lies in the opposite direction—the transfer of technology developed in the Federal laboratories to business and industry. This view is shared by Congress, as evidenced by the Stevenson–Wydler Act and the bills now before it. The working group was impressed by the large number of instances of technology transfer already on record. We have referred to only a few in this article. The group nevertheless agreed with the Packard panel that Federal laboratories could do even more to transfer technology to the private sector.

Renewed efforts in this direction are required by the growing dependence of US industry on technology, the worldwide challenge to US industrial leadership and the ever-increasing sophistication and rate of development of technology itself. Progress toward transferring technology to industry has been less widespread and more uneven than progress toward greater access to lab facilities.

First of all, technology transfer is an inherently difficult process: It requires development of the technology itself, advancement of the technology to a stage permitting practical application and recognition by both the developer and potential user that a transition can occur (which itself assumes effective contact and communication between the two parties). Another set of difficulties arises from legal and policy issues lying outside laboratory jurisdiction and control—for example, the features of enabling legislation and, especially, Federal patent policy. Many of these issues are now being considered by the Department of Commerce, which has the chief responsibility for implementing the Stevenson–Wydler Act. Additional helpful proposals have been prepared by the Department of Energy in response to the ERAB report. These two currents of activity, together with the influence of the Packard report, appear to have produced a renewed commitment to technology transfer in most Federal agencies. The working group offered recommendations of its own to speed this process:

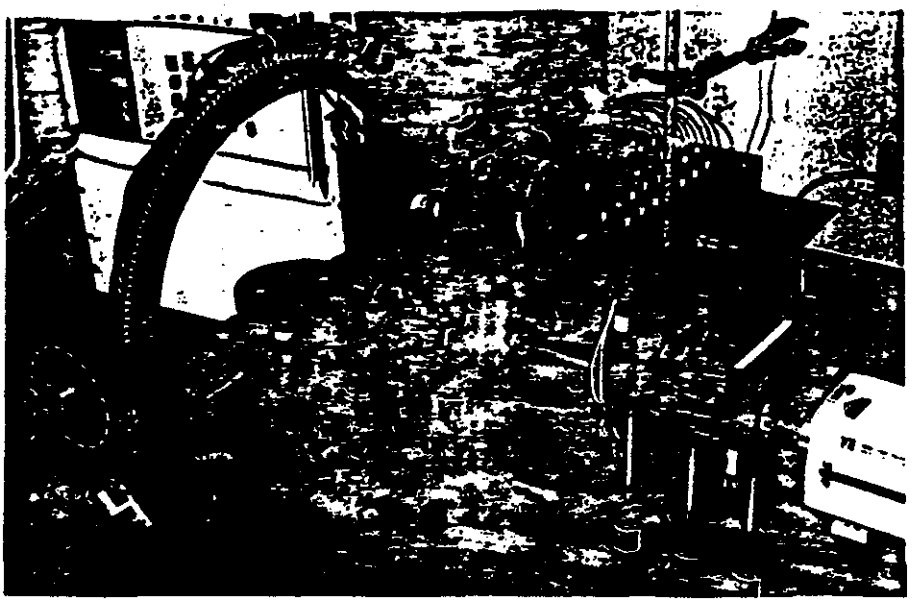
- Agencies and laboratories should promote means by which US industry can participate in identifying the nation's basic research needs.
- The transfer of technology to private industry should be incorporated into the laboratory mission so as to provide management focus and a positive environment for this work. Laboratories should involve industry in technology planning at the earliest appropriate time, strengthen techniques to determine the commercial potential of new laboratory technology, and obtain modest additional funds to facilitate the spinoff of laboratory technology.
- The authority of the laboratories should be extended to permit them to enter into a wide variety of cooperative research projects and to allow them to provide an incentive program for laboratory inventors.
- The authority of government-owned, government-operated laboratories should be extended to allow them to grant patent rights in existing or future inventions to industry, universities or nonprofit organizations.
- Organization incentives and training programs should be developed at the laboratories to promote technology transfer and the commercialization of laboratory research results.
- The Federal government should endorse the granting of patent rights in advance to all laboratory contractors.
- Guidelines should be established concerning the transfer of technology from Federal laboratories to foreign organizations.
- The Department of Commerce should draft proposals to ensure that implementation of the foregoing recommendations does not result in unfair competitive practices by the Federal laboratories.

A little perspective on these recommendations is in order. First, the working group concluded that industry should be brought into the process of technology transfer at the very beginning, when basic research needs at the laboratories are initially identified. Some laboratories appear to be making good progress toward this objective through use of advisory bodies whose members include industry representatives.

Second, it seems essential to make technology transfer part of the laboratory-mission statement in those cases in which this has not already been done.

The next four working-group recommendations offer more specific suggestions to speed technology transfer. As a practical matter, stronger incentives are needed for both partners in the technology-transfer process, but especially for industry. The working group benefited from the studies of both ERAB and the President's Commission on Industrial Competitiveness[7] in this connection.

Moreover, the working group recognized an acute need for guidelines on the transfer of technology to foreign organizations, particularly in areas that affect the nation's international competitive position. A balanced, two-way transfer is required, and knowledge gained from foreign organizations should be exploited to this nation's advantage.



Automated-manufacturing research at NBS. This device measures surface roughness: The semicircular array contains 87 sensors that monitor the light from a He–Ne laser scattered by the metal surface being tested.

Finally, the working group noted the need for procedures to preclude unfair competitive practices—a danger identified in the Packard report.

Simplifying Federal procedures

The Packard panel recommended that contracting by agencies and laboratories of universities and industry to conduct research and development "should be encouraged by simplifying the necessary Federal procurement procedures. The procurement process should give laboratory directors greater flexibility in contracting." The report reflects the widely held view that Federal labs would contract out more R&D work if it were simpler to do so. The working group concurred with this conclusion.

The Federal procurement process now requires some 135 000 employees to handle transactions through 1600 offices. Such transactions were governed through 1983 by 6300 pages of regulations. Fortunately, there is hope for progress in the form of a recent and thorough study of Federal procurement regulations by the National Academy of Public Administration. The recommendations advanced in the academy's report[8] appear to enjoy the widespread support of Federal procurement executives and to offer the best available approach to continued, systematic progress in this area. Accordingly, the working group concluded that it could do no better than to bring greater attention to the academy's findings. The action required would be government-wide and enormously complex.

Because revision of Federal procurement procedures lies entirely beyond the control of individual laboratories, and largely beyond control of the agencies themselves, only modest progress has been made since the Packard report. To make matters worse, the working group discovered that other factors can restrict the numbers of external contracts awarded by Federal laboratories. Poor management practices, such as an internal laboratory requirement for many levels of review and approval, can constitute a major barrier to the contracting process. On the other hand, laboratory directors and managers may often have quite legitimate reasons to retain significant fractions of R&D work in-house. In some cases, laboratories may be required by parent agencies to provide direct R&D support for regulatory processes. In others, directors may need to maintain a minimum level of expertise in various scientific and technical fields, simply to ensure that they can continue to be intelligent buyers of additional support services in those fields. These points need to be more widely understood by support contractors, who are apt to perceive the complexity of the procurement regulations as the sole cause of frustration or delay.

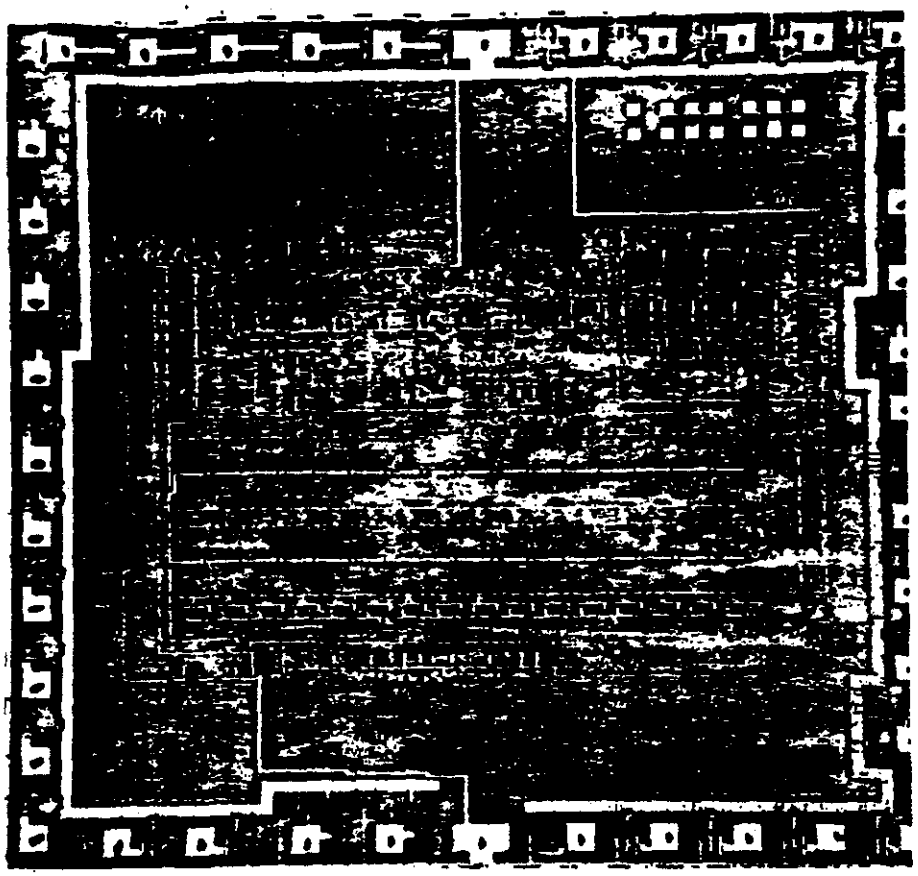
As it happened, a second major procurement issue arose during 1983, after the Packard report had been completed: the drive within the Federal government to foster greater competition among bidders for contract awards. This concern stemmed from accounts of irregularities in military procurements. By the time the working-group study was under way, this issue had eclipsed interest in the complexity of the procurement regulations themselves. In reaction, Congress began to consider legislation designed to restrict acceptance of unsolicited contract proposals and discourage award of sole-source contracts—measures that could seriously impede the procurement of basic research results from university groups.

The effort to broaden procurement competition had actually started somewhat earlier. For example, P.L. 98–72 was enacted in 1983 to improve small-business access to Federal procurement opportunities. This law requires that a proposed procurement of $10 000 or more be publicized in the *Commerce Business Daily*, with eight exceptions, one of which covers a "unique or innovative unsolicited research proposal, the publication of which would disclose original or innovative research." The working group learned, however, that this vital provision was being unevenly interpreted. Some procurement officials were choosing to require that all university proposals be advertised, arguing that they could not be expected to determine whether a given proposal was "unique and innovative" or not.

The danger of this development was compounded by various Congressional proposals during 1983 that would have treated the procurement of basic research essentially on a par with military hardware acquisitions. It appeared to the working group that the benefits of peer review, long used to weigh the value of proposals for basic research, were being overlooked in the debate on competition in procurement. Peer review is certainly a form of competition—albeit not the price competition appropriate to military hardware procurements—and this point needed to be made and understood more widely. Finally, the working group could not ignore the increasing delay between proposal submission and contract award observed in Federal agencies, even though the Packard report did not mention this problem explicitly. A fundamental timetable for basic university research is set by the academic calendar and the pace of graduate-school training. Significant progress on a research problem must usually be made within a matter of months. Such research cannot be sustained if the time required for a decision on awarding, rejecting or renewing a contract stretches to a year or beyond, as is now often the case.

Here, then, is how the working group's own recommendations stood at the conclusion of its task in May 1984:

▶ The Federal government should continue to support the 1983 recommendations of the National Academy of Public Administration, which are aimed at a systematic reduction in the complexity of Federal procurement regulations.



Radiation hardened against single-event upsets, this integrated circuit developed at Sandia Laboratories will be used in the attitude-control computer of NASA's Project Galileo spacecraft. Seen here is an enlarged slice of a 4-bit microprocessor, about 0.15 inches on each side and containing 2700 transistors. A single-event upset occurs when a high-energy particle passes through a transistor, causing a voltage surge that scrambles binary-digit information.

▶ Legislation and executive orders designed to increase competition for Federal contract awards should also protect the procurement of innovative basic research.

▶ The peer-review system should be defended as a form of selection appropriate to the procurement of basic research, meeting the concern for competition in procurement.

▶ All agencies should adopt the objectives of the National Science Foundation for the funding of basic research: a decision on award within six months of proposal receipt, a proposal length of less than 15 pages and the safeguarding of the technical proposal as the property of the proposer.

With respect to competition in procurement, at least, the story has a happy ending. University representatives and others brought their case to Congress, and provisions of the Competition in Contracting Act of 1984 are favorable to the procurement of basic-research from universities. The act broadens the definition of "competitive procedures" by including the selection by peer or scientific review of basic research proposals submitted in response to a broad agency announcement of interest. Because many, if not most, research proposals are already submitted in response to some agency statement of interest and reviewed in this way, the act nicely implements the working group's third recommendation.

The act also authorizes the use of "other than competitive procedures" in certain circumstances. Two are important to universities: the establishment or maintenance of an essential engineering, research or development capability at an educational or other nonprofit institution or Federally funded research and development center; and the funding of a unique and innovative research proposal through award of a sole-source contract. Taken together, these provisions should help to ensure the vitality of university research and the preservation of the present partnership of universities, industry and Federal laboratories in the national R&D enterprise.

In summary, the composite progress report compiled by OSTP does not include all of the points and recommendations made by the Working Group on External Interactions. However, many of the most important recommendations, together with suggestions of the other three working groups, appear in sections outlining "Future directions" that ought to be seriously considered by the Federal government. If these actions are taken, there appears to be the best chance in two decades that the reforms originally envisioned in the Bell report will actually be completed.

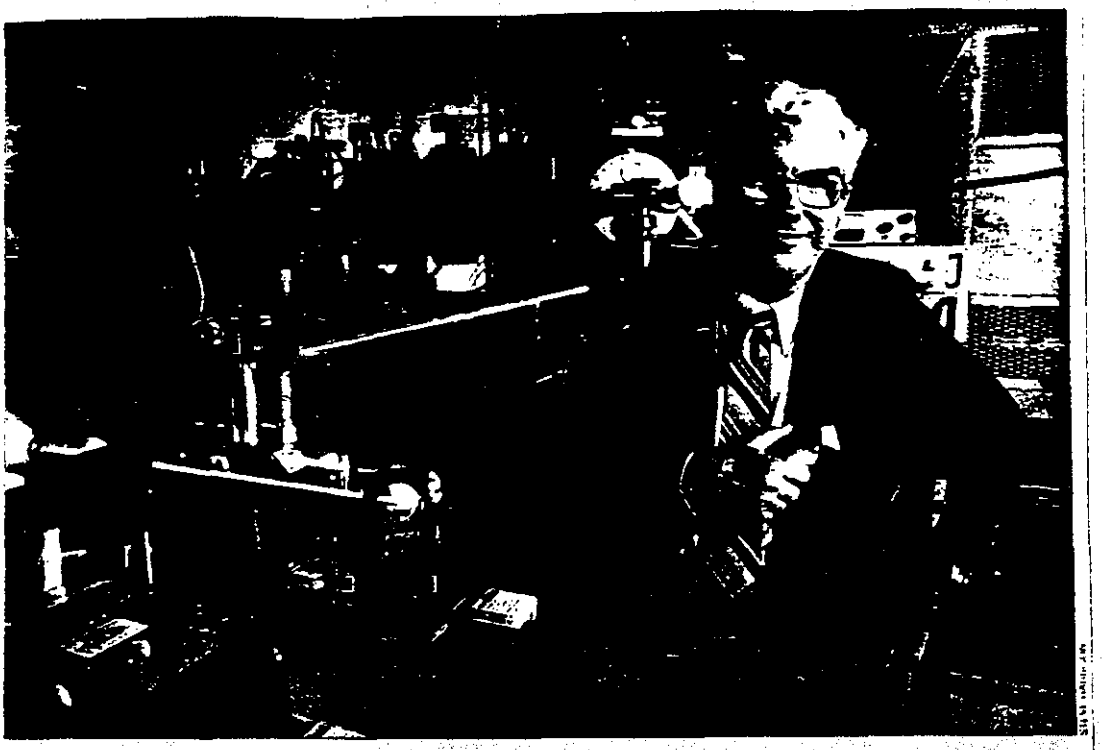
• • •

In addition to McDonald and Blanchard, the working group included the following members: Robin Brett (US Geological Survey, Department of the Interior), Philip Chen (National Institutes of Health, Department of Health and Human Services), Alan Claflin (Department of Energy), Don Ehreth (Environmental Protection Agency), James Hall (Department of Agriculture), Leslie Meredith (National Aeronautics and Space Administration), Donald Potter (Department of Defense), E. J. Richards (Department of Transportation), Howard Sorrows (National Bureau of Standards, Department of Commerce) and Jack Williams (Department of Commerce). Other regular participants were Norman Kreisman (Department of Energy) and Giora Pelled (Department of Defense, but affiliated with the National Science Foundation during the working-group study).

References

1. J. M. Wyckoff, ed. *Federal Laboratory Directory, 1982*, National Bureau of Standards (January 1983). See also H. Mark and A. Levine, *The Management of Research Institutions*, National Aeronautics and Space Administration (1984), for an excellent account of the history and operation of the Federal laboratory system.
2. *Report of the White House Science Council, Federal Laboratory Review Panel*, Office of Science and Technology Policy (May 1983). For an overview, see PHYSICS TODAY, September 1983, p. 39.
3. *Progress Report on Implementing the Recommendations of the White House Science Council's Federal Laboratory Review Panel*, vols. I and II, Office of Science and Technology Policy (July 1984).
4. See PHYSICS TODAY, December 1985, p. 20.
5. *Report to the President on Government Contracting for Research and Development*, Bureau of the Budget for Committee on Government Operations, US Senate (17 May 1962).
6. *Final Report of the Multiprogram Laboratory Panel*, vols. I-III, Energy Research Advisory Board, Department of Energy (September 1982). For an overview, see PHYSICS TODAY, January 1983, p. 59.
7. The President's Commission on Industrial Competitiveness, *Global Competition: The New Reality*, Government Printing Office (January 1985).
8. *Revitalizing Federal Management: Managers and their Overburdened Systems*, National Academy of Public Administration (November 1983).

NATIONAL LABS,



AT YOUR SERVICE

by Herb Brody

Forty years ago, World War II came to an end with the use of a terrifying piece of technology from new, top-secret government laboratories. Those facilities, at Oak Ridge, Tenn., Los Alamos, N.M., and a few other sites, have since grown into multipurpose "national labs" that perform wide-ranging R&D. While nuclear weapons still constitute much of their work, these labs are increasingly being enlisted to fight civilian battles. During the '70s the enemies were pollution and the energy shortage. The latest crusade: moving lab technology into the private sector to help restore the country's industrial competitiveness.

Closer collaboration with the private sector is helping to spawn new firms and shore up tired industries

The battle is being waged on several fronts. Patent policies, commonly cited as a major hindrance to commercialization of government technology, are loosening up. The labs now welcome private sponsorship for proprietary product development. A new exchange program lets companies send their technical people to work shoulder to shoulder with their colleagues at national labs, while the government picks up much of the tab. The labs are also being enlisted to apply their resources to aid struggling basic industries, like steel.

Until recently, the government took the position that the fruits of publicly funded R&D should be available equally to everyone. Thus any patent awarded for work at the labs became government property; the government then offered licenses to all interested U.S. companies for a small fee.

But these nonexclusive licenses discourage commercialization. Because the technology produced by the labs is unrefined—typically 90% of product development remains to be done when

Hal Schmidt (above) formed Atom Sciences with patents and consulting from Oak Ridge. "There aren't a lot of barriers now," he says.

therefore contributing insufficiently to the national good. The Packard panel recommended that the size of each lab be "allowed to increase or decrease (to zero if necessary) depending on mission requirements," adding that "preservation of the laboratory is *not* a mission."

A direct outgrowth of the report, and a striking example of how the labs can be channeled to industry's service, is the "steel initiative." The plan is to use the potent scientific and engineering talents of the national labs to perform basic research that the ailing steel companies cannot fund themselves.

Because of financial hardships, steel company R&D is "typically geared for results in six months to a year," explains John Roberts, associate director of Argonne National Laboratory (Argonne, Ill.), which will do much of the work. The companies recognize the magnitude of their plight. The steel initiative will look 10–15 years into the future, says Roberts; it is to be a collaborative project in which steel companies like U.S. Steel, Bethlehem, National, Armco, and LTV will send their scientists to work in teams with the lab scientists to solve problems jointly agreed upon. "Incremental improvements aren't enough" to restore the industry's badly eroded competitive position, says Reginald Dietz, vice-president for research at National Steel (Weirton, W.V.). "We're going after 'leapfrog' technology that will put us a couple of steps ahead." The labs will work not on proprietary projects but on generic technologies that the entire industry should share.

One thrust of the program will be to find new ways to convert iron ore into liquid metal, bypassing the expensive coking ovens and blast furnaces now used. Another focus will be on casting the liquid metal into pieces close to the dimensions of the final product. One possibility is to use powerful, precisely shaped magnetic fields to confine the molten metal so it can be cast into thin sheets, obviating the need for strip mills to flatten thick billets. The technology loosely resembles that being developed to confine hot hydrogen gas for controlled nuclear fusion. Oak Ridge, which has a long-standing program in fusion, will contribute its magnet expertise to the problem of casting steel.

Shortly after the steel initiative was organized, George A. Keyworth II, Reagan's science advisor, asked the national labs to identify other industries that might benefit from a similar effort. The result was a proposed project for applied research on off-road machinery. In March, Argonne met with several manufacturers to determine which technical issues were appropriate for cooperative action. The resulting list includes advanced engines, electronic controls, and continuously variable transmissions. The lab hopes to begin work in fiscal 1987.

Unlike the steel initiative, the off-road equipment project will aim to develop specific products rather than basic technology. To make this work, the labs will have the liberty—unusual for the government—to keep proprietary secrets. "We won't have to tell Deere what we're doing with Caterpillar," says Argonne's director of technology transfer, Brian Frost.

Increasingly, the national labs are becoming spawning grounds for technology-based start-ups. From Oak Ridge's inception during World War II until 1980, about 20 companies started up with technology developed at the lab, according to technology transfer manager Donald Jared; in the following four years, he says, there were more than 30 such spinoffs.

A glass devised to encapsulate nuclear waste may be adapted for lens making by an Oak Ridge start-up.

Some of these new companies are formed under arrangements that would have been unheard of a short time ago. Perhaps the most dramatic example comes from Los Alamos. Scientists there developed a way to identify viruses and bacteria in minutes, rather than the days or weeks needed with existing methods. A laser illuminates the sample with a beam that alternates between two kinds of polarization, and a detector senses the difference in how one polarization is scattered relative to the other. This difference, it turns out, correlates with certain features of the specimen's DNA molecule.

The procedure was invented at Los Alamos in a project funded by the National Institutes of Health. NIH had no interest in commercialization, though, and ceased its support while the device was still far from market readiness. The lab began looking for companies to acquire the technology. When David Silver, a Chicago venture capitalist, came to Los Alamos in 1983 in search of technologies ripe for commercial exploitation, the rapid analyzer stood out.

Silver raised $8.5 million through an R&D limited partnership with Prudential-Bache Securities (New York) and gave half the money to the lab to develop a commercial prototype. The partnership (a tax shelter to encourage investment in technology) acquired full ownership of the technology and then granted an exclusive license to a new company, Mesa Diagnostics (Los Alamos). Mesa is wholly owned by Silver's venture capital firm, the Santa Fe Private Equity Fund.

It is a curious reversal of conventional practice, with the big government lab working for the small company instead of the other way around. The partnership pays the lab for use of its staff during regular hours and hires lab scientists as consultants after hours. "It's cheaper than hiring our own staff," says John Lonergan, Mesa's chief financial officer and vice-president for marketing.

It took two years to put the radical deal together, according to Eugene Stark, the lab's industrial liaison officer. The main hang-up was the patent. DOE had to waive its title to the University of California (which operates the lab), and then the university had to waive its title to Silver's partnership. Eventually, 11 contracts were needed to cement the agreement, according to Silver.

While the Mesa deal is unusual in its magnitude, it is one of a growing number of cases in which a small company is launched with national lab technology that would not have been available under old policies. For example, Keltus (San Carlos, Cal.) bought into the sensor business with an exclusive license to the technology of remote fiber fluorimetry developed at Lawrence Livermore National Lab.

DAVE VANDEVEER

Sandia's Stromberg (left) says companies now "realize it's worth bothering" to work with national labs. The ailing steel industry looks to the future by collaborating with the labs in developing radical steel-making methods, says National Steel's Dietz (above). Venture capitalist Silver (top) struck an unusual deal: His new company hired Los Alamos to develop a marketable product.

Westinghouse with a bid that heavily emphasized industrial participation and strengthening the local economy.

"We proposed doing business in a new and different way," says Carpenter at Martin Marietta Energy Systems, the subsidiary formed to handle the lab contract. For example, Martin Marietta has asked DOE for ownership of all patents the company deems to be of commercial potential—an "advance waiver of title" that would let Martin Marietta act with autonomy. As owner of the technologies devised at Oak Ridge, the company would grant other firms exclusive licenses to bring the inventions to market. Although DOE has not yet granted this waiver, Martin Marietta has begun negotiating license agreements with other companies in anticipation. "When the word comes, we'll be ready to go," says Carpenter. "We expect to have some home runs."

Martin Marietta also strongly encourages the Oak Ridge technical staff to serve as consultants—to "get our smarts out into the private sector," as Carpenter puts it. In contrast, Union Carbide had put a ceiling on how much a lab scientist was allowed to earn on the outside; some other national labs, particularly Sandia, continue to enforce tight restrictions on off-hours consulting.

In another shift, Oak Ridge now welcomes private sponsorship of proprietary R&D. A number of companies, including Cabot (Boston), Homogeneous Metals (Clayville, N.Y.), and Universal Cyclops (Bridgeville, Pa.), are paying the lab to develop a new class of alloys with a unique property. Unlike most metals, which get weaker as they heat up, these "ordered intermetallic alloys," such as nickel aluminides, get stronger. This property is especially useful for engines, which operate most efficiently at higher temperatures. Present nickel aluminides are barred from structural use by their brittleness. Oak Ridge is working on ways to increase ductility and has obtained dramatic improvements by adding small amounts of other materials, such as boron.

Martin Marietta has also made a significant commitment to accelerating the growth of the local economy, having allocated 10% of its annual contract fee (for running the lab) to launching new companies. (The fee ranges from $5 million to $20 million, depending on Martin Marietta's performance.) In addition, the company has promised to build a 290-acre industrial park near the lab. The first tenant will be the Tennessee Innovation Center, a new subsidiary that will invest in and "incubate" high tech start-ups. The center is co-owned by Tran Tech Systems (Salt Lake City), which runs the similar Utah Innovation Center.

The Tennessee Innovation Center, a for-profit organization, identifies promising technologies at the national lab and "does everything necessary to make them commercially successful," says vice-president Melvin E. Koons. The center makes equity investments, typically of $50,000–$150,000, for start-ups that satisfy several key requirements—a product or service on the cutting edge of technology, potential for generating revenues of $7–10 million in 5–8 years, and a promise to locate in Oak Ridge.

The center tries to find commercial uses for inventions geared to specific government purposes. For example, a new lead-iron phosphate glass was de-

At Last—A Reagan Technology Policy?

The President's Economic Policy Council has a program to stimulate R&D and stop the stealing of U.S. technology.

by John M. Barry

For close to a decade, the attitude of several Presidents toward encouraging research and innovation resembled what Mark Twain said about the weather—everybody talked about it, but no one did anything about it. But a fistful of technology-related initiatives, first raised in the Carter Administration and recommended by the Reagan Administration's task force on global competitiveness headed by Hewlett-Packard Corp. Chairman John Young, were recently endorsed by the White House Economic Policy Council, the President's top domestic policy group. This means that action is on the way.

The recommendations involve both domestic and trade policy. On the domestic side, one of the most significant proposals is to exploit the research done in federal laboratories, which spend $17 billion in R&D funds annually and employ about one-sixth of all American scientists. The idea is to speed technology transfer to the private sector by letting these labs cut their own deals with business on the rights to their technological breakthroughs. Such a sea change, supporters say, would sprout dozens of Silicon Valleys and Route 128s around the more than 300 federal labs.

The House has passed a bill giving such power to the federal labs. In the Senate, Majority Leader Bob Dole backs the bill, but wants to guarantee the inventor 15% of the royalties. Companies that treat their inventors less generously are lobbying against this provision—but not the bill. It's likely a compromise will be worked out this year.

The Economic Policy Council also endorsed two initiatives of National Science Foundation chief Erich Bloch. One is that federal agencies encourage the building of university-based multidisciplinary science and engineering centers. The second would restructure the R&D tax credit to make it more attractive to business. The proposal comes at a time when the House tax bill extends the credit for only three years while cutting it to 20% from 25%. The EPC initiative, however, could help keep the credit at its current level and make it permanent.

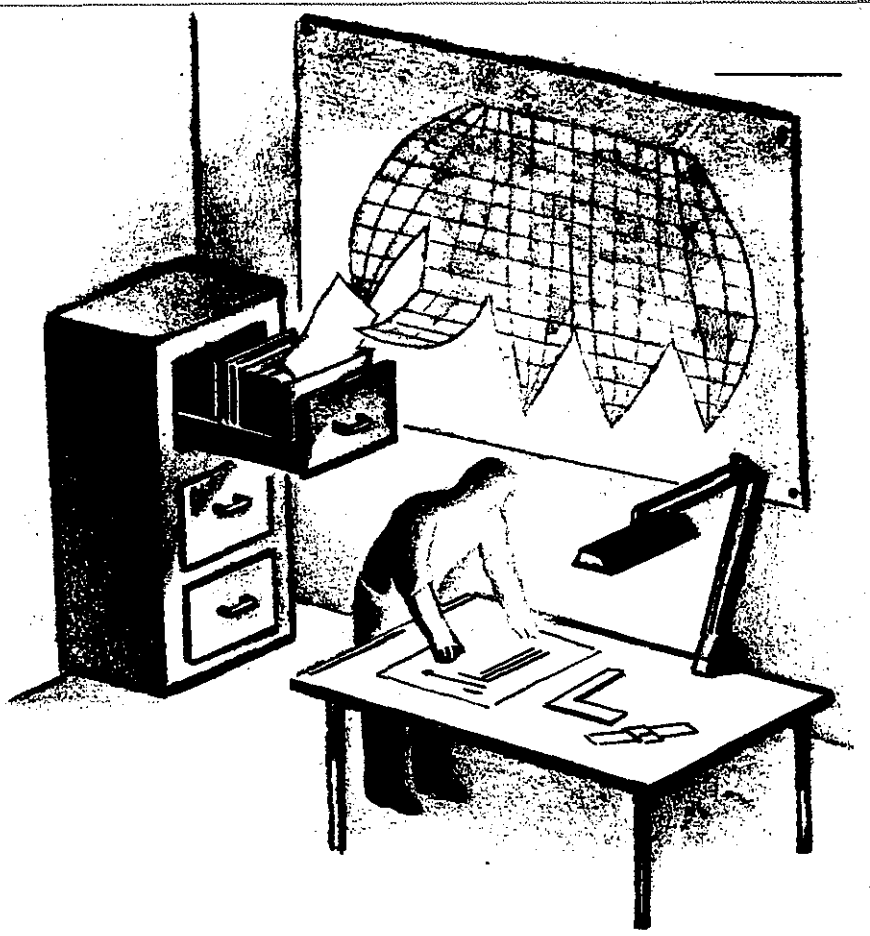
Lastly, the EPC proposes that ownership of software and technical data developed under government contract be granted to contractors, with the government using it royalty-free. This proposal overrules the Pentagon, which wants to use such data to set up second source suppliers to compete with the company that developed the data in the first place. The fight over this issue has only begun.

On the trade front, the EPC recommends that the U.S. pursue an aggressive bilateral strategy with key countries. The most important issue is what U.S. industry regards as theft of "intellectual property," including patents, copyrights—of software and microchips as well as books—and trademarks. Notes one lobbyist active on the issue: "I've been pounding away on these things for a dozen years. All of a sudden, agencies are tripping over each other to get part of the action."

Incensed by the stealing of its property, American business has been in an ongoing war over technology policy with almost all the Third World countries. Indonesia, for example, has no patent protection at all, and few developing countries enforce "process patents" (patents on the way a product is made). Korea, among others, prohibits patenting any chemical compound and denies copyright protection to software, semiconductors or foreign works. The Commerce Department estimates Korean infringement on U.S. intellectual property costs companies $700 million a year.

Pfizer, Inc.'s experience in Argentina typifies U.S. business' patent problems in the Third World. Just three weeks before Pfizer was to introduce its antiarthritis drug Feldene into Argentina in 1980, an Argentine company began producing the same product. Four years later, twenty Argentine firms were producing generic equivalents to the tune of $17 million in sales. Pfizer's sales were only $1.6 million.

Still another issue that incenses U.S. companies is forced technology transfer. Most Third World nations prohibit the import of many technologies to force the company to build a local plant. Another gimmick is to require an importer of technology to license local companies to use that same technology for modest fees. Even Canada engages in this, and, after prodding by U.S. manufacturers, President Reagan personally raised the issue with Prime Minister Brian Mulroney at their last meeting. But Ottawa has not changed its stance.



The Administration has made some tangible progress in pressuring U.S. trading partners to stop stealing American technology. The drive is being sparked by Special Trade Representative Clayton Yeutter, who is a member of the Economic Policy Council. Last fall, the White House initiated a complaint under the Trade Act of 1974 against South Korea for unfair trading practices, and Yeutter is threatening Taiwan with one. Says Yeutter: "Intellectual property issues have high priority. It's not a twenty-first-century problem. It's an immediate problem."

Yeutter was given another powerful club when Congress mandated in 1984 that intellectual property should be a consideration in granting Generalized System of Preferences trading benefits. These are breaks that the U.S. grants to help Third World nations. The biggest infringers of intellectual property, trade experts say, are also the biggest beneficiaries of GSPs.

The White House's longer-term goals include putting patent and copyright issues on the agenda for the next round of trade negotiations, and possibly creating a joint patent system with other nations. Currently, patents have extraterritoriality only in Europe, which set up a joint system in 1978.

The EPC also wants to change the U.S. law, which makes it much tougher to enforce process patents against imports than against domestic products. A patent holder must only prove infringement to win in court against a U.S. company. But against a foreign firm, a patent holder must prove to the International Trade Commission not only infringement, but also that the infringement substantially injures the U.S. industry and that restrictions are in the public interest.

Process patents are critical to the biotechnology industry, which often makes old, nonpatentable products in new ways. But biotech is not alone. Corning Glass has a process patent covering fiber optics, which the ITC conceded was being infringed by the Japanese, although it denied the company protection because it couldn't substantiate the other criteria.

Companies pushing for greater protection of intellectual property insist that without it they can not afford huge R&D budgets. Roy Massengill, Allied-Signal Corp.'s patent counsel, worries about patent infringement of a new amorphous metals technology the company spent $85 million and fourteen years to develop. He is leading an industry coalition lobbying Congress to tighten the law to make enforcement of process patents easier. The effort should pay off this year. The measure likely to emerge from Congress will probably grandfather current infringements, but it will make it far easier to protect future patents.

Gerald Mossinghoff, head of the Pharmaceutical Manufacturers Association, likes the Reagan initiative and is optimistic that Congress will act on domestic policy. But he is pessimistic about the trade issues and believes that the Third World will wage a guerilla war against U.S. efforts to protect intellectual property.

But what most concerns even admirers of the Reagan effort is the dramatic shift of federal R&D money from basic research to the Pentagon. Last year, about 70% of federal R&D funds went to Defense, up from only 47% in 1980. Worries the president of a company that devotes massive resources to R&D: "The critical mass for technological development comes from basic research. No business really funds that. Right now, I'm afraid we're eating our seed corn."

If that's the case, all the reforms in trade policy and patent law won't stop the erosion of the nation's competitiveness. ■

ILLUSTRATION BY DAVID SUTER

PATENT POLICY CHANGES STIMULATING COMMERCIAL APPLICATION OF FEDERAL R&D

E. Jonathan Soderstrom and Bruce M. Winchell

Ability to offe. exclusive licensing agreements should generate increasing interest in federal laboratory technologies among industry.

Even though the federal government is both a primary supporter and a major performer of R&D, only a small fraction of the results of this research is finding its way into commercial applications. One example of this trend is the fact that less than 5 percent of the nearly 30,000 patents owned by the federal government are licensed for commercial use. This statistic is a reflection both of the fact that many government patents have little or no commercial value, and that agencies have made little effort to seek private sector users for even their most important commercial inventions. As this paper will discuss, the patent policy of the United States government continues to undergo dramatic changes in efforts to stimulate the increased commercial application of technologies developed by federally-sponsored R&D.

The growing realization that the laws governing the ownership of patents were a major barrier to the commercial application of government-sponsored research has prompted the Congress to enact major changes in government patent policies. The latest change occurred on November 9, 1984 when President Reagan signed into law the Federal District Court Organization Act of 1984 (P.L. 98-620). This law contains the third major change in government patent policy since 1980. Each new initiative was aimed at increasing access to the results of federally-sponsored R&D and promoting cooperative R&D between public institutions such as universities and industry.

The first major change was enacting P.L. 96-517, the so-called Bayh-Dole amendments to the Patent Act. This Act established the general rule allowing non-profit organizations and small business government contractors in most instances to retain title to inventions conceived while under contract to the federal government to conduct research. The Act also included an initial effort to set up rules for exclusive, royalty-bearing licensing of federal inventions. Contractors could either further develop the inventions themselves or work with a licensee to transform the invention into a viable commercial product. Thus, because it held the potential for significant economic gains through licensing and new product development, this law represented the first attempt to provide universities and small businesses with an incentive to promote inventions made under federal contract.

In contrast to agency practice, major research universities that produce a significant number of inventions now report that they are careful to invest in patent protection only for the ideas that appear to have significant commercial potential, and then actively promote their licensing. As a result, these universities are able to obtain royalty-bearing licenses for about 35 percent of their patents.

The experience from the first two years under the Bayh-Dole Act was positive enough to lead to the second major patent policy initiative. President Reagan issued an Executive Order on February 18, 1983 to expand the scope of P.L. 96-517. This order states in part:

To the extent permitted by law, agency policy with respect to the disposition of any invention made in the performance of a federally funded research and development contract, grant or cooperative agreement award shall be the same or substantially the same as applied to small business firms and nonprofit organizations under [the provisions of P.L. 96-517].

In awards not subject to [the provisions of P.L. 96-517], any of the rights of the Government . . . may be waived or omitted if the agency determines (1) that the interests of the United States and the general public will be better served thereby as, for example, where this is necessary to obtain a uniquely or highly qualified performer; or (2) that the award involves co-sponsored, cost sharing or joint venture research and development, and the performer, co-sponsor, or joint venturer is making substantial contribution of funds, facilities or equipment to the work performed under the award.

This order would appear not to leave much room for discretion and require virtually every federal agency to give patent rights to contractors in most instances. However, because over 20 varied patent statutes and provisions are in effect for different agencies, a uniform federal patent policy could not be established by Executive Order alone.

Jon Soderstrom is director-technology applications for Oak Ridge National Laboratory at Martin Marietta Energy Systems. He is responsible for identifying technologies developed at the Laboratory with significant commercial potential, negotiating licenses for the commercial exploitation of patents granted on these technologies, and the start-up of new business ventures based on Laboratory developments. Prior to assuming this position in 1984, he was group leader of the Technology Transfer Research Group in the Energy Division of Oak Ridge National Laboratory, focusing on research on innovation, entrepreneurship, and the commercial exploitation of government R&D. Bruce Winchell is a licensed member of the Ohio, the Tennessee, the U.S. Patent and Trademark Office, and the Canadian Patent Office bars. He is General Patent Counsel for Martin Marietta Energy Systems, Inc.

Amendments to the Bayh-Dole Act

By taking precedence over many of these existing pieces of legislation, the amendments to Title 35 of the U.S. Code embodied in P.L. 98-620 represent another step toward a more uniform patent policy. While the Act calls for relatively minor changes in the language of the Bayh-Dole Act, the provisions should provide a significant incentive to establish active technology transfer and patent programs that may lead to the commercialization of the research conducted at the national laboratories.

In particular, with regard to the disposition of patent rights, Congress deleted a primary exception in the Bayh-Dole Act which restricted patent ownership at government-owned, contractor-operated (GOCO) research or production facilities. Congress, with these amendments, submitted a different exception relating only to foreign contractors instead of GOCO contractors. Thus, by this one rewriting of a critical exception in the disposition of rights portion of the Act, Congress opened the door for GOCOs to also directly obtain ownership of their patents.

GOCOs can obtain the rights, however, only if they can fit within the definitions of the Bayh-Dole Act. The pertinent point of the definition is that the GOCO must be a small business firm or a nonprofit organization such as a university or other institution of higher education. Congress thus allowed all nonprofit- or university-type GOCO operations to obtain the patent rights in an effort to greatly expand the transfer of technology developed through the activities of government-owned R&D facilities.

For-profit GOCOs such as Martin Marietta Energy Systems, operators of Oak Ridge National Laboratory, were excluded from this legislation. Some members of Congress expressed concern that big business GOCOs would try to maintain ownership of especially promising ideas and not make them available to potential competitors. In passing P.L. 98-620, however, Congress requested federal agencies to issue regulations as quickly as possible to provide for arms-length dealings between the contractors' subsidiaries running the government facilities and those developing commercial products.

On February 5, 1985, Department of Energy Secretary Donald P. Hodel signed a new Departmental patent policy. The policy states, in part:

It is the policy of the Department to allow contractors to retain title to inventions to the maximum extent possible consistent with the President's Memorandum on Patent Policy, applicable statutory authority and mission requirements.

This new patent policy extended the provisions of the recent patent legislation to for-profit contractors. Thus, all Department of Energy GOCOs now maintain ownership of inventions arising from federally-supported research conducted at their facilities.

In addition to granting patent rights to GOCOs, this legislation and policy directives removes some restrictions with regard to the length of the exclusive licenses that can be granted, and allows agencies to require outside parties to pay royalties for the right to use government inventions. The five-year licensing period restriction was removed and replaced with other requirements. These requirements relate to the distribution of royalties received from licensing agreements. The requirements are intended to provide incentives to participants in technology development to engage in technology transfer activities.

Incentives to license patents provided labs by recent legislation has encouraged them to become more aggressive in transferring their technologies to the private sector.

First, royalties or income earned by the contractor with respect to licensing inventions are to be used to cover expenses incidental to patenting and licensing the inventions. Second, to provide an incentive for inventors to participate in the transfer of the technology, the Act contains an additional requirement to share royalties derived from a patent licensing agreement directly with the inventors.

After payment of the patenting, licensing, and other expenses for the administration of the inventions, however, the balance of any royalties or income earned and received by the contractor is to form a discretionary fund. This fund is intended to provide an incentive to laboratory directors, since commercialization of inventions is tangential to the laboratory's primary mission, and can create a manpower drain on that mission. The fund is to be used by the contractor for scientific research, development, and education consistent with the R&D mission and objectives of the facility. Allowable expenditures would include activities such as advanced applications engineering that increase the licensing potential of other inventions of the facility.

A cap was placed on the amount of revenues accruing to this fund so that the laboratory mission would not become skewed by such an endowment-like source of funds. If the balance of the fund exceeds 5 percent of the annual operating budget of the facility, then 75 percent of the excess would be returned to the U.S. Treasury, with the remaining 25 percent to be used for the same purposes as described above. In any event, this fund will increase as royalty income increases. The intention of Congress,however, is clearly for the funds to be restricted to uses that will lead to the development of additional technologies and fostering additional technology transfer to the private sector.

It is important to note that Congress expressly stated that to the extent it provides the most effective technology transfer, the licensing of inventions shall be administered by the contractor employees on location at the facility. Such decentralization of authority to administer patent portfolios was considered important because the contractors have the most interest and incentive in transferring technologies.

The Secretary of Commerce was assigned the task of issuing the implementing regulations under P.L. 98-620 which were published for comment in the Federal Register on April 4, 1985. The proposed Commerce regulations closely follow OMB Circular A-124 except where mandated by P.L. 98-620. Those regulations had not been finally issued at the time this article was being written. The Department of Energy has worked out the implementing language of proposed class waivers that would be used for the operation of this program in the DOE. These waivers are expected to be issued after the final issuance of the Commerce regulations.

Experience with university contractors has shown that the organization conducting government-sponsored research is most likely to move the results of this development activity to the marketplace. Such movement is possible, however, only when the contractor conducting the research has the incentive provided by controlling the ownership of patents on inventions and the right to enter into royalty-bearing licensing agreements. The prospects offered by P.L. 98-620 for financial return to the laboratories and staff from licensing agreements should provide a stronger incentive in making technologies more readily available to industry. The intent of Congress in enacting this legislation was clearly to provide GOCOs with the same incentives to establish active technology transfer and patent licensing programs which would encourage the use of the results of government-sponsored R&D from federal laboratories. Through these efforts, technologies with significant commercial potential are more likely to be brought to the attention of industry in an efficient and productive manner.

The incentives to license patents provided laboratories by this recent legislation has encouraged them to become more aggressive in transferring their technologies to the private sector. In the same manner, the support and protection afforded by removing questions about the ability of GOCO laboratories to control their patent portfolio should provide companies with motivation to become more interested in commercializing the results of federally-funded research.

For example, Oak Ridge National Laboratory has already entered into three licensing agreements and is negotiating about six additional since it began receiving rights to patents in mid-1985. One of these licenses was to Cummins Engine Company for the exclusive right to use in heavy duty diesel engines a new alloy developed at Oak Ridge. As a further example, Mesa Diagnostics, a new company, was formed to develop and market a series of specialized diagnostic instruments invented at Los Alamos National Laboratory. Mesa received exclusive rights to the inventions under the provisions of P.L. 98-620. Research staff from the laboratory are consulting for the new company. An $8.5 million R&D limited partnership has been formed to assist the company in further developments, and the partnership will invest $4.3 million to support research at Los Alamos to expand the family of technologies to be marketed by Mesa. (See "R&D Limited Partnerships Are Starting To Bridge the Invention-Translation Gap," p. 9 this issue.)

Increased Industry/Laboratory Cooperation

The ability to offer exclusive licensing arrangements should generate increasing interest in federal laboratory technologies among industry. In many cases, industrial firms are first attracted to a laboratory by interest in an existing invention. These inventions often require additional development before becoming marketable products. The federal laboratory where the technology originated, because of its unique understanding of the development, may be viewed as the best place to conduct the follow-on work. In such situations, industrial firms may wish to enter into cooperative arrangements to further develop the invention.

For this reason, a new series of bills have been introduced to amend the Stevenson-Wydler Technology Innovation Act (P.L. 96-480) giving federal labs greater authority to enter into joint agreements with private parties. The proposed legislation, S. 1914 and H.R. 3773 (prior bills were S. 65, H.R. 695, and H.R. 1572), is targeted at federally-operated laboratories like the National Bureau of Standards. It would grant these laboratories the same rights to transfer technology and enter into technology development pacts as P.L. 98-620 granted to GOCOs. H.R. 3773 passed the House of Representatives on December 9, 1985. Senate passage of these provisions would continue a five-year effort by the Reagan Administration to improve industry's access to government laboratory inventions and facilities. Although the Senate version contains provisions for inventor royalty sharing similar to those included in P.L. 98-620, the House rejected these provisions related to federally employed inventors as inappropriate for government-wide implementation.

More important, however, this legislation would allow the heads of federal agencies to authorize their laboratories to enter into a broad range of cooperative R&D programs with other federal laboratories, units of state or local government, industrial organizations, universities, or other organizations or individuals, including licensees of laboratories' inventions or general partners of R&D limited partnerships, when there is mutual interest. These cooperative R&D programs must be consistent with the missions of the laboratories. The primary purpose of these agreements, however, is to stimulate or support development of technologies originating in the laboratories.

Such collaboration is certain to lead to future inventions. Because all parties need to be clear on the ownership of inventions before work begins, efforts to establish cooperative agreements have been hindered by the uncertainties over the disposition of future patent

rights and the attendant delays of 12–24 months waiting for approval from agency headquarters. Theoretically these decisions can be made by the government, but in practice they are difficult and time consuming. Often, no decision is made either because the company grows frustrated and loses interest in the project, or the market opportunity to capitalize on the project passes.

Together with the right to enter into licensing agreements, federal laboratories would have greater freedom in making some very important and difficult decisions. This legislation would allow laboratories to negotiate the conditions for the cooperative venture directly with industrial firms and assign rights in future inventions to the outside parties. This provision should help to eliminate many of the delays and uncertainties companies have experienced in the past when attempting to enter into a collaborative agreement with a federal laboratory. Thus, industry will have a single non-government entity with the authority to reach intelligent and equitable decisions, and the ability to implement such decisions within a time frame essential to industry to make the technology commercially viable and attractive.

These incentives should help to promote closer linkages between the laboratories and industry. Such linkages are essential if the results of federally-sponsored R&D are to be applied in the commercial, as well as the government, sector of the economy. Collaborative research between industry and federal laboratories permits cross fertilization between laboratory and industry scientists which result in the generation of new ideas and technologies that enhance the productivity of both organizations.

Proposed legislation would allow labs to negotiate the conditions for a cooperative venture directly with industrial firms and assign rights to future inventions to the outside parties.

Cooperative ventures with industry will help the federal laboratories to become more fully integrated into the nation's economy. These laboratories are a vast resource of new technology that can lead to new products and processes. Only when these developments are exploited in the commercial sector, however, can the nation be certain that it is receiving the maximum utilization of the national scientific and technical resource that the federal laboratories embody. The increased integration of such a vast technical resource will facilitate achieving the goal of enhanced economic productivity through technological innovation. □

The Washington Post
Thursday, October 16, 1986

PETER BEHR

Plugging the U.S. Knowledge Leak

The United States has quarreled with its trading partners over autos, TV sets, oranges, steel bars and semiconductors. Next comes a battle over knowledge.

The protection of American inventions, laboratory research and intellectual property from unfair exploitation has moved to the top of the Reagan administration's agenda for the next round of international trade negotiations.

It also has become a prime issue for leaders of universities and government labs, who argue that the basic research at their institutions constitutes America's best remaining competitive edge in world trade.

There are now suggestions that some of that research be put off limits to foreigners or that access be limited, at least temporarily. Call it a "buy American" approach to government-funded research and development.

Richard M. Cyert, president of Carnegie-Mellon University—one of the nation's centers of research on advanced industrial processes—says the competitive importance of the U.S. research establishment must be recognized.

"The United States, in my view, is in an analogous position to being on the frontier in colonial times. We really are fighting for our economic life. Unless we are able to do some things in universities to help in this, I think our whole way of life, our whole standard of living in this country is going to go down the drain."

Cyert said he would be willing to consider a proposal that would boost federal research support for American universities—with the requirement that the research work be restricted to U.S. citizens.

"I'd be interested in it, if we limited the period . . . . I'd be willing to go along with that for a little while. I'm sure it would be unpopular, in the sense that we like to think of ourselves as world citizens.

"It's obviously something I'm uncomfortable with. . . . But we want to have America get some temporary advantage from the research that we can do. . . . The notion that somehow you want to do something for your country should not be something that a university president is ashamed of," said Cyert.

Congress is not considering such a proposal. But it has approved and sent to President Reagan

See BEHR, E2, Col. 4

BEHR, From E1

legislation called the Federal Technology Transfer Act of 1986.

The bill's main purpose is to help American companies, universities and other institutions tap research in the nation's 700 federal laboratories. The labs would be authorized to enter into cooperative joint research arrangements aimed at speeding their technology into commercial use.

Foreign companies aren't prohibited from joining in such cooperative ventures, but preference is to be given to American firms that agree to manufacture in the United States.

Senate Majority Leader Robert J. Dole (R-Kan.), and Sen. John D. Rockefeller IV (D-W.Va.) added a section that is aimed at assuring that American companies get reciprocal access to foreign labs. In reviewing proposals by foreign companies, federal lab directors "may examine the willingness of the foreign government to open its own laboratories to U.S. firms," the legislation says.

Although the bill has strong congressional backing, there is some question whether Reagan will sign it.

Access to American research facilities—government and university—will become even more important in a competitive sense as these laboratories try to push their discoveries into the marketplace more rapidly.

University of Michigan has set up an "intellectual properties" office to help inventors obtain patents and to offer advice and aid in turning the inventions into products or commercial services. Like Carnegie-Mellon and most other major universities, Michigan is expanding its connections with American manufacturing companies.

In all of these area, universities must walk the narrow line between advancing the U.S. national interest and maintaining a tradition of open access to all. It is a microcosm of the free-trade, fair-trade dilemma confronting Congress and the administration.

Gilbert R. Whitaker, dean of the University of Michigan's Graduate School of Business Administration, notes that the school still looks actively for non-American MBA candidates.

"The Japanese send 10 to 15 students a year. Now we're getting increasing numbers of Koreans. They're obviously here to learn something about American culture and American business to take back with them. We're trying to learn similar things about their culture," he said.

Whitaker believes that the United States has more to gain through a continuing exchange of ideas, technology and expertise. "We'd like to get technology from elsewhere to put together with our knowledge. . . . We don't have a monopoly on brains."

Cyert agrees, with one qualification. "One of the great accomplishments of the United States has been the dissemination of its knowledge and technology around the world. . . .

"We want the bucket to leak. We do want the stuff out there. To the extent we can hold back a little bit, say by some restrictions on licensing, or on access to the most up-to-date [research], it would give us a little bit of a comparative advantage."

The search for that advantage promises to transform the way universities, company managers and politicians think about the American research establishment.

Bill Aims to Ease Transfer of Technology From Federal Laboratories to Businesses

By TIMOTHY K. SMITH
Staff Reporter of THE WALL STREET JOURNAL

Clifford Hesseltine's experience as a U.S. government scientist was classic. He did some research on toxins, published results that caught the eye of industrialists with a problem, and won a government citation for saving an industry.

The citation was the Third Order of the Rising Sun, bestowed on behalf of the Emperor of Japan, in recognition of Mr. Hesseltine's service to Japan's soy-sauce brewing industry.

The taxpayer-funded research done in the 700 or so federal laboratories should be a rich mine of ideas that U.S. businesses can develop into new technologies. But it hasn't worked that way. Most American companies shun the laboratories, and the technology that comes out of them usually goes to foreign countries.

"Private companies do not take seriously looking for new technology" at the federal laboratories, says Clifford Lanham, executive secretary of the Federal Laboratory Consortium for Technology Transfer, an umbrella group.

Problems on Both Ends

The transfer of technology from the U.S. government to corporations is rife with problems on both ends. Finding and developing basic research at companies rarely commands a priority as high as quarterly profits. And at the government laboratories, red tape and legal obstacles prevent most inventions with commercial potential from ever getting out the door.

"The labs spend about $18 billion a year" on research, says Bruce Merrifield, the Commerce Department's assistant secretary for productivity, technology and innovation. "I would say that about 95% of (their work) has not been been available for commercial development."

But that may soon change. A House-Senate conference panel yesterday completed negotiations on a bill that would make it easier for companies to exploit government research, primarily by removing administrative hurdles and giving laboratories incentives to commercialize their ideas. The legislation now goes to the House and the Senate for final votes, and sources on Capitol Hill say its chances for passage are good.

"We see this as landmark legislation," Mr. Merrifield says. "It seems so obvious and so much in the national interest."

He and other proponents of the bill argue that one reason the American technological edge has been slipping is that unlike other countries, the U.S. has been unable to narrow the gap between basic and applied research. That, they say, is why the U.S. still wins plenty of Nobel prizes but no longer seems able to build a decent automobile.

Congressional Action

Prodded by Congress, federal laboratories have been trying to promote their inventions in recent years, with varying degrees of enthusiasm and success. A 1980 law required the laboratories to appoint part-time officers to encourage technology transfer. Another law passed the same year permitted some laboratories—but not all—to do cooperative research with outside entities such as universities and small businesses. And legislation in recent years allows federal laboratories to get exclusive rights to inventions and license them—keeping some of the revenue.

> **'WE SEE this as landmark legislation,' says a Commerce Department official. 'It seems so obvious and so much in th[e] national interest.'**

Still, the bureaucracy remains nightmarish, and progress has been slow. Glenn Kuswa, technology transfer manager at the Department of Energy's Sandia National Laboratories in Albuquerque, N.M., describes the arduous journey an invention takes from his laboratory to the market. "It's checked for classification, and if it's not classified, it's sent to the local DOE office to see if a search for licensing should be made. Then it goes to Washington for evaluation, and if it looks promising, we write a disclosure, and it goes to a patent attorney and gets sent off to the patent office. The end result is a patent that is owned by DOE. If the inventor wants to, he can ask for license rights." Mr. Kuswa adds that from the time the inventor asks for a license until the product is developed is usually more than a year.

And that's just one laboratory owned by one agency; rules and procedures differ at laboratories owned by the Defense Department, NASA, the National Institutes of Health and other branches of the government. "It's going to take a while to turn this dinosaur around," Mr. Lanham says.

The new bill would grant blanket authority to all federal laboratories to set up cooperative research-and-development agreements with businesses. It would provide money to expand a communications system linking federal laboratories, giving businesses centralized access to a smorgasbord of government research. It would raise the status of technology transfer officers and make their positions full-time. Perhaps most important, it would reward government researchers whose inventions are licensed, requiring the laboratories to give them either 15% of license revenue or a fixed minimum payment.

Optimism at Labs

Officials at the laboratories are optimistic about the bill. "There has been a slow change, but now it almost looks like we might be on an exponential change curve," Mr. Lanham says.

But there are some problems that the bill can't address. There is, for instance, the basic difference in the cultures of scientists and businessmen. Scientists generally disseminate their findings as widely as possible; businessmen keep information secret to make money. "There is a feeling that the growth of science takes place by a vigorous exchange of information among scientists, and anything that inhibits that exchange is detrimental," says James Wyckoff, liaison officer for state and local governmental affairs at the National Bureau of Standards in Gaithersburg, Md.

And some of the agencies running federal laboratories fear that injecting a dose of entrepreneurship could divert researchers' attention from larger national goals and cause laboratories to compete with one another. "The question is: What is the mission of the labs? Is it to develop near-term technologies for development, or to focus on long-term research, national security and so forth?" says Vid Beldavs, executive director of the Technology Transfer Society, Indianapolis.

4-30-86 Wall St. Journal

Germany's 75 Years of Free Enterprise Science

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

Munich

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

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

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

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

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

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

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

Culver Pictures, Inc.

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

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

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

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

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

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

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

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

Germany's 75 Years of Free Enterprise Science

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

Munich

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

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

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

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

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

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

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

Culver Pictures, Inc.

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

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

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

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

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

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

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

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

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 eleetronics 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.

U.S. to Seek Trade Talk Priorities

Yeutter Will Walk Unless 5 Key Items Are Included

By Stuart Auerbach
Washington Post Staff Writer

U.S. Trade Representative Clayton Yeutter said yesterday that the Reagan administration would "walk away" from a new round of global trade talks if they do not include America's five "big ticket" priorities.

Yeutter's statement is likely to intensify the confrontation between the United States and a handful of other nations, including France, that will try to sidetrack U.S. aims when trade ministers meet next week in the Uruguayan beach resort of Punta del Este.

That meeting, which starts Monday, will open a new round of global trade talks that President Reagan wants to strengthen the world trade compact, the General Agreement on Tariffs and Trade (GATT), and to end barriers to the sale of American products overseas.

Yeutter listed the U.S. priorities for the trade talks as an end to export subsidies in farm trade; stricter international rules against piracy of intellectual property; an end to barriers to trade in services such as banking and insurance; free flows of investment funds, and strengthening of GATT's dispute settlement procedures.

"These are our big ticket priorities. We will not abandon any of them and will be willing to walk away from a new round if we don't get satisfactory language" in the agenda for the new round, he said.

Winning or losing, he said, will be determined by whether the American priorities are on the negotiating table for the new round. "If they are

See TRADE, D2, Col. 1

Circulate

Tip ✓
Joe ✓
Dick ✓
Regina (return to Norm)

WASH. POST 10/27/86

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.

Federal Focus®

A Publication for Key Policy Officials

Multinational Business Services, Inc.
1333 New Hampshire Avenue, NW, Suite 900
Washington, DC 20036
(202) 293-5886

Jim J. Tozzi
Editor

Volume I, Number 10 October 1986

FEDERAL TECHNOLOGY POLICY REFORM

Marc B. Goodman

With over 200 laboratories, the federal government spends some $55 billion on research annually, making technology one of the federal government's largest assets. Despite the need for innovation to remain competitive in years ahead, some existing U.S. policies discourage a more complete commercial application of this research. The Reagan Administration has sponsored numerous initiatives to privatize government functions, to more effectively utilize federal assets and to ensure managerial efficiency and productivity in federal operations. Despite numerous executive and legislative initiatives in recent years, essential federal technology reforms remain to be acted upon.

Federal laboratories are like research universities. Both entities create new discoveries which must be developed before marketable products result. Since 1980, universities have been able to license inventions developed with federal funds, but they must share any royalties with the actual inventors. As a result, more university-developed inventions are being reported. With closer ties to industry, universities are enjoying new funding, royalties, and industrial support. The biotech revolution is one university-oriented example of this trend.

In contrast, the federal government denies its own employees a stake in what they create. The federal government is the largest owner of unlicensable patents and is allowing the patentability of ideas and technologies to be lost to foreign competitors. The university experience illustrates that both the government and the private sector could benefit from incentive-based federal technology policies. A key element is allowing federal employees some predictable share in the fruits of their inventions.

Both the House and Senate have passed different versions of The Federal Technology Transfer Act which would provide the federal research establishment the authority to cooperate with U.S. industry to meet government needs and create new commercial products. Although the legislation has wide bipartisan support, some opposition to a Senate provision requiring sharing royalties with the actual inventors has developed, and some in the Executive Branch have suggested that the provision would make the bill unacceptable.

In the end, will the Administration continue its efforts toward privatization, revitalization, and free market solutions by providing royalty incentives for federal inventors?

Cilco 26—20M—4-64—Hgs.

CLIPPING SHEET

CENTRAL ILLINOIS LIGHT COMPANY

Tip — Norm — Dick — FYI

Peoria
CITY

CLIPPED FROM Journal Star DATE OF ISSUE 8/15/86

Senate OKs Michel's ag-research legislation

The U.S. Senate gave its approval this week to House Republican Leader Robert H. Michel's bill designed to allow creation of the proposed Agricultural Research Consortium in Peoria.

The bill, which passed the House last year, must now return for differences in the two versions of the measure to be ironed out by a conference committee.

The veteran Peoria lawmaker's bill is designed to increase research cooperation between federal laboratories and private entities, and would help clear the way for greater commercial use of ideas and inventions resulting from such research.

"This action by the Senate brings us one step closer to final enactment, thus clearing the way for creation of the consortium," Michel said.

He said he was confident differences between the House and Senates versions could be worked out quickly and that the measure could be sent to the president by the end of September.

The legislation represents part one of a two-step effort required to make the consortium a reality. It provides the legal authority. Step two, which provides the necessary financing, passed the House last month and is awaiting Senate action. It calls for a $2 million initial federal grant.

Michel said the consortium can mean a lot to Peoria because of its potential "to make us one of the national centers for agricultural research. With the research will hopefully come new products and new companies to produce the products, which can only work toward the economic betterment of our area."

Dr. Andrew Cowan, the Northern Regional Research Center's agricultural and industrial development officer, said he's been working with local economic developers on the consortium project for about two years.

"I think there's the possibility that research done by the consortium could provide the technological base for new economic development in Peoria," he said.

Cowan said that there is a need for such a cooperative effort between federal research labs like the one in Peoria and industries.

Cowan said that most of the work done in the federal labs is on a fairly basic level, but with additional funds, that research could be taken a step further, to the point where it would benefit industry.

In a related matter, the Illinois General Assembly approved legislation last year earmarking $50 million in low-interest loans for agricultural research and development.

NOW, R&D IS CORPORATE AMERICA'S ANSWER TO JAPAN INC.

BUSINESS IS INVESTING ALMOST AS MUCH IN RESEARCH AS THE GOVERNMENT DOES

Call it Science Inc. In less than a decade, as U.S. companies have struggled against the wave of competition from abroad, they have reshaped the way new products and processes are developed. Company scientists are working shoulder-to-shoulder with academic researchers. Arch-competitors are forging alliances with one another. And research spending is soaring. "Industrial research has become the principal driving force behind the process of technological change," says Herbert I. Fusfeld, director of the Center for Science & Technology Policy at New York University.

Since 1979, U.S. industry has logged double-digit increases in its R&D outlays. Last year was no exception. The 844 companies included in BUSINESS WEEK's annual R&D Scoreboard (page 139) spent a total of $48.8 billion on R&D in 1985, a gain of 10% over 1984. And they reached deeper into their coffers to do it. The share of sales that companies devote to R&D, which languished at 2% during the 1970s, topped 3.1% last year.

This year, business will invest almost as much on R&D as the federal government—about 48% of the nation's total research budget of $122 billion. With the additional funds it gets from federal and other sources, industry will perform fully 74% of all U.S. R&D.

TOGETHERNESS. In the process, companies have rediscovered the critical importance of universities in providing the foundations for new products. Industry is boosting its funding of academic research to nearly $600 million this year and is rushing to participate in on-campus centers that bring together academic and industrial scientists (page 135). Companies are also stepping up their support of the basic research that leads to new products. Overall industry spending on basic research rose to $2.7 billion last year, double its outlays in 1980.

Moreover, companies have formed more than 40 research consortiums to find solutions to common problems from television transmission to plastics recycling. And business is playing an unprecedented role in setting science policy in Washington. The National Science Board is chaired by Roland W. Schmitt, General Electric Co.'s senior vice-president for corporate R&D. Erich Bloch, a former International Business Machines Corp. vice-president, heads the National Science Foundation.

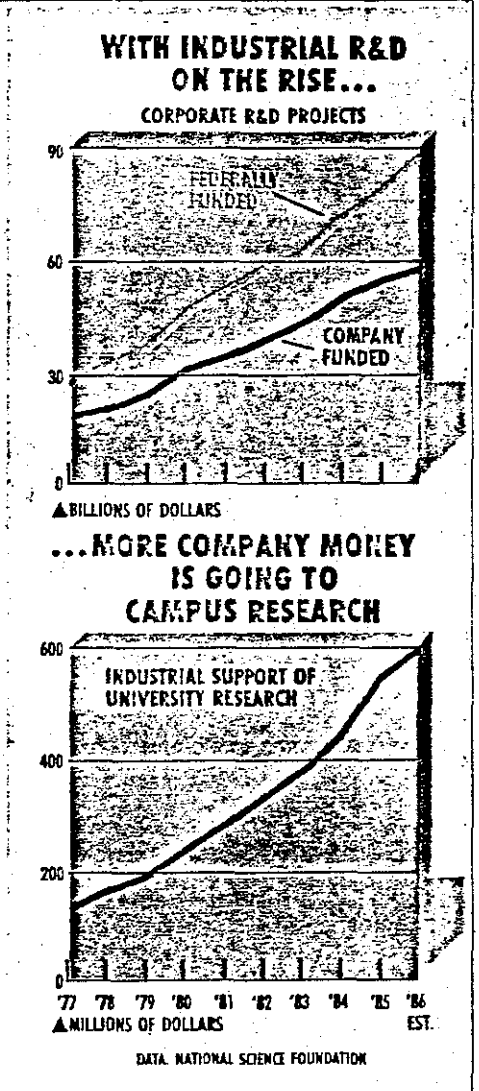
Just a decade ago, corporate research and development seemed to have gone to sleep. Most of the huge industrial labs that pioneered everything from electricity to the automobile had become technological white elephants. The federal government dominated the funding of science. Important new disciplines, such as biotechnology and artificial intelligence, emerged from federal funding of university research and from startup companies—not the established labs.

That's because federal spending on R&D shot up 14% every year from 1953 until 1961. Universities, dependent on federal research dollars, became increasingly remote from the marketplace. The fragile bridges that had existed between business and universities were largely destroyed. But contributions from the federal government leveled off in 1968 as funds were diverted to the Vietnam War, and they remained flat for the next decade. Industry continued to rely on basic science from the colleges while keeping its own R&D focused on short-term development. By the 1980s the flow of fresh ideas from industrial and university labs had slowed to a trickle in some critical fields.

NEW INSIGHTS. Now it's not uncommon for a large industrial company to finance more than 100 small university research contracts. A few companies, such as Monsanto (page 136), are even forging multimillion-dollar agreements with schools. At Rensselaer Polytechnic Institute, corporate funding now accounts for 30% of research dollars. Universities have become so important that "you have to go there for technology," says Alexander MacLachlan, senior vice-president for technology at Du Pont Co.

Business is getting results. Four years ago, Bristol-Myers Co. cemented a $3 million cancer research deal with Yale University. That collaboration has produced three promising drugs and given Bristol-Myers scientists new insights into the nature of cancer. Now the company is building a $150 million cancer research lab close to Yale's campus, and it plans to renew its research agreement.

Some companies are even turning to the universities to give new projects an entrepreneurial edge. GE's sprawling R&D laboratory in Schenectady, N.Y., probably discards more inventions in a decade than most companies produce in a century. But two years ago the company tried a new approach when it wanted to develop quickly computer software to automate industrial design and production. It quietly set up a "skunk works" on the campus of nearby Rensselaer Polytechnic. GE is now testing several



HAYES COHEN/BW

programs developed by the company's engineers working with RPI faculty and students. "Technology is so complex and changing so rapidly that no one company can maintain all the necessary R&D resources," says Robert M. Price, chairman of Control Data Corp., which has R&D agreements with 50 schools.

A JUMP AHEAD. Technology-hungry companies are just as eagerly cooperating with one another. Relaxed antitrust laws have spawned a host of collaborative arrangements, most aimed at keeping a jump ahead of Japan Inc. Two of the earliest—Semiconductor Research Corp. and Microelectronics & Computer Technology Corp.—are already making strides in R&D (page 138). Others companies, especially in biotechnology, have turned to strategic alliances with start-ups. And many have embraced research and development limited partnerships to finance product development. Since 1978 they have pumped an estimated $2.5 billion into more than 218 RDLPs.

Industry's new willingness to collaborate suits the federal government. Although government support of science and technology has risen dramatically in the past six years, this new era of steady increases is likely to come to an abrupt halt as Washington moves to curb huge budget deficits. NSF's Bloch, for one, wants the government to play a more important role as a broker between industry and universities. "The government shouldn't pay the full freight, but it should stimulate research," says Bloch. "We are trying to get academia and industry together in joint funding and research that leverages tax dollars."

One way the NSF hopes to accomplish that is by setting up cooperative research centers. Businesses are lining up to enter the deals, especially since the government picks up part of the tab. Last year a dozen companies, including Control Data, Burroughs, Cray Research, and IBM, anted up millions each to join five NSF-funded supercomputer research centers. Later, the NSF called for proposals to form six innovative engineering centers chartered to conduct research in such fields as composites manufacturing and biotechnology process engineering. The agency was deluged with 142 proposals from university-industry groups representing some $2.2 billion in requests for the modest $10 million in seed money it was offering.

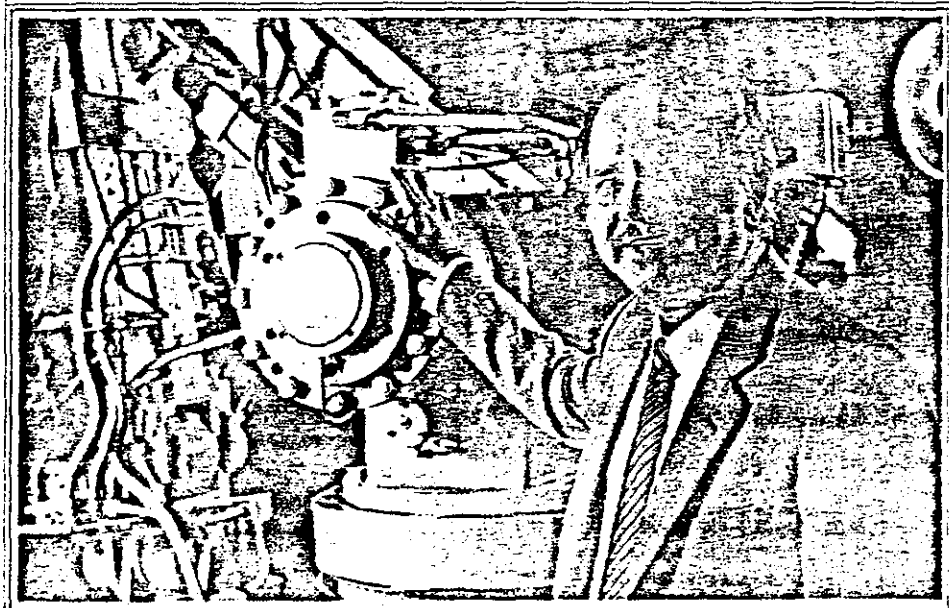
Dozens of the nation's top corporations are overhauling their internal research operations as well. Olin Corp.'s diversification from commodity chemicals to specialties and electronic materials turned its laboratory upside down. In about two years, John P. Morano Jr.,

THE HEAVY HITTERS IN CORPORATE R&D

1985 SPENDING ON RESEARCH AND DEVELOPMENT

	Millions of dollars		Millions of dollars
GENERAL MOTORS	$3,625	ITT	1,085
IBM	3,457	GENERAL ELECTRIC	1,069
AT&T	2,210	EASTMAN KODAK	976
FORD MOTOR	2,018	UNITED TECHNOLOGIES	916
DU PONT	1,144	DIGITAL EQUIPMENT	717

DATA: STANDARD & POOR'S COMPUSTAT SERVICES INC.



CARNEGIE MELLON'S REDDY: MOVING TECHNOLOGY FROM CAMPUS TO THE FACTORY FLOOR

AN INSTITUTE WHERE THE GRADUATES ARE ROBOTS

When Ford Motor Co. Chairman Donald E. Peterson wanted to know more about how his company could use robots and artificial intelligence, he flew to Pittsburgh to see Raj Reddy at Carnegie-Mellon University. Soon after, the auto maker purchased 10% of Carnegie Group Inc., an AI software company that Reddy co-founded.

Reddy, the director of the CMU Robotics Institute, is on a good many executive itineraries these days. The 49-year-old computer scientist, who learned mathematics in his native India from teachers who drew characters in the sand, has made a career out of transferring technology from campus laboratories to industry.

Under Reddy's direction, the institute, which is the world's largest industry-financed center for research on robotics and manufacturing technologies, tailors technology for its sponsors. Of the 27 companies associated with the center, nine ante up $50,000 a year just to have access to its information. But the majority of the institute's $7.2 million annual budget is supplied by companies that draw on the expertise of the center's 200 scientists and engineers to design manufacturing systems using robotics, computer vision, and other artificial-intelligence technologies. Since it was founded in 1980, the institute has completed more than two dozen contracts.

20 YEARS, 30 WORDS. Westinghouse Electric Corp., for example, supplied the center with its first $1 million in funding six years ago. Since then, institute scientists have designed a fully automated system to forge turbine-engine blades. They have "spun out applications in two or three years instead of the normal five," says Thomas J. Murrin, president of Westinghouse's Energy & Advanced Technology Group.

Reddy has also turned his own academic research into technology that is useful to industry. Nearly 20 years ago, he began developing a speech-recognition system that could understand 30 words and direct a robot to find, lift, and move a set of blocks. "It turned out to be much, much harder than anticipated," he says. That research is now the basis of software that is used in everything from expert systems to signal analysis for radar and sonar to designing programs for flexible factory-automation systems.

By Matt Rothman in Pittsburgh

vice-president for R&D at Olin Chemicals Group, has fired 50 scientists. But he has hired 32 more who are trained in new-materials and electronics research. It's a net loss of 20 people but it represents a "tremendous change in discipline," he says.

Companies are also exploring new ways to get technology onto the production line. General Motors Corp. had increased its R&D staff by 12%, to 1,700 employees, in its drive to leapfrog Japanese competitors. But technology wasn't moving into the divisions because researchers didn't want to leave the labs. So Robert A. Frosch, vice-president of GM's research laboratories, found a solution. Frosch and the business divisions jointly hire engineers who work in R&D during the development of critical technology projects. When a project is ready, these engineers move to the divisions to implement it. "We manufacture people for technology transfer," he says.

YEARS OF NEGLECT. Although industry is breathing vigor into R&D, problems remain. For one thing, the new collaborations—both among companies and with universities—are still uneasy. Academics worry that working with industry on applied projects may compromise the research and teaching process. And science policymakers are concerned that basic research is still not getting sufficient attention.

Of the $63 billion in R&D money that the Reagan Administration is asking from Congress in the current budget, only $8.6 billion is earmarked for basic research. Defense has come to dominate the federal R&D budget: Last year it accounted for 70¢ of every federal R&D dollar, up from 42¢ a decade ago, but most of the money goes for expensive weapons such as stealth aircraft and Trident submarines. Defense spending on basic research, which has spawned such valuable commercial spinoffs as integrated circuits and composites, represents a scant 2.5% of the budget, down from about 5.8% a decade ago. "It's a disastrous trend," comments Bloch. "If you spend only on development, sooner or later you go bankrupt."

In addition, the universities, which conduct some 60% of the nation's basic research, are just beginning a painful process of rebuilding their outmoded facilities after years of neglect. About 240 of the nation's 290 engineering schools operate with substandard equipment, and educators estimate that it would take more than $30 billion to refurbish these facilities.

At the same time, faculties in key scientific disciplines are aging, and the number of undergraduate and graduate students in engineering and the sciences

SCHNEIDERMAN: HE'S NEARLY DOUBLED MONSANTO'S R&D SPENDING IN THREE YEARS

MONSANTO: MEET THE BIG COMPANY ON CAMPUS

"To maintain our markets—and not become another steel industry—we must spend on research and development," says Howard A. Schneiderman. The 59-year-old senior vice-president for research and development at Monsanto Co. is doing just that. Schneiderman is the man behind an R&D plunge designed to transform the chemical maker into a powerful force in biotechnology and drugs.

He has been pumping up Monsanto's R&D budget ever since he left a post as dean of biological sciences at the University of California at Irvine to join the St. Louis company in 1979. This year, Monsanto will spend about $520 million on R&D—almost double the figure for only three years ago. That will approach 8% of the company's sales—far above the 1.5% average for the chemical industry. In addition, Schneiderman presided over the building of a $150 million life sciences research laboratory and increased the company's R&D forces to 5,000 scientists and technicians.

MORE MILK. Where Schneiderman really scored, however, was in drawing on his academic ties to forge an agreement between Monsanto and Washington University. With this far-reaching collaboration, which will provide the university with $62 million in research funds by 1990, Monsanto hopes to come up with new products to replace the more than 60 lackluster businesses it has divested over the past decade. Some 30% of Monsanto's money supports basic research; the balance can be aimed at product development. Monsanto and university faculty select projects. The company has an option to license any patents.

The new products Monsanto is rushing to develop are as high-tech as those of any California startup. The Washington University deal already has produced discoveries in atrial peptides, which promise better treatments for high blood pressure, and tissue plasminogen activator, which dissolves blood clots. By 1988 the company—under license from Genentech Inc.—hopes to sell genetically engineered bovine growth hormone, which can increase a cow's milk production by up to 40%. And it is developing herbicide-resistant plants in its own laboratories.

Monsanto hopes its $2.7 billion acquisition of G. D. Searle & Co. last year will pull together all the pieces of its grand scientific plan. Besides a small drug development program and a much-needed pharmaceutical sales force, Searle markets the highly successful NutraSweet sweetener. That provides an earnings bridge until Monsanto's high-tech products can generate strong profits in the 1990s. Meanwhile, Schneiderman is trying to meld the two R&D operations. Last January about 400 research positions were eliminated when weak and duplicate programs were scrapped. "It ensures that we have a powerful organizaton we can afford," he says.

By restructuring, Monsanto is dealing itself a financial body blow for now. Operating earnings plunged 48% in 1985, to $351 million, on sales of $6.7 billion. Still, Schneiderman believes skeptics will soon see that technology is the route to profits. "We're running hard," he admits—but when a biotech product bolsters Monsanto's bottom line, "it will convert all the heathens."

By James E. Ellis in St. Louis

is shrinking. Some steps to shore up the universities are already being taken. Many schools are cutting back weak departments and diverting resources to their areas of strength. The University of California at Berkeley has launched a $150 million initiative to reorganize and refurbish its biological sciences departments. A Defense Dept. program that gives universities grants to upgrade their equipment is pumping $90 million into schools this year and will provide an additional $50 million next year. And business is donating millions of dollars in new equipment.

All in all, a major link in the R&D chain has been reforged. Carnegie-Mellon University President Richard M. Cyert is convinced that cooperative R&D ventures are the new vanguard of U. S. science. The NSF's Bloch has proposed setting up a network of 100 more NSF collaborative centers. And industry shows no sign of backing away from its new R&D commitment. This year companies say they will push R&D spending to another double-digit increase. With such momentum behind R&D, Leo Young, director of research at the Defense Dept., is confident that the supremacy of U. S. science is ensured: "When you compare us with the rest of the world, we are still way ahead. I believe we'll stay that way."

By Emily T. Smith in New York and Evert Clark in Washington, with bureau reports

SRC PRESIDENT SUMNEY: HIS GROUP CREATED A MODEL FOR ALL OF U. S. INDUSTRY

ROGER RAUL

A SURPRISE HIT: HIGH-TECH RESEARCH CONSORTIUMS

Early in 1982, 11 chipmakers and computer manufacturers reined in their normally competitive natures and pooled $4 million to form a nonprofit research consortium called Semiconductor Research Corp. A year later, 12 more companies in those high-tech industries formed the Microelectronics & Computer Technology Corp. Both groups had the same mission: to conduct cutting-edge research to keep the U. S. semiconductor and computer industries from falling behind Japan Inc.

These were heroic steps. Few thought the companies would bury the competitive hatchet to fund projects of common interest. Then there was the Justice Dept. Regulations have since been relaxed, but it took MCC many months to convince the department that its plans were not anticompetitive.

CAMPUS RESEARCH. Surprisingly, the research consortiums seem to be working. That makes SRC President Larry W. Sumney think he's on to something big. One of the reasons he took the job, he says, is that former Chairman Erich Bloch, who now heads the National Science Foundation, told him: "If you do this right, you are going to create a model for U. S. industry."

SRC, which has 36 members, now supports more than half the silicon-semiconductor research done at U. S. universities. The consortium's budget this year is $18.4 million, 90% of which will be funneled to 43 campuses. SRC-sponsored research has produced 16 patent applications for improving chipmaking technology. And 61 students receiving support from SRC have graduated, two-thirds of whom have taken jobs with such member companies as AT&T Technologies Inc. and Xerox Corp.

Unlike the semiconductor consortium, MCC does its own research at laboratories in Austin, Tex. There, a staff of 430, hired by the consortium or borrowed from member companies, works under the direction of MCC Chairman Bobby R. Inman, a retired admiral who was No. 2 at the Central Intelligence Agency during President Reagan's first term. The group now has 21 members—including nine in common with SRC—and a budget of $65 million.

Inman has surprised even MCC's founders with the pace of development. Last December, less than three years after starting up, the consortium handed member companies two innovations. The first was an artificial-intelligence computer program called Proteus, which simplifies building so-called expert systems. The other: preliminary designs for an automated system to encapsulate chips in protective coverings. A prototype should be ready later this year. Inman also plans to deliver an advanced computer-aided system for designing computer chips in 1987. "Inman has brought together one of the finest technical organizations I've seen," says John Martin, vice-president of Boeing Electronics Co.

EASING TENSIONS. Even so, MCC is experiencing some shifts in its ranks. Mostek Corp. became the first dropout. Its parent, United Technologies Corp., shut down the unit last October, and it was not replaced until Westinghouse Electric Corp. bought out Mostek's interest in MCC on June 5. BMC Industries Inc. wants to sell out, and Gould Inc. is considering doing so as well. RCA Corp. and Sperry Corp. are also question marks. Their prospective acquirers, General Electric Co. and Burroughs Corp., respectively, are obligated to continue funding MCC programs through 1987, but both have declined to join MCC in the past.

Still, these consortiums have managed to hold together a group of highly competitive rivals, though it has not always been easy. Only last year did MCC's suspicious collaborators relinquish the right of a single company to veto new projects. SRC's Sumney recalls similar problems. "When we first started, everybody was guarded," he says. But the tension is easing as member companies see evidence that working together may pay off, and the approach has already left its mark. MCC, says Thomas F. Gannon, R&D director at Digital Equipment Corp., is "already influencing the direction of our product development."

By Evert Clark in Washington and Todd Mason in Dallas

WASH. POST 10/24/86

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.

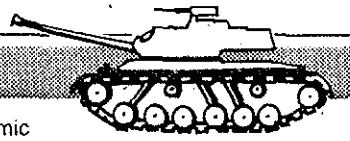
Giffen said that a "substantial" venture probably would meet with their approval if it was interesting enough and well thought out.

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.

Military Spending Questioned



Military Spending and Industrial Performance

Countries spending more on military research have generally scored lower in economic competitiveness, a study by Lloyds Bank Review shows.

Country	Military research and development, as % of G.D.P.		Civil research and development, as % of G.D.P.		Competitiveness indicator*	
	1979	1982	1979	1982	1979	1982
Britain	0.68%	0.68%	1.6%	1.6%	99.0	94.3
United States	0.58	0.72	1.8	2.0	100.3	99.7
France	0.50	0.38	1.4	1.6	103.5	100.2
Sweden	0.22	0.24	1.7	1.7	102.9	117.2
West Germany	0.13	0.11	2.2	2.5	111.3	128.9
Japan	0.01	0.01	2.3	2.5	110.3	138.3

*Competitiveness indicator represents excess of output over domestic absorption.

The New York Times/Nov. 11, 1986

By PAUL LEWIS

Special to The New York Times

PARIS, Nov. 10 — A spate of studies by economists in Europe and the United States is raising questions about the effect of military spending on the health of a country's civilian industry.

The studies are appearing at a time when governments on both sides of the Atlantic are re-emphasizing their long-held view that large military expenditures, particularly for research, spur growth in the economy as a whole.

In a speech late last month, for example, President Reagan contended that his Strategic Defense Initiative "could open whole new fields of technology" to the civilian sector, likening the anticipated benefits to the wealth of jobs and industries created by the space program. France's new conservative Government has made much the same claim in defending its decision to increase funds for military research at nearly twice the rate as spending on civilian projects.

But three British economists, writing in the current issue of Lloyds Bank Review, say there appears to be an inverse relationship between high military spending and industrial performance throughout the Western world.

The economists — Mary Kaldor, Margaret Sharp and William Walker — note that Britain and the United States, which consistently spend more than other Western countries on military research, tend to score low in a gauge of economic competitiveness used by the Organization for Economic Cooperation and Development. In contrast, West Germany and Japan, which spend next to nothing on military research, have highly efficient industries as measured by the organization, whose members are 24 Western industrial countries.

And the Council on Economic Priorities, a New York-based nonprofit research group, will shortly issue an updated version of its 1985 study of the economic effects of the President's Strategic Defense Initiative, warning again that the space-oriented missile plan is likely to accentuate a shortage of scientists in private industry while developing systems that are too expensive and specialized for civilian application.

Even a study commissioned by the French Defense Ministry, due to be published later this month, presents a mixed picture. The study by two French economists, Christos Passadeos and Gerard Duchêne, examined civilian spinoffs from military spending on lasers, fiber optics and composite materials. It found that although a few aerospace companies had profited from military-funded discoveries in these areas, most of French industry gained little.

Over the years, economists have advanced many contradictory views about the impact of military spending on the health of a nation's economy. Some see the spending as a valuable tool for maintaining employment and providing stability. Others believe it is inherently inflationary because it

Continued on Page D5

sellers, organized under the name AFG Partners, to share the profit if a new bidder emerges or if Lear Siegler decides instead to restructure.

Continued on Page D25

Oil-Price Rise Urged By Saudis

MANAMA, Bahrain, Nov. 10 (Reuters) — Saudi Arabia's King Fahd renewed a call today for higher oil prices and was reported to have sent a message to Iran, a traditional rival within OPEC, expressing his readiness to cooperate on the organization's affairs.

His statement came after the decision over the weekend by key ministers of the Organization of Petroleum Exporting Countries to meet in Quito, Ecuador, on Friday and Saturday to discuss a Saudi call for prices to be set at $18 a barrel, up from the present price of about $15.

The official Saudi press agency quoted the Saudi Information Minister, Ali al-Shair, as saying in Riyadh that King Fahd told his Cabinet that he was committed to seeking a price of $18 a barrel. It was the first public pronouncement on oil by King Fahd since he removed Sheik Ahmed Zaki Yamani from his post as oil minister 11 days ago.

Teheran radio, monitored by the British Broadcasting Corporation, said King Fahd had also sent a message to Iran's President, Hojatoislam Ali Khamenei.

"In the message, the Saudi king, while supporting Iran's views and expressing the unanimity of views between the two countries concerning oil and OPEC, expressed Saudi Arabia's readiness for greater collaboration with Iran concerning OPEC issues and requested Iran's support

Continued on Page D21

Questions Raised on Military Spending

Continued From First Business Page

puts money into workers' pockets without producing extra goods for them to buy.

Most recently, however, the debate has centered on the role of military spending in promoting technological innovation. Some economists argue that military research can develop new technologies that companies could never afford to finance. Others believe that on balance it weakens a nation's civilian industry by encouraging inefficient methods and absorbing scarce skills and resources that would be better used to produce goods for mass consumption.

"So many of the failings of British industry — its aversion to risk, its failings in marketing, its neglect of the simple for the complex product, and the increasingly chronic skills shortage in the electronics sector — can be explained at least in part by the continuing (and recently expanded) presence of a substantial and protected defense sector," the study in the Lloyds Bank Review concluded.

Few Civilian Applications

Some experts argue that as modern weaponry becomes more sophisticated, the technologies it requires are becoming increasingly disassociated from civilian needs.

"The accent today is on performance at any cost and equipment 'hardening' to withstand nuclear battlefield conditions," said Luc Soete, a military economist at Limberg University in the Netherlands. "This has little relevance to civilian industry, which should be driven by the consumers' need."

As a concrete example, Eric Stubbs at the Council on Economic Priorities points to military interest in replacing silicon with gallium arsenide in microchips because it is far more tolerant of high levels of atomic radiation, a technological advance that would have little civilian application.

The forthcoming French study, to be published by the Fondation pour les Etudes de la Défense Nationale, a research institute connected with the Defense Ministry, also stresses the practical difficulty of transferring military technology to civilian industry.

Small Companies Left Out

Big, high-technology concerns like the Aérospatiale Aircraft Company are able to make immediate use of military-financed discoveries in some civilian products, the study said. But it found a range of "filters" that hamper transfer of such technology to smaller companies, including a tendency for military research to emphasize performance over cost and to be directed at overly specialized ends.

"Very litle gets through because the receivers lack money and knowledge to exploit what is developed," Mr. Passadeos, one of the authors, said in an interview.

He cited the failure of the troubled French automobile industry to take advantage of composite materials, which are stronger and lighter than steel, that were developed for military aircraft and missiles. "The cultures are different," he said.

Still, there is no guarantee that pumping government resources into civilian research and development will necessarily raise the general level of technology in an economy.

Bottled-Up Ideas

In a new study published by the Center for European Policy Studies, a Brussels-based research group, Henry Ergas of the Organization for Economic Cooperation and Development argues that the results depend on whether the "national environment promotes diffusion of new ideas and the rapid adoption of new technologies."

In Britain and France, military research discoveries with civilian applications tend to remain bottled up inside of a few companies that often do not make full use of them, Mr. Ergas found. The result is an increasing polarization that separates a few high-technology companies heavily dependent on military orders from the bulk of industry, which gets little benefit from governments' encouragement of innovation.

France, in particular, has sought to escape from this trap and derive some broader economic gains from its military research by concentrating on weapon systems suitable for export to developing countries. But as Jacques Fontanel, a military economist at Grenoble University, points out, the heyday of French arms exports is ending — developing countries are not only short of money, but they are increasingly demanding local production.

West Germany falls into a different category, according to the Ergas study. It puts less emphasis on "cutting-edge technologies" and stresses instead "the widespread dissemination of technological capabilities throughout industry," chiefly by promoting technical skills and investment.

"Germany makes good tanks today because it modernized its civilian machine tool industry," Professor Soete said. "Private industry is driving military industry, not the other way around."

High Court To Rule on Road Tax

WASH. POST 10/27/86

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.

A. Sometimes it can be straightforward economic news. Lower interest rates and cheaper oil helped send equities soaring early this year. Both factors were expected to foster low inflation and steady economic growth. Recently, a weak bond market has caused stocks to take some spills.

But short-term price swings often re-

... when the market is falling. That way, if the market drops further they can buy futures at a lower price, making a profit that would offset losses on stock holdings. Portfolio insurance is a hot concept; by some estimates, there is more than $30 billion of it in place.

... vestors want to buy bond mutual funds, instead of stocks. "I think the market's getting more volatile, and psychologically that makes it harder for people to participate," says Stan Weinstein, the editor of the Professional Tape Reader, a Hollywood, Fla., newsletter.

... the buyer s ... $322, or about ... the Chrysler ... buyer would ... for the re-

... even greater ... ence were in- ... annual return ... er in the above ... er $62 over the ... s, Rivoli. ... it requires an ... car deals, but ... o do the math,

... roller for a Chi- ... who has ana- ... co-workers: ... as a free

... wer payments, ... ate and taking ... interest rates ... s, Mr. Brazas ... carries much ... portion of the ... tax-deductible ... payments on

... vould be espe- ... es buying cars, ... bill businesses ... deduct all such ... individual con-

... rees that "so ... t the financing ... people analyze ... well as they

... n for General ... GM's financing ... ons that most ... better deal." ... allow buyers ... vehicles more ... bank loans. ... he price of the ... of the rebate ... e Big Three's ... even on their

... s on a 2.9%, ... a $17,195, 1986- ... tised in a De- ... after a $5,000 ... a month, ac- ... g GM's offer of ... nk loan on the ... -a-month pay- ... $14 a month. ... es could affect ... es and low-in- ... for instance, ... price if they ... wants a manu- ... ause financing ... e dealers the ... le tag-ons such

Bill Aims to Ease Transfer of Technology From Federal Laboratories to Businesses

By Timothy K. Smith
Staff Reporter of The Wall Street Journal

Clifford Hesseltine's experience as a U.S. government scientist was classic. He did some research on toxins, published results that caught the eye of industrialists with a problem, and won a government citation for saving an industry.

The citation was the Third Order of the Rising Sun, bestowed on behalf of the Emperor of Japan, in recognition of Mr. Hesseltine's service to Japan's soy-sauce brewing industry.

The taxpayer-funded research done in the 700 or so federal laboratories should be a rich mine of ideas that U.S. businesses can develop into new technologies. But it hasn't worked that way. Most American companies shun the laboratories, and the technology that comes out of them usually goes to foreign countries.

"Private companies do not take seriously looking for new technology" at the federal laboratories, says Clifford Lanham, executive secretary of the Federal Laboratory Consortium for Technology Transfer, an umbrella group.

Problems on Both Ends

The transfer of technology from the U.S. government to corporations is rife with problems on both ends. Finding and developing basic research at companies rarely commands a priority as high as quarterly profits. And at the government laboratories, red tape and legal obstacles prevent most inventions with commercial potential from ever getting out the door.

"The labs spend about $18 billion a year" on research, says Bruce Merrifield, the Commerce Department's assistant secretary for productivity, technology and innovation. "I would say that about 95% of (their work) has not been been available for commercial development."

But that may soon change. A House-Senate conference panel yesterday completed negotiations on a bill that would make it easier for companies to exploit government research, primarily by removing administrative hurdles and giving laboratories incentives to commercialize their ideas. The legislation now goes to the House and the Senate for final votes, and sources on Capitol Hill say its chances for passage are good.

"We see this as landmark legislation," Mr. Merrifield says. "It seems so obvious and so much in the national interest."

He and other proponents of the bill argue that one reason the American technological edge has been slipping is that unlike other countries, the U.S. has been unable to narrow the gap between basic and applied research. That, they say, is why the U.S. still wins plenty of Nobel prizes but no longer seems able to build a decent automobile.

Congressional Action

Prodded by Congress, federal laboratories have been trying to promote their inventions in recent years, with varying degrees of enthusiasm and success. A 1980 law required the laboratories to appoint part-time officers to encourage technology transfer. Another law passed the same year permitted some laboratories—but not all—to do cooperative research with outside entities such as universities and small businesses. And legislation in recent years allows federal laboratories to get exclusive rights to inventions and license them—keeping some of the revenue.

> **'WE SEE this as landmark legislation,' says a Commerce Department official. 'It seems so obvious and so much in the national interest.'**

Still, the bureaucracy remains nightmarish, and progress has been slow. Glenn Kuswa, technology transfer manager at the Department of Energy's Sandia National Laboratories in Albuquerque, N.M., describes the arduous journey an invention takes from his laboratory to the market. "It's checked for classification, and if it's not classified, it's sent to the local DOE office to see if a search for licensing should be made. Then it goes to Washington for evaluation, and if it looks promising, we write a disclosure, and it goes to a patent attorney and gets sent off to the patent office. The end result is a patent that is owned by DOE. If the inventor wants to, he can ask for license rights." Mr. Kuswa adds that from the time the inventor asks for a license until the product is developed is usually more than a year.

And that's just one laboratory owned by one agency; rules and procedures differ at laboratories owned by the Defense Department, NASA, the National Institutes of Health and other branches of the government. "It's going to take a while to turn this dinosaur around," Mr. Lanham says.

The new bill would grant blanket authority to all federal laboratories to set up cooperative research-and-development agreements with businesses. It would provide money to expand a communications system linking federal laboratories, giving businesses centralized access to a smorgasbord of government research. It would raise the status of technology transfer officers and make their positions full-time. Perhaps most important, it would reward government researchers whose inventions are licensed, requiring the laboratories to give them either 15% of license revenue or a fixed minimum payment.

Optimism at Labs

Officials at the laboratories are optimistic about the bill. "There has been a slow change, but now it almost looks like we might be on an exponential change curve," Mr. Lanham says.

But there are some problems that the bill can't address. There is, for instance, the basic difference in the cultures of scientists and businessmen. Scientists generally disseminate their findings as widely as possible; businessmen keep information secret to make money. "There is a feeling that the growth of science takes place by a vigorous exchange of information among scientists, and anything that inhibits that exchange is detrimental," says James Wyckoff, liaison officer for state and local governmental affairs at the National Bureau of Standards in Gaithersburg, Md.

And some of the agencies running federal laboratories fear that injecting a dose of entrepreneurship could divert researchers' attention from larger national goals and cause laboratories to compete with one another. "The question is: What is the mission of the labs? Is it to develop near-term technologies for development, or to focus on long-term research, national security and so forth?" says Vid Beldavs, executive director of the Technology Transfer Society, Indianapolis.

Wall St. Journal
Oct. 1, 1986

Critics Say White House Is Ignoring Challenge of Foreign Competition

Senate Democrats and some Administration sources believe current policies regarding competition are inconsistent and often counterproductive

Concern is rising in Washington over alleged Reagan Administration indifference to the country's plight in meeting the competitive challenge from Japan. The latest criticism comes predictably from the Democratic Party in a new report.

News Analysis

But voices are rising from within the Administration itself. They say the Reagan Administration has not really heard the message that a unified national drive is needed to avoid lagging further in the technological race.

One hope is that the recently confirmed science adviser, William R. Graham, will be able to parlay his connections with key staff members in the White House to convince them that the country's dilemma is indeed a serious one. The Office of Science & Technology Policy that he now directs already has an interagency panel examining competitiveness issues. But Graham, though a fast learner, is nevertheless burdened by the knowledge that the position of science adviser is not the top level link to the Presidency it was originally designed to be.

The situation contains its paradoxes and puzzles. Under Reagan the basic research budget has just about doubled and the National Science Foundation under Erich Bloch has more influence than ever before. Moreover, a few key pieces of legislation designed to work to the benefit of technological innovation have made it into law. One measure amended antitrust regulations, making it easier for corporations to pool research projects without fear of breaking antitrust law.

Another strengthened patent law by creating a single patent court in Washington. Previously, suits challenging patent validity were heard by various judges in various circuit courts around the country. These judges' decisions proved to be inconsistent and thus discouraging to inventors and their attorneys.

In a third example, universities with federal grant money are now free to patent and license any inventions their faculty and corporate collaborators make in the course of research. Another bill signed by Reagan established in the Commerce Department a center for translating Japanese technical documents into English. Finally, under a bill just passed, companies doing collaborative research with federal laboratories are free to patent any inventions emanating from that work.

Still, the concerns continue to rise. The very agency that has most promoted these steps is one of the least favored by the Administration: the Commerce Department's Office of Productivity, Technology & Innovation, headed by assistant secretary of Commerce D. Bruce Merrifield. The Office of Management & Budget has repeatedly attempted to eliminate OPTI, but Congress has reliably come to its rescue. The feeling is that the Administration hasn't really thought too deeply about competitiveness issues and thus has no comprehensive view of them.

The tax overhaul bill just passed by Congress is one example. Critics say it works against innovation by eliminating the tax advantages on capital gains from money invested in new ventures. "If all profits are taxed the same," comments one OPTI staff member, "why should anyone put their money in long-term investments when they can put it in the highest short-term rates? There is no incentive to invest in our long-term economic growth."

In addition, current lobbying efforts by NSF director Bloch and National Science Board chairman Roland Schmitt to double the NSF budget in three years aren't coordinated with Merrifield's efforts. Department of Energy laboratories have consistently fought the patent initiative ever since the idea was suggested, their directors believing the government should own any inventions paid for by the public. The Administration has done little to establish a consistent perspective.

A few key pieces of legislation designed to work to the benefit of technological innovation have made it into law

"Everyone seems to be going off in their own directions," comments Alan H. Magazine, executive director of a new organization, the Council on Competitiveness, just formed in Washington. The council is an outgrowth of the President's Commission on Industrial Competitiveness, which was chaired by John A. Young, chairman of Hewlett-Packard Co. It, plus a number of new industrial groups now forming, plan to "raise the issue of competitiveness

to the top of the national agenda," according to Magazine. The council's members believe the initiative was necessary because no leadership on the issue was coming from the White House. Moreover, it was hoped that the Administration's deliberate devaluation of the dollar would increase the trade balance in high technology products. Instead the deficit, running at $170 billion a year, has never been bigger.

So partly because competitiveness is perceived as nowhere near one of the Administration's top concerns, the Democratic Party is trying to take advantage of the vacuum with its recently issued report, "Economic Competitiveness—Promoting America's Living Standard."

The report was prepared by the Senate Democratic Working Group on Economic Competitiveness, headed by Sen. Jeff Bingaman (D-N.M.), and was commissioned by the Senate Democratic Policy Committee. It includes proposals to make foreign technologies more readily available to American business, upgrade private sector research and development, generate a more flexible and mobile workforce, and develop a permanent national council to spearhead a more competitive position for the U.S. in the international marketplace.

Bingaman's plan is true to the Democratic tradition of increased government spending to get a job done. It would give the Patent & Trademark Office the policy function of assessing, forecasting, and informing the public about technological developments abroad. It would "expand and diversify" NSF's Engineering Research Centers and set up a fund for upgrading the infrastructure of research universities. It would establish a fellowship program to train science teachers. It would add money to already existing state programs to retrain workers and otherwise adapt them to changing technological conditions.

And to provide institutional overview, the plan would establish a National Council on Economic Competitiveness that would do such things as monitor the country's competitive capacity, set up ways by which the various sectors of industrial America get together to discuss problems and solutions, assess private sector needs for federal assistance and relief, and send an annual report to the President on the competitive situation. Total cost: $525 million a year.

Some believe the key to the policy structure is OPTI. Merrifield has tried hard to play the good Administration soldier by minimizing conflict and raising confidence about inherent American ingenuity. But OPTI has never become the national command center for policies concerning competitiveness that some had hoped it would be.

Says one discouraged staff member, "There's no focus for the issue anywhere. I don't think there is anyone in the White House that understands anything about the problem. That's why we're so frustrated. We're the only people who can say we've been doing something continuously. What makes it even worse is that we reflected all the things this Administration said it wanted. We never built an empire. We achieved low-cost solutions. And all we've gotten out of it is a lot of crap."

What in the end is clear, though, is that there is powerful national concern within the technical community about coming to grips with the issue, whatever the Reagan Administration is or isn't doing. The meaning of competitiveness is taking on clearer definition as countries are seen to be focusing on cooperating with each other as well as competing.

As New York University professor Herbert I. Fusfeld says in his recent book, "The Technical Enterprise," technology is too interdependent around the world to assume an "us versus them" stance. The key, he says, is linkages in today's world. "Competition," he underscores, "occurs directly between companies and only indirectly between countries."

Wil Lepkowski, Washington

distributed since 1980, that the department either has taken back or was in the process of taking back from the housing authorities. The department, which distributes operating subsidies to the housing authorities, said the agencies had received more than they actually used for running public housing each year. The lawsuit, filed in U.S. District Court here in 1984, said HUD changed its rules retroactively, and failed to meet requirements of the Administrative Procedure Act.

Group Health Executive Director Resigns

■ The executive director of Group Health Association stepped down yesterday citing, in part, friction generated by last spring's 24-day physicians' strike at Washington's oldest health maintenance organization.

Dr. Robert G. Rosenberg, who has run the day-to-day affairs of Group Health for the past 3½ years, said he will take up a post today as head of the regional office of Partners National Health Plans. Partners, a joint venture between Aetna Life Insurance Co. and the Voluntary Hospitals of America, was established recently to set up HMOs and other prepaid health plans around the country.

From news services and staff reports

Fall Season D

By David A. Vise
Washington Post Staff Writer

NEW YORK, Sept. 15—CBS's chairman, William S. Paley, and its chief executive officer, Laurence A. Tisch, sat side-by-side on top of the desk in Tisch's new office today, a position symbolizing their newly won control of the troubled media company.

Until last Wednesday afternoon, that desk and that office on the 35th floor of CBS's headquarters belonged to Thomas H. Wyman.

Norm
F-YI
9-16-86
Dick

RUDOLPH A. PYATT JR.

Jealousy Dogs Va. Center

Efforts to get Virginia's controversial Center for Innovative Technology (CIT) started have become the embodiment of a prophetic warning that a governor's task force issued three years ago.

"Narrow parochial concerns, regional and institutional jealousies, will destroy the prospect of effective action," the Governor's Task Force on Science and Technology in Virginia cautioned in its report to then-Gov. Charles S. Robb.

The task force, of course, endorsed the concept of the CIT as a way to "expand and exploit the capabilities" of the state's major research universities in partnership with industry. To be sure, educators and business leaders, particularly those from high-technology industries, endorsed the concept. But the CIT has been mired in controversy from its inception.

Although established as an agency to promote the growth of the high-technology industry in Virginia by coordinating research, funding and other activities between industry and research institutions, the role of the agency is still unclear to many of the would-be participants in its activities. Moreover, its floundering two-year existence has been marked by petty regional jealousies, pitting Northern Virginia interests against those in other parts of the state.

The presence of a blue-ribbon gathering for the ceremonial groundbreaking for a CIT headquarters near Dulles International Airport last week failed to temper, even temporarily, the bitterness borne of regional jealousies. A clash among board members of the CIT is the kind of thing that could do precisely what the governor's task force warned of three years ago.

Robb candidly acknowledged he doesn't think the CIT will ever be free of controversy. Nonetheless, the former governor added after the dust had settled—literally and figuratively—the CIT is "right on target."

If Robb means that starting contsruction on the $24 million CIT complex is on target, he's right. But the clash among board members minutes earlier indicates he's wrong about the concept of CIT, about

See PYATT, C2, Col. 2

Wall Street Rallies After Bear Week

Dow Rises 8.86 In Nervous Market

By Stan Hinden
Washington Post Staff Writer

The stock market reversed direction yesterday and staged a small rally after last week's massive losses.

Stock prices fluctuated narrowly as bargain hunters helped return some equilibrium to a still nervous market.

The Dow Jones industrial average of 30 blue-chip stocks finished the day at 1767.58, up 8.86 points.

Volume was relatively small compared to last week when the Dow lost a historic 141.03 points or 7.4 percent. On the New York Stock Exchange, 155.62 million shares changed hands, down from 240.49 million shares Friday, an all-time record.

On Wall Street, where rumors have many lives, analysts said the market may have been cheered by a report that West Germany and Japan may heed U.S. appeals to cut their interest rates.

Reports last week that the same two nations would not cut their

RUDOLPH A. PYATT JR.

CIT Cooperation Lags

PYATT, From C1

cooperation among educators and other principals and about people's perception of the CIT's role as a catalyst for high technology growth in the state.

When the president of George Mason University declares he's "no longer clear on what the [CIT] is," a return to the drawing board seems in order. And the prospect for effective action is damaged, if not destroyed, when GMU president George W. Johnson demands to know from his colleagues on the CIT board: "What's in it for me to get tangled up in your procedure, which seems likely to go on forever, when I can go out and get industrial money myself?"

That may be the loudest signal yet that the CIT may be doomed to a fate of becoming a $24 million white elephant.

The concept, though plausible in many respects, was bound to get chewed up in fractious regional disputes. The concept was part of a proposal that was jointly developed by the University of Virginia, Virginia Commonwealth University and Virginia Polytechnic Institute and State University. But because of the political and industrial realities of the state, George Mason University was included as a participant in the CIT. GMU and the state's biggest concentration of high-tech industry, after all, are in Northern Virginia.

If the principals in Virginia can't agree on the proper role of the CIT, then it's doubtful that business leaders and educators in metropolitan Washington will have much success soon in promoting the growth of the Washington region as a major center of technology. If intrastate differences threaten the CIT, then there is little reason to believe that cooperation will bridge state boundaries.

Efforts by the Greater Washington Board of Trade to promote cooperative use of high-tech information and facilities notwithstanding, local jurisdictions in Virginia and Maryland are caught up in their own empire building. The goal of making this area "another [North Carolina] Research Triangle" or "another Silicon Valley," as some local business leaders have suggested, will be difficult enough to achieve with cooperation among local officials and high-tech executives. But it will be next to impossible in the absence of such cooperation.

Most of the major high-tech centers, in addition to having a large concentration of high-technology industry, have developed around major universities with strong research and graduate-degree programs. This area has such an institution in the University of Maryland, whose computer science and engineering departments are highly ranked. But when asked not long ago if he favored a cooperative program between high-technology companies in Northern Virginia and the University of Maryland, which is only minutes away by car and milliseconds by computer, the head of a Northern Virginia high-tech company dismissed the idea as unworkable.

The Virginia governor's task force may have been more prescient than anyone ever imagined.

Disagreements Mark Opening Session of GATT Trade Talks

GATT, From C1

a preventive strike against efforts by the 12-nation European Community to deny Tokyo the benefits of the new round of trade talks until it eliminates barriers covered in past negotiations. That proposal was part of the opening statement by EC minister Willy de Clercq.

And in another dispute, U.S. officials [illegible] progress in per- legislation this year out of concern it could became a vehicle for protectionist measures.

Yeutter said the United States "would defend its own interests" if other countries refuse to agree to an agenda that will ease America's record trade deficits, which he said will approach $200 billion this year. He called the United States "the major victim" of the trade "disequilibrium" in the world.

farm subsidies, received a boost over the weekend when a group of 14 agricultural nations backed the American stance as a fallback if they cannot get even stronger language in the final communique. This was seen as making it harder for France to water down GATT rules on farm trade.

The dispute between Japan and the EC threatened to become a major issue as European nations, increasingly angry at their inability to sell in the Japanese market, sought support for its resolution, which a senior member of the Japanese delegation termed "Japan bashing."

The Japanese official said the EC statement singled out one country in a way that violates the trade compact's rules and tradition. U.S. Deputy Trade Representative Mi-

Safeway, (Vote to Pl

RETAIL, From

people felt the comp getting the same calib cause of the low pay an they were doing mo cause some of their v not qualified," McNutt

At Safeway, about the local workers have company less than th are in the lower tier. rapid expansion, has cent of its work force tier.

Safeway employes ly approved the contra voice vote at a two-h Capital Centre yeste Giant employes a changes in a separat vote, McNutt said. Ar closed while the meeti

In addition to the t sue, Safeway workers cerned about job secu in light of the recent of the chain to a new Holdings Corp., that w thwart a takeover by Herbert H. Haft family.

Safeway employes, c the large debt incurred will force the chain to s assets—particularly mid-Atlantic divisic strike if they didn't job-security provision

Under the new co has agreed that if it

Bond D

BONDS,

state. Dwindlin past year have board cuts in s foreign banke ue waiting, A

"It's one afford to d said. "Rig that kind

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.

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, 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.