Edited by Howard Banks

GOVERNMENT'S R&D TREASURE TROVE

Federal spending continues to increase

SPENDING ON RESEARCH AND DEVELOPMENT IN THE U.S.—government, corporate plus universities and foundations—will total $131.5 billion in 1988, according to a new survey by Battelle's Columbus division.

That's a healthy 7% or so up on 1987 levels, but slower than the 10% to 11% national average maintained through the mid-1980s.

Slower growth this year mainly affects corporate spending. Economic uncertainty is to blame, says Battelle's Jules Duga.

Federal R&D spending, however, is slated to remain buoyant. The National Science Foundation predicts around a 10% increase over 1987, despite budget squeezes. The feds in 1988 will account for over 49% of all R&D spending (up from 46% in 1987).

The big spenders—who they are and what it's for

FOUR GOVERNMENT DEPARTMENTS DOMINATE, not surprisingly headed by the Department of Defense (about two-thirds of federal R&D spending). The others are Health & Human Services, mostly through the National Institutes of Health (around 12%); Energy (8%); and the National Aeronautics & Space Administration (7%; *see p. 101*).

Aerospace will continue to dominate. Of the $24 billion to be spent on R&D in this sector in 1988, almost 80% will be federally funded. The electrical machinery and telecommunications sectors will together spend just over $10 billion, 40% of it federally funded.

But most manufacturing sectors pay for much of their own R&D. In 1988 machinery will spend $11.9 billion (12.5% federal money); chemicals $9.4 billion (3%); autos and trucks $9.2 billion (23%); instruments $6.8 billion (15%); petroleum $2.5 billion (virtually none of it federal money); rubber $1.5 billion (16%); and food and beverages $1 billion (none).

The top ten corporate spenders? General Motors, IBM, Ford, AT&T, GE, Du Pont, Eastman Kodak, UTC, Hewlett-Packard and Digital Equipment.

Please, won't somebody take advantage of us?

SPENDING BY THE 600 FEDERAL LABORATORIES and their 100,000 scientists, run by 12 government departments—$16.4 billion this year, up from $15.5 billion in 1987—is included in these totals.

An attempt is under way to encourage industry to use the results of this government research commercially. The Federal Technology Transfer Act of 1986 even allows corporations to negotiate exclusive rights to particular government research, for a share of the profits.

Individual government researchers can benefit, too, with up to 15% a year of industry's payments for the life of the patent, to a maximum of $100,000 a year. One winner is Robert Gallo of NIH's National Cancer Institute for techniques used in detecting the AIDS virus.

But this sort of example is rare. Few corporations have latched on to what should be a treasure trove—U.S. corporations, that is. Since the doors on these federal labs were opened, U.S. business visitors have been outnumbered ten to one by those from Japanese companies.

Copy to Susan, Hannah

Business and Health | Glenn Kramon

Guide Assesses New Technology

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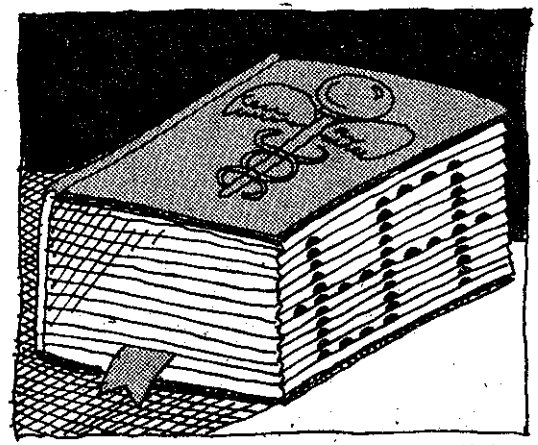

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CARL
FYI
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High-Tech Life Reshapes U.S., Analysts Say

Hill Study Predicts Rapid Transformation

Associated Press

The next two decades will be a time of massive change in which virtually every U.S. product, service and job will be reshaped, according to a four-year government study of new technologies.

The congressional Office of Technology Assessment study released yesterday said that emerging technologies should offer chances to expand educational opportunities, extend life, reduce illness and make work more rewarding by using machines for tedious, repetitive jobs.

But the study warned that rapid change also threatens to "shake the foundations of the most secure American businesses."

"We know that we are moving away from an economy heavily dependent on raw materials, where most businesses were isolated from international trade," said project director Henry Kelly.

As one example of how change already has reshaped the country, the study said the number of lawyers, bankers, scientists and accountants needed to supply Americans with food is now roughly equal to the number of farmers.

The study said that for the country to take full advantage of emerging technologies, Congress should consider making fundamental changes in tax laws and government regulations.

"Regulations designed to protect consumers . . . may have outlived their usefulness in areas ranging from banking to housing to electric utilities," the study said.

In the tax area, the study urged reducing or abolishing the tax on capital gains and revising or abolishing the corporate income tax. The report said these taxes reduce needed investment to boost U.S. productivity.

for home mortgage interest should be limited to a fixed amount because it makes little sense to encourage investment savings in the form of home purchases, but not permit the complete deductibility of educational expenses.

Among the report's predictions:

■ New technologies for collecting, storing and manipulating information have the potential to revolutionize the economy. Businesses are already spending 40 percent of their investment dollars on computers and other "information" machines, double the 1978 share.

"The potential productivity gains in this area—the movement and organization of information—are at least as great as those produced [by] the first Industrial Revolution," the study said.

■ Increased foreign competition was inevitable with the post-World War II recovery of Japan and Western Europe and the emergence of sophisticated production in places such as Korea and Taiwan. Undisputed U.S. economic leadership may be lost, but the change does not necessarily mean that U.S. living standards will decline.

■ Consolidation of farm ownership is likely to continue so that by the year 2000, the 14 percent of farms with annual sales higher than $250,000 will account for 80 percent to 90 percent of total sales. Likewise, grocery stores will continue getting larger. "Super stores" with 200,000 square feet of space and offering 20,000 products account for 28 percent of all grocery store sales.

■ The U.S. housing industry, to combat the decline in home ownership, may follow the trends of Sweden and Japan, moving toward prefabricated homes built on assembly lines, sold in showrooms and assembled on the site.

■ The nation's educational system is on the brink of major technological changes through the use of computers that will make learning more productive and fun while allowing teachers more time to spend with individual students.

Richard
Carlin
Sid Bleier
Carl Weather
FYI
NJL

WASH. POST

5/17

Travelers' Diarrhea Blocked By Modified Cows' Milk

An infection-fighting protein found in cows' milk can safely prevent travelers' diarrhea, researchers reported in last week's New England Journal of Medicine.

A number of micro-organisms can cause travelers' diarrhea, but the most common culprit is enterotoxigenic *Escherichia coli*. A benign form of this bacteria is normally found in the human gut, where it causes no problems. Travelers' diarrhea strikes 30 to 50 percent of visitors to developing countries.

Scientists have known for some time that mother's milk protects infants from a number of infectious agents, including bacteria that cause diarrhea, because the milk contains antibodies, which are infection-fighting proteins produced by the immune system. Infants initially fail to make antibodies because their immune systems are immature. To compensate, milk provides a form of passive immunity.

Dr. Carol Tacket and others at the University of Maryland School of Medicine's Center for Vaccine Development in Baltimore developed the treatment by vaccinating nursing cows with the pathologic *E. coli* and some of its proteins. The cows produced antibodies against the bacteria; some of the antibodies were found in the milk. The antibodies were purified from the milk and dried into a powder that could be taken orally. To test the preparation, 10 volunteers mixed the antibody powder with water and drank it three times a day, 15 minutes after each meal for a week. The treatment was found to stimulate the volunteers to make active immunity against the bacteria.

To test effectiveness, the 10 treated volunteers, along with 10 volunteers who did not receive the powder, drank a solution contaminated with diarrhea-causing bacteria. Fifteen minutes later, those receiving the antibody drank one last dose of antibody.

The result: No volunteer who received the antibody treatment got sick, but nine of the 10 who did not receive antibody treatments did.

Travelers' diarrhea is usually prevented with drugs, including bismuth salicylate tablets and antibiotics, but the drugs can cause side effects. There were no side effects with the milk treatment.

The research group, will try to develop the concentrate into a treatment that could be widely available.

— Larry Thompson

WASHINGTON POST 5/17/88

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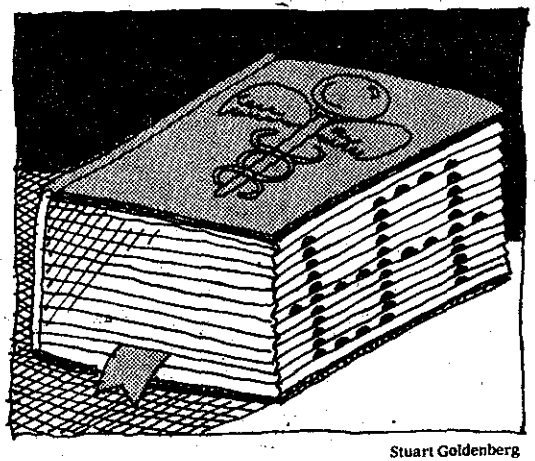

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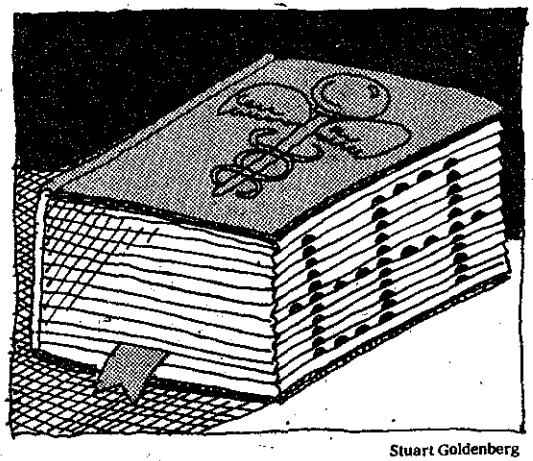

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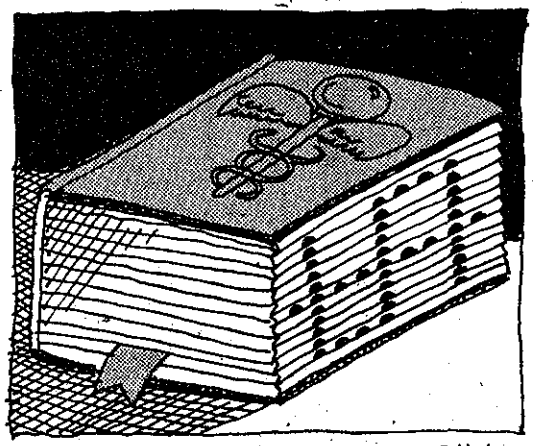

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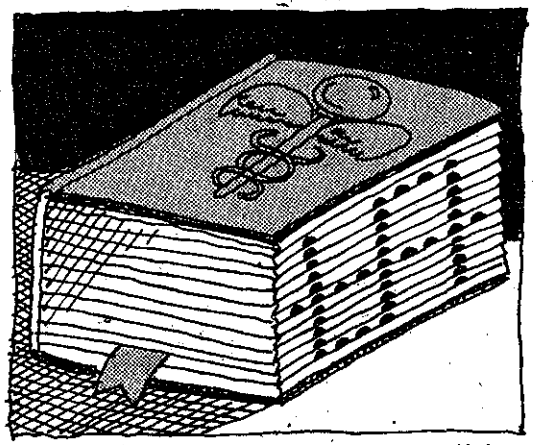

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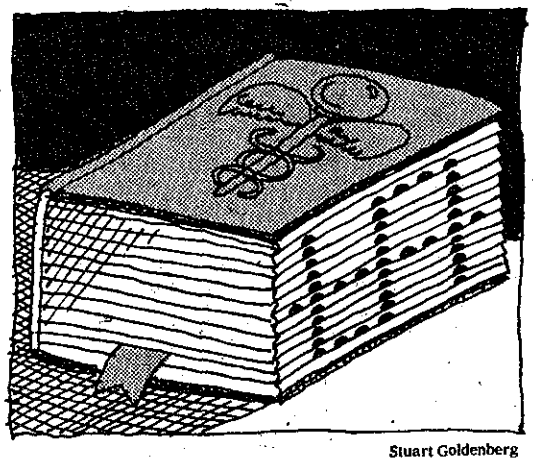
The council, now two years old, has been looking for ways to find answers to bewildering questions about the rapidly growing array of medical procedures, devices and drugs. For example, should a pancreas transplant be covered under a health insurance plan? Should the hospital acquire a lithotripter that uses shock waves to destroy kidney stones, or stay with surgery or other techniques? In what cases is magnetic resonance imaging worth the cost, and when will CT scans or conventional X-rays suffice? Is the insurance plan paying too much because doctors are performing too many costly Caesarean sections? And where are the gaps in research that need to be filled?

The answers are important at a time when health-care insurance premiums have been rising by double-digit percentages and insurers and providers are expressing frustration that they do not have more information on how best to serve their patients yet restrain costs. "We need to encourage people to demand more proof that medical technology is more efficacious," said Lawrence C. Morris, a council member and a senior vice president at the Blue Cross and Blue Shield Association.

The Washington-based council, composed of authorities from all sectors of the health-care industry and financed by Federal grants and contributions from dozens of private organizations, has



Stuart Goldenberg

taken several tacks. One is to become an information clearinghouse. The Medical Technology Assessment Directory describes many private and government groups that conduct medical technology evaluations, and the work they are doing. "It is designed to become dog-eared," said Clifford S. Goodman, council program officer.

"Until now many of the people who were prominent players were unaware of who some of the other players were and how to get in touch with them," he said. "We need a network."

The directory, which complements existing data bases, includes a cross-listing so that a number of reports on a given technology can be seen at once. And it includes references to work in "fugitive" areas that might not be easily found elsewhere, such as industry studies, professional association reports and conference proceedings.

But the council emphasizes that the directory could someday be much better. For one thing, it is not yet available electronically, for use through computers. For another, it is by no means exhaustive. Its creators hope that as news of the directory spreads, groups not listed will contact the council for inclusion in future volumes. And suggestions for the guide are welcomed.

The council, which is under the Institute of Medicine, part of the National Academy of Sciences, has also established a panel to improve on methods of assessing technologies. And it plans to begin a project to find ways to create a standardized electronic medical record that provides detailed health information on every American.

"Currently, records don't move between hospitals or with the individual," said Dr. Richard A. Rettig, director of the council. "An electronic record would provide more organized access to patient records to improve the quality of care, would provide more data for clinical research and studies of the care process, and would allow us to tie much better into billing systems." The project could also examine how to prevent such a system from invading people's privacy.

On another front, the council's evaluation panel is looking for ways to stimulate, coordinate or possibly commission technological studies.

But some health-care specialists strongly support a more aggressive body that would draw on literature and experts in the field to provide standards for use of the most common medical procedures and compare their efficacy and cost with those of other procedures. They say that the current council, which has authorization for $750,000 annually from Congress contingent on matching funds from the private sector, is woefully underfinanced and inadequate.

One specialist who has taken this position is Dr. Robert H. Brook, a professor of medicine and public health at the University of California at Los Angeles whose research has shown that at least a third of some medical procedures are unnecessary. "If I were the czar," he said, "I would take the 50 or 100 most commonly used procedures, go through the process we've been going through in our research, and develop appropriateness standards. It would cost at least $50 million to $100 million to test the validity of it so you don't screw up. But remember, that compares with the $500 billion annual cost of health care in this country."

Business and Health | Glenn Kramon

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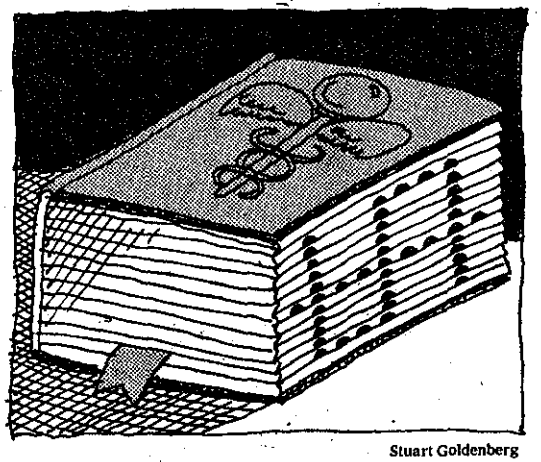

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NEXT

file

MEMORANDUM **April 13, 1988**

MEMO NO. NL025IM

TO: Carl Wootten / Sid Alpert

FROM: Norman Latker NL

SUBJECT: Mouse Patent - The Washington Post and New York Times, April 13, 1988

These two news articles report on a new area of protection that is particularly relevant to university research. I would suggest that you make the articles available to your staff (including Technical Liaison Officers) with a suggestion that they alert investigators in this area of research of the new opportunities that arise from the Patent Office decision.

cc: Lowell Harmison

NL/im

THE WASHINGTON POST - APRIL 13, 1988

Mouse Patent May Bolster Research Efforts

New Genetic Techniques Could Reduce Drug Costs

By Malcolm Gladwell
Washington Post Staff Writer

The patent awarded yesterday to Harvard University for a genetically engineered mouse—the first patent ever for an animal—could open up a large new market for genetically altered animals used in drug research and development.

Officials at the Patent Office are considering patent applications for 21 genetically altered animals. Some—like the Harvard mouse, genetically altered to provide a more effective model for research into breast cancer—cover improved versions of laboratory animals. Other pending patent applications concern revolutionary techniques to allow for the use of animals in the production of pharmaceuticals.

Industry experts said that with the guarantee of patent protection for the fruits of research and development, the number of companies doing research—and the amount of money spent on it—could skyrocket in the next few years. The result could be dramatically lower costs for producing drugs.

"Patent protection is the lifeblood of the pharmaceutical and biotechnology industries," said Steven Holtzman, chief operating officer of the Ohio-based Embryogen Corp., one of a handful of companies nationwide that have been developing genetically altered animals for laboratory and commercial use. "This means that we finally have the same protection as everyone else."

"The stakes have now been raised," said Don Hudson, president of the Worcester, Mass.-based Transgenic Sciences Inc. "This patent decision gives everyone much more incentive to enter this field."

The Harvard patent covers any mammal that contains a piece of DNA that normally

See MOUSE, F2, Col. 3

Patent May Bolster Research

MOUSE, From F1

occurs in humans and that results in breast cancer. (DNA, or deoxyribonucleic acid, is a basic material in the chromosomes of the cell nucleus and is a vital component of all living matter.) Researchers at the Harvard Medical School's department of genetics have developed techniques to insert these cancerous genes into mice embryos, enabling a female mouse to develop what essentially is human breast cancer.

An animal with cancer genes would allow for more sophisticated and effective testing of carcinogens and potential drug therapies, permitting scientists to study breast cancer in a living system and test drugs without involving human patients.

Officials of Du Pont Co., the Delaware-based chemical company that owns the rights to the Harvard mouse, said that although they had no plans to get into the mouse breeding business, they would entertain offers from other firms wishing to breed and sell the mice to commercial laboratories. The mice now are only available free to government and university researchers in the cancer field.

Industry sources said that a number of the other pending animal patent applications could have enormous commercial potential, particularly in the area of using animals to produce commercially valuable proteins and industrial enzymes.

For example, Integrated Genetics Inc. of Framingham, Mass., in combination with researchers at the National Institutes of Health, has filed for a patent for a female mouse that has been altered to secrete the human protein TPA, which has enormous commercial value as a drug used in the treatment of heart attacks.

The company hopes that by applying the same techniques to goats, sheep or cows, they could produce a cost-effective manufacturing alternative for a drug that now costs $2,200 a dose—largely because of the high cost of conventional protein manufacturing techniques.

"The potential is here to lower the cost of producing TPA 100 times," Hudson said. "Right now it's being produced in a $50 million plant the size of football field. You could produce the same amount in 100 farm animals."

Hudson's firm, Transgenic Sciences, is working on inserting commercially valuable human genes into the reproductive organs of chickens so that they could be harvested cheaply and easily from eggs.

Before the Patent Office's announcement, questions had been raised about the commercial future of the animal biotechnology industry because of a movement in Congress and among environmental groups for a moratorium on the granting of animal patents. Richard Godown, president of the Industrial Biotechnology Association, said that such a moratorium could have had the effect of driving firms overseas.

THE NEW YORK TIMES - APRIL 13, 1988

Mouse Patent Is Issued to Harvard, World's First for Higher Life Form

By KEITH SCHNEIDER
Special to The New York Times

WASHINGTON, April 13 — Calling it a "singularly historic event," the United States today issued to Harvard University the world's first patent for a higher form of life, a mouse created by researchers at the Harvard Medical School through techniques of genetic manipulation.

The United States Patent and Trademark Office issued patent No. 4,736,866 for "transgenic nonhuman mammals" developed by Dr. Philip Leder, a 53-year-old geneticist at Harvard Medical College in Boston, and Dr. Timothy A. Stewart, 35, a former Harvard researcher who is a senior scientist at Genentech Inc., a leading biotechnology company in south San Francisco.

The two scientists isolated a gene that causes cancer in many mammals, including humans, injected it into fertilized mouse eggs and developed a new breed of genetically altered mice. Because half the females develop cancer, the altered breed serves as a more effective model for studying how genes contribute to the development of cancer, particularly breast cancer, said Dr. Leder.

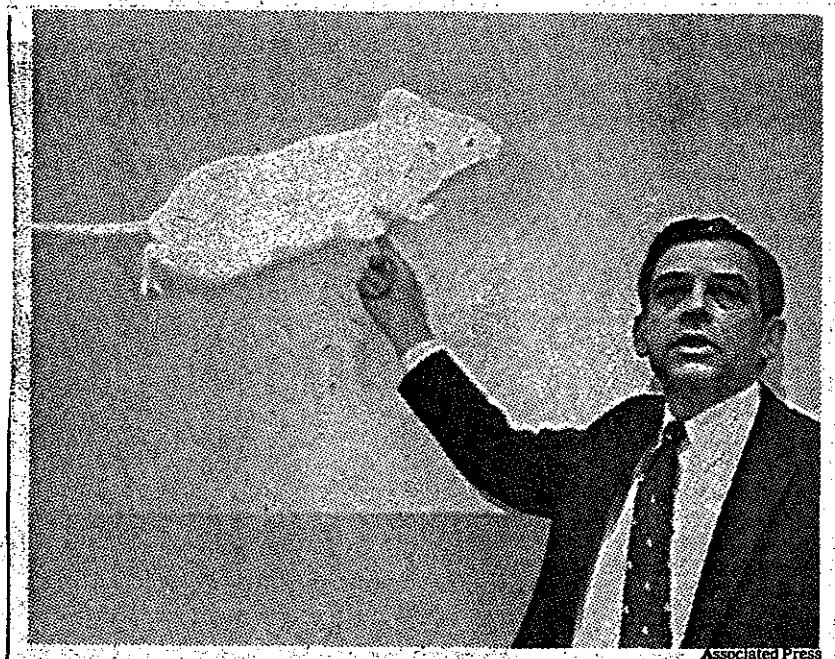
Range of Benefits Seen

Other experts said the invention presented scientists with a more efficient biological system for testing new drugs and therapies to treat cancer, and for determining whether chemicals and other toxic substances found in food or the environment are harmful.

The announcement elated researchers and biotechnology industry executives who said it would attract more investments for research and lead to safer and more effective biological inventions in medicine, agriculture, forestry and other industries. But critics, including several powerful members of Congress, protested the decision, arguing that a handful of officials appointed by the Reagan Administration had in a single act determined a new and important public policy in defiance of a request from Congress to delay the action and without a public debate.

Donald J. Quigg, the Assistant Secre-

Continued on Page A22, Column 5



Associated Press

Dr. Philip Leder, a geneticist at Harvard Medical School in Boston, with a photograph of a genetically engineered mouse in 1986.

Mouse Patent Is Issued to Harvard, World's First for Higher Life Form

Continued From Page A1

tary of Commerce, who is also Commissioner of Patents, said the approval of the first animal patent was a logical and lawful extension of previous decisions by the 198-year-old agency. In 1930 the first patent for a crop plant was approved. In 1980 the Supreme Court ruled that scientists could patent genetically altered microorganisms. A year ago the Patent Office announced that it would allow inventors to patent new forms of animal life created by gene-splicing and other biological technologies.

Would Speed Cancer Research

Mr. Quigg said the potential of the altered mice to hasten the development of treatments for cancer was an important factor in granting Harvard the first animal patent, which allows the inventor the exclusive right to use a product for 17 years. "I know I'm not supposed to get on a soapbox," he said in an interview today, "but how can anybody say this kind of development is unethical or wrong?"

But some members of Congress protested, and in a letter to be sent later this week after more signatures are sought called on the Patent and Trademark Office to refrain from issuing another animal patent. The Patent Office said 21 patent applications for genetically engineered animals are pending.

Both the House and Senate are considering legislation that would impose a moratorium on approving patents for genetically altered animals. The moratorium would be in force until Congress has more thoroughly considered a range of economic and moral issues raised in the last year by farm groups, religious leaders, animal welfare organizations and environmental groups.

"The Patent Office has been given no clear and certain signal from Congress that the unrestricted patenting of animals is acceptable public policy," said the letter, which was signed by Representative Charlie Rose, Democrat of North Carolina, sponsor of the proposal in the House, and more than 20 other members of Congress.

Quickening Pace in Field

The Patent Office decision recognizes the quickening pace of developments in biotechnology, particularly in creating and duplicating new forms of animals. Along with genetically engineered pigs, cattle and sheep that have been produced in laboratories across the country, scientists are also beginning to transform aquatic species.

The genetically altered mice produced at Harvard carry multiple copies of a single cancer-causing gene, C-Myc, that is ubiquitous in mammals. Dr. Leder and Dr. Stewart isolated the gene from mice, and altered its function by tampering with the portions of the chromosome that surround the gene and regulate its behavior.

The result was that they engineered C-Myc to express itself in the mammary tissue of female mice to cause breast cancer. Half of the females in the gene-altered breed develop breast cancer within 10 months of their birth, said Dr. Leder.

Dr. Leder said the development of the patented mouse started in 1982 and application for a patent was made in 1984. "I'm involved in trying to understand and to do something about a terrible problem, namely cancer," said Dr. Leder.

NEXT

Telecommunications Network Management Heats Up

Giants Race to Develop Products, Seeking to Dominate Crucial Markets

By JANET GUYON
Staff Reporter of THE WALL STREET JOURNAL

When the automatic teller machines would crash at Mechanics Bank in Richmond, Calif., the bank's branch office, its computer center and the phone company would fight for as long as three days over whose problem it was. Meanwhile, customers fumed.

Then Mechanics hired the PacTel Spectrum Services network management unit of **Pacific Telesis** Group, a regional Bell company, to pinpoint the problems. Now "We never have more than a couple hours of down time," says Anthony J. Chavez, Mechanics vice president, data processing.

PacTel Spectrum is one of many concerns working the hottest product development area in telecommunications: network management. As their vast phone and computer networks swell and proliferate, companies find that the software and processing systems to manage them have become critically important.

For **International Business Machines** Corp. and **American Telephone & Telegraph** Co., network management has become essential in the race to dominate the market among retailers, banks, brokerages and manufacturers for large phone, video and computer networks. Because customers increasingly want computers that hook into manageable systems, "Network management is crucial to what we are doing in telecommunications," says Ellen M. Hancock, an IBM vice president who heads its Communication Systems Group.

While IBM and AT&T draw up battle lines, the rest of the industry is scrambling to develop software compatible with either giant's plan. Some companies have bought technology. Several computer companies have allied with makers of multiplexers, relatively obscure pieces of equipment that boost phone line capacity and usually incorporate some network management functions. "Without question, network management is the biggest issue for our company," says Martin Singer, director of marketing at **Tellabs** Inc., a Lisle, Ill.-based maker of multiplexers resold by AT&T.

Development Pact

Last year, **Unisys** Corp. bought Timeplex, another multiplexer maker, to form the core of a new network and network management unit. **Network Equipment Technologies** Inc., a hot new multiplexer concern in Redwood City, Calif., has a network management development pact with IBM, which also is rumored to be interested in forming a relationship with PacTel Spectrum. IBM declines to comment. A number of companies have sprung up, which, like PacTel Spectrum, sell network management services instead of software. Telecommunications managers say **Digital Equipment** Corp. also is developing major network management products. **Rockwell International** Corp.'s telecommunications unit also is trying to sell network management software to large companies, as well as to the Bell companies.

But just what is "network management" generates intense debate. The size of the market is unclear, because network management software usually is sold along with basic communications and computer equipment. Forrester Research Inc., Cambridge, Mass., estimates that Fortune 1000 buyers spend about $500 million a year on such systems, or 1% of their total communications budgets, and will increase that to $2.8 billion, or 3.7%, by 1991.

What is clear is that customers are becoming increasingly reluctant to buy gear that doesn't link into a system that controls an entire network. "Any . . . product that isn't easy to manage is going to fall by the wayside," says John Miller, AT&T's director of network management market planning. "Customers face a dilemma between building more powerful information networks and creating the greater burden of managing that complexity."

Merrill Lynch & Co., for example, manages and monitors links to its more than

600 brokerage locations in the U.S., Canada and overseas from a low-rise, yellow brick building in lower Manhattan. The increasing globalization of securities markets has forced Merrill's communications managers to keep the network running 24 hours a day, seven days a week. "Without the links, we can't do business," says Kenneth Stagg, a vice president who manages Merrill's network group.

Numerous Vendors

But it isn't easy to identify those links that are down and those that have problems, and to figure out their traffic loads. Merrill buys gear for its network from more than 30 vendors, and each piece has its own peculiar way of tracking the equipment's performance. Since the break-up of the Bell system, Merrill can't go to one phone company each time a line fails. Usually, it must pinpoint the failure itself to forestall finger-pointing between, say, New York Telephone Co. and AT&T.

To manage this vast maze of wires, computers, switches and terminals that it has dubbed Mernet, Merrill has installed a disparate hodgepodge of terminals from a dozen or so companies. In one corner, terminals run network management software from **Racal Corp.**, a data communications concern. Nearby are similar terminals running different, but similarly functioning, network management software from AT&T, Network Equipment Technologies, **Northern Telecom Ltd.**, **General Datacomm Industries** Inc. and Unisys's Timeplex.

No one yet has developed a comprehensive system to manage any of these huge networks. But IBM and AT&T have drawn up opposing plans to develop standards. Industry consultants say Digital Equipment will emerge as a third major contender later this year when it announces a new network management product; Digital Equipment won't comment on future product plans, but one executive says its current network management products will evolve to manage devices made by other companies.

Managing Computer Networks

Estimated spending by Fortune 1000 on network management out of total communications budgets

	TOTAL BUDGET (In billions)	NETWORK MANAGEMENT (In billions)	PERCENTAGE
1987	$50	$ .5	1.00%
1988	55	.7	1.27
1989	60	1.1	1.83
1990	66	1.7	2.57
1991	76	2.8	3.68

Source: Forrester Research Inc.

So far, however, IBM is leading the pack, having commercially introduced its NetView PC software, which manages networks of IBM computers, Rolm phone switchboards and IBM's local area network. IBM also published enough details about its product to allow for some compatibility with equipment of outside vendors. IBM says at least 29 telecommunications equipment vendors have pledged to make their gear work with its NetView PC product, which it hopes will become, de facto, an industry standard.

Compatible Products

While sales of IBM's older NetView product, which manages only networks of IBM computers, exceeded expectations last year, results were disappointing for NetView PC, IBM product managers say. Customers want more graphics, and fewer vendors have develo,ed products compatible with NetView PC than IBM anticipated.

AT&T last fall said it would develop its own standards, called Unified Network Management Architecture. It doesn't yet have a commercial product in the market, and it has announced two initial products that will only manage AT&T phone equipment and lines, though AT&T says one product will hook into IBM's NetView.

Competitors believe it may be two years before AT&T has a comprehensive product, because the company wants to use network management standards that aren't fully agreed upon by industry standard-setting bodies. But that won't hold AT&T back, Mr. Miller, the network management planning official, says.

Meanwhile, many companies are contracting with specialized software houses for custom-made systems, while some are giving up on plans to build networks and turning back to the local phone company. **Du Pont Co.**, which is installing a new network in the U.S. connecting 108,000 phones and computer terminals, will use IBM's NetView for its computer network, AT&T software for its voice network and parts of two computer networks, Digital Equipment software for parts of the Digital network, Network Equipment Technologies' multiplexers for another part of the network, and special software from **Atlantic Research Corp.** that will bill departments for phone use from 20 office switchboards.

Many companies have turned to closely held **Applied Computing Devices Inc.**, based in Terre Haute, Ind. William Schindel, president and founder, says the company's backlog of orders is the largest in 14 years. "When you get right down to it, network management is a highly arcane discipline," Mr. Schindel says. "In its infancy, you will see something less than universal systems until further enhancements are made."

Wall Street Journal 3-4-88

Business Day

The New York Times

Setbacks for Artificial Intelligence

Companies Are Hurt By Poor Decisions

By ANDREW POLLACK

Special to The New York Times

SAN FRANCISCO, March 3 — A major retrenchment is occurring in the artificial intelligence industry, dashing the hopes of many companies that thought they would prosper by providing the technology to make computers "think."

Some of the setback stems from the failure of artificial intelligence to quickly live up to its promise of making machines that can understand English, recognize objects or reason like a human expert — to be used for such purposes as diagnosing machinery breakdowns or deciding whether to authorize a loan. Despite this, the technology is making slow but steady progress, and now is being subtly incorporated into more conventional computer programs.

Poor Business Moves

Far more of the artificial intelligence industry's problems result from poor business decisions by companies that were heavily weighted with technologists rather than business minds. Their main mistake was trying to use special computers for artificial intelligence; the machines were too expensive and did not mesh well with those used by potential customers.

"People believed their own hype," said S. Jerrold Kaplan, co-founder of one leading artificial intelligence company, Teknowledge Inc., and now president of the Go Corporation, a startup software company in San Francisco. "Everyone was planning on growth that was unsustainable.'

Although computers often appear to be intelligent in their everyday applications, they generally perform repetitive tasks following rigid rules set down by programs. They do not learn or make cognitive decisions, as humans do.

Artificial intelligence aims to make computers do tasks that are said to require intelligence when people do them. One goal has been to make computers understand English and other human languages, so that people do not have to use special computer languages. Another has been to make computer vision systems that can recognize objects — to allow robots, for instance, to find objects on conveyer belts and allow military tanks to steer by themselves and choose their own targets.

A third area, so-called expert systems, involves allowing computers to reason like experts, to give investment advice or to analyze seismic data to decide where to drill for oil. Developing such a program generally involves conducting lengthy interviews to corporate their thought processes into a computer program.

Hardest hit in the retrenchment so far have been companies that sell special computers for use in artificial intelligence. Symbolics Inc. of Cambridge, Mass., the leader in that market, has had several quarters of heavy losses and recently ousted its chairman. Its archrival, Lisp Machines Inc., declared bankruptcy last

Trouble for Many of the Artificial Intelligence Companies

As the industry realigns, the companies that relied on special purpose machines are languishing.

Company/ Headquarters	Description
EXPERT SYSTEM DEVELOPMENT TOOLS	
Teknowledge Palo Alto, Calif.	Four quarters of losses. 60 workers of 220 laid off. 1987 sales: $20 million.
Intellicorp Mountain View, Calif.	Six quarters of losses. 30 workers of 200 laid off. 1987 sales: $20 million.
Carnegie Group* Pittsburgh	Losses. 20-40 workers of 200 laid off. 1987 sales: $12 million.
Inference* Los Angeles	Losses. 20 workers of 130 laid off. 1987 sales: $12 million.
MACHINE MANUFACTURERS	
Symbolics Cambridge, Mass.	Continuing losses. Third round of layoffs last fall. Ousted chairman and founder. 1987 sales: $104 million.
Lisp Machines Andover, Mass.	Filed for bankruptcy last year. 1986 sales: $12 million.
Xerox Stamford, Conn.	First to sell this kind of equipment, but dropping out of ousiness.
Texas Instruments Dallas	Big push in artificial intelligence. Announced a chip containing LISP to go into Macintosh.
EXPERT SYSTEM APPLICATIONS	
Syntelligence* Sunnyvale, Calif.	No layoffs. 1987 sales: $9 million.
Applied Expert Systems* Cambridge, Mass.	Layoffs. 1987 sales: $4 million.
Palladian* Cambridge, Mass.	Layoffs. Ousted chairman and founder. 1987 sales: $6 million.

*Private company, estimates.

Source: DM Data, Harvey Newquist

Gains Are Slow for Artificial Intelligence Industry

Continued From First Business Page

year. Texas Instruments Inc. and the Xerox Corporation, the two other vendors in that market, are also experiencing sluggish sales. Meanwhile, Texas Instruments and Apple Computer Inc. announced yesterday that Texas Instruments would sell a version of the Macintosh containing the favored artificial intelligence programming language, Lisp.

Also being hurt are companies that sell software tools that allow users to develop their own expert systems. Teknowledge, based in Palo Alto, Calif., halted sales of its product and laid off more than one third of its employees last month. Intellicorp of Mountain View, Calif., has had six quarters of losses, and its chief operating officer resigned in January. The two other major companies in that market, Carnegie Group of Pittsburgh and the Inference Corporation of Los Angeles, have also had problems.

Still, while companies are suffering, artificial intelligence as a technology continues to make progress. Some companies that have adapted are still doing well. The Aion Corporation, a small, privately held company in Palo Alto, saw its sales triple last year, though from a tiny base. It sells tools that include artificial intelligence technology to help data processing employees develop programs for I.B.M. mainframes. The AI Corporation of Waltham, Mass., has successfully sold programs that allow corporate computer users to use English commands to retrieve information from data bases on I.B.M. mainframes.

Use in General Software

Artificial intelligence techniques are also being incorporated into general computer programs without necessarily being labeled as artificial intelligence. Symantec Inc. of Cupertino, Calif., sells a data base program for personal computers called Q & A that responds to English queries. A new class of data bases, such as Agenda by the Lotus Development Corporation, also use some artificial intelligence techniques to organize data.

"You're beginning to see the embedding of A.I., sub rosa," said Louis G. Robinson, publisher of the Spang Robinson Report, an artificial intelligence newsletter.

There are also probably more than 1,000 expert systems now being used by companies, according to Paul Harmon, editor of Expert Systems Strategies in San Francisco. Popular applications include diagnosing failures in equipment and scheduling factory operations.

For instance, when a merchant calls American Express to verify whether to allow a customer to make a large purchase using an American Express card, an expert system helps make the decision. Du Pont has more than 100 expert systems doing things like scheduling medical examinations and diagnosing computer failures. United Airlines uses a computer program to schedule the docking of airplanes at its terminal in Chicago.

A Narrow Customer Base

A major problem for the industry, some analysts say, is that artificial intelligence has long been the preserve of a relatively small number of researchers at a few leading colleges, mainly the Massachusetts Institute of Technology, Stanford University and Carnegie-Mellon University.

These researchers flocked to start companies in the early 1980's, when it looked as if artificial intelligence was about to boom. But good academicians often do not make good business people.

The academic researchers believed in a special programming language for artificial intelligence called Lisp, and they used computers tailored to run it. At first, sales were strong because machines were being sold to research and development arms of large corporations, which were setting up divisions to explore artificial intelligence.

> **'Everyone was planning on growth that was unsustainable.'**

But soon that market became saturated, and artificial intelligence had trouble migrating to the mainstream of corporate America. Corporate customers did not want to spend $50,000 to $100,000 for a special machine used by one person. They wanted artificial intelligence programs to run on their existing computers, such as I.B.M. mainframes and Digital Equipment minicomputers, to be shared by many users. Preferably, they wanted to develop artificial intelligence programs without requiring their own programmers to learn Lisp.

New Source of Competition

Yet another factor has been that engineering work stations and personal computers have now become powerful enough to run Lisp at a fraction of the price of special artificial intelligence computers.

An acknowledgment of that came today when Texas Instruments said it would sell a version of Apple's Macintosh II personal computer for use in artificial intelligence. The machine, with a Lisp processing circuit board made by Texas Instruments, will sell for about half the price of Texas Instruments' special artificial intelligence computers. Lisp processing is already available on powerful I.B.M. and compatible personal computers as well, using software sold by companies like Gold Hill Computers of Cambridge, Mass.

The result has been that sales of special-purpose artificial intelligence computers have dried up. And the expert-system tools that were designed to run on such machines have also suffered. So have the expert systems that were designed to run on those machines rather than on general-purpose computers.

At the same time, many corporations that invested heavily in developing expert systems have not been able to put their systems into use. "Most corporate programs have failed to fulfill their promise," said Ed Mahler, program manager for artificial intelligence at Du Pont.

The Sale of Expert Systems

A few companies are trying to sell expert systems as a product. These include Palladian Software and Applied Expert Systems, both of Cambridge, Mass., and Syntelligence of Sunnyvale, Calif. These companies, which are selling products to financial services companies, have also suffered setbacks.

In some cases vendors and companies have chosen the wrong problem to attack, said Sheldon Breiner, chairman of Syntelligence. For problems like evaluating home loans or life insurance policies, expert systems are not really needed. Statistical techniques exist, expertise is widespread and the consequences of a mistake are not severe. A good candidate for an expert system is one that many people can use, in a field in which actual experts are scarce and in which using the computer can save the company millions of dollars, he said.

Syntelligence ran into its own hurdle when it came to choosing a problem to solve with artificial intelligence. It began work on a product that would give expert investment advice to financial firms. The idea was to incorporate the expertise of Wall Street luminaries like Henry Kaufman, the former Salomon Brothers chief economist. But the company discarded the project because it determined that there were not any real experts when it comes to investment decisions.

Richard Curlin
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High-Tech Life Reshapes U.S., Analysts Say

Hill Study Predicts Rapid Transformation

Associated Press

The next two decades will be a time of massive change in which virtually every U.S. product, service and job will be reshaped, according to a four-year government study of new technologies.

The congressional Office of Technology Assessment study released yesterday said that emerging technologies should offer chances to expand educational opportunities, extend life, reduce illness and make work more rewarding by using machines for tedious, repetitive jobs.

But the study warned that rapid change also threatens to "shake the foundations of the most secure American businesses."

"We know that we are moving away from an economy heavily dependent on raw materials, where most businesses were isolated from international trade," said project director Henry Kelly.

As one example of how change already has reshaped the country, the study said the number of lawyers, bankers, scientists and accountants needed to supply Americans with food is now roughly equal to the number of farmers.

The study said that for the country to take full advantage of emerging technologies, Congress should consider making fundamental changes in tax laws and government regulations.

"Regulations designed to protect consumers . . . may have outlived their usefulness in areas ranging from banking to housing to electric utilities," the study said.

In the tax area, the study urged reducing or abolishing the tax on capital gains and revising or abolishing the corporate income tax. The report said these taxes reduce needed investment to boost U.S. productivity.

for home mortgage interest should be limited to a fixed amount because it makes little sense to encourage investment savings in the form of home purchases, but not permit the complete deductibility of educational expenses.

Among the report's predictions:

- New technologies for collecting, storing and manipulating information have the potential to revolutionize the economy. Businesses are already spending 40 percent of their investment dollars on computers and other "information" machines, double the 1978 share.

"The potential productivity gains in this area—the movement and organization of information—are at least as great as those produced [by] the first Industrial Revolution," the study said.

- Increased foreign competition was inevitable with the post-World War II recovery of Japan and Western Europe and the emergence of sophisticated production in places such as Korea and Taiwan. Undisputed U.S. economic leadership may be lost, but the change does not necessarily mean that U.S. living standards will decline.
- Consolidation of farm ownership is likely to continue so that by the year 2000, the 14 percent of farms with annual sales higher than $250,000 will account for 80 percent to 90 percent of total sales. Likewise, grocery stores will continue getting larger. "Super stores" with 200,000 square feet of space and offering 20,000 products account for 28 percent of all grocery store sales.
- The U.S. housing industry, to combat the decline in home ownership, may follow the trends of Sweden and Japan, moving toward prefabricated homes built on assembly lines, sold in showrooms and assembled on the site.
- The nation's educational system is on the brink of major technological changes through the use of computers that will make learning more productive and fun while allowing teachers more time to spend with individual students.

WHAT'S NEW IN CONTACT LENSES/ By Jonathan Gill

A Sharper Focus on New Customers

DURING the 1970's the contact lens went from a medical novelty to a mass-market consumer product. But the $1.5 billion industry is still experiencing growing pains. The explosive 30 percent annual expansion of the late 1970's brought price wars in the early 1980's. As the cost of lenses dropped, so did profits, bringing a wave of mergers. When the dust began to settle early this year, the number of lens wearers had climbed to more than 20 million, but annual growth in contact lens sales had slipped to below 10 percent.

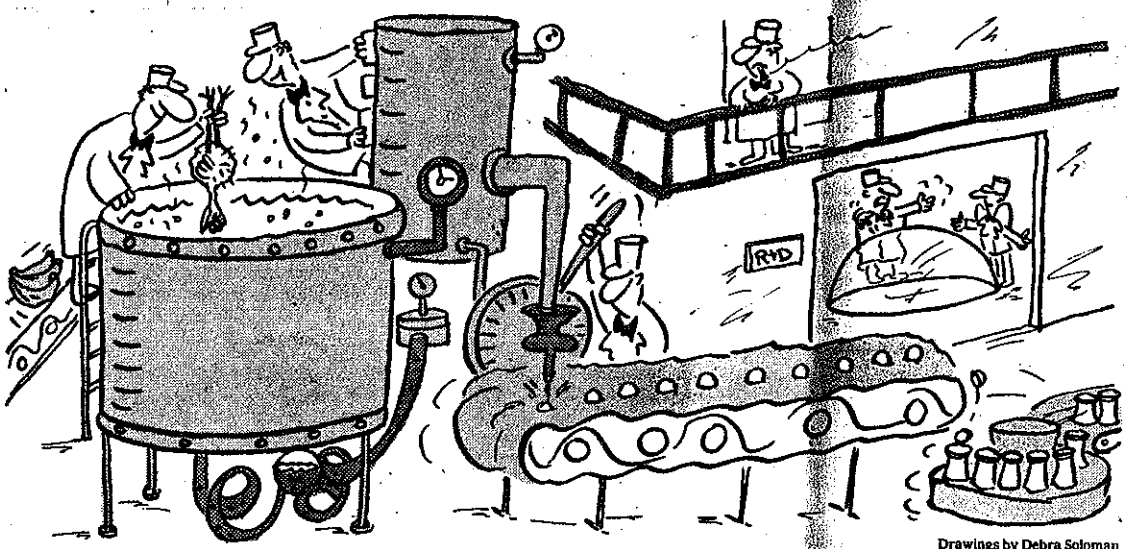
Today, five companies make close to 90 percent of the lenses, a handful of optical chains sell half of them, and multimillion-dollar advertising campaigns are the rule for both. Hard lenses, soft lenses and everything in between are available, including disposable, bifocal and colored lenses. Cleaning solutions are a $400 million industry.

Yet for all the upheavals the fundamental strategic issue for the industry is still the same. "Our competition is not Bausch & Lomb and it's not Wesley-Jessen," said Clive L. Pollard, a spokesman for Sola-Barnes-Hind, a subsidiary of Pilkington Ltd., the British optical giant. "Spectacles," said Mr. Pollard, "that's our competition." With a 20 percent share of the market, Sola is the second-largest American lens maker.

Nowhere is the competition more apparent than in the industry-wide race to fit 30 million aging baby boomers with bifocal contact lenses. Because available bifocal lenses are expensive, uncomfortable, difficult to fit, and often fail to focus sharply for both close viewing and for distances, none have met with success. So the recent approval of a fluoropolymer lens by the Food and Drug Administration, which regulates the manufacture and sale of contact lenses, has attracted the attention of all of the major companies. According to researchers, a bifocal made with fluoropolymers, a substance also used in teflon frying pans, could solve the problems of bifocal lenses and bring in a whole new group of consumers.

"Half of the people in the U.S. wear glasses," said Fred Fritz, a spokesman for Wesley-Jessen, the third-largest lens manufacturer, best known for its success last year with colored lenses. "Only 20 percent of those people wear contact lenses. That is the opportunity we all focus on."

Now, Disposable Lenses and Contact Bifocals



Drawings by Debra Soloman

IN search of an antidote to flattening growth, companies have been increasing research and development budgets, which were cut as growth slowed in the early 1980's. Almost without exception that investment is directed at bifocals and new materials that will combine the good vision correction of hard lenses with the comfort of soft lenses.

SmithKline Beckman's Allergan Optical subsidiary, which bought International Hydron last November and now holds 8 percent of the contact lens market, plans to increase research and development expenditures at International Hydron by 15 percent annually over the next five years. The Cibavision Corporation, a division of Ciba-Geigy, ranked No. 4 in United States market share with 13 percent, raised its eye care research and development budget by 40 percent this year from 1987.

"The industry is becoming more research-intensive," said Eugene Melnitchenko, an optical industry analyst with the Dallas brokerage firm of Eppler Guerin & Turner. The results are already showing, from frills like sunlenses to genuine advances like fluoropolymers, not to mention the many therapeutic uses of contact lenses, Mr. Melnitchenko said.

"The only way to get the market to get going was to introduce new products," said Irving Bennett, a Florida optical industry consultant.

Bausch & Lomb, the largest American lens manufacturer, controlling a quarter of the lens industry, has increased contact lens research 20 percent over last year. Most of the growth came in the area of bifocals and extended wear lenses. Last December, the company's subsidiary, the Polymer Technology Corporation, became the first company to receive F.D.A. approval to market fluoropolymer lenses. Bausch & Lomb also recently introduced an extended-wear rigid gas permeable lens that, unlike normal hard lenses, can be worn for several days because of their superior permeability.

Paragon Optical, a subsidiary of Sola-Barnes-Hind, the second-largest lens company, received fluoropolymer marketing approval in January. Now the company is ready to introduce a hybrid lens, already in use in Europe, that combines the superior vision correction of a hard lens in the center of the lens with the comfort of a soft lens in the perimeter.

Another interesting development is taking place in California and Florida, where Johnson & Johnson's Vistakon subsidiary, which holds 5 percent of the market, is test-marketing the first disposable contact lens. At $520 a year, Vistakon's bifocal, which is thrown away after a week, is thought to be too expensive to succeed. But Bausch & Lomb and a number of smaller companies say they are close to introducing their own disposable lenses.

"It's such a convenience," said Barry J. Farkas, a New York optometrist and optical industry consultant who helped Johnson & Johnson develop disposables, "that nobody quibbles about the price of these lenses." ■

The Bitter Battle Between Doctors and Chain Stores

TEN years ago, private optometrists and ophthalmologists prescribed and fit 80 percent of all lenses. Today, that figure has shrunk to less than 50 percent, in the face of competition from high-volume retail chains and phone and mail order companies. The largest of the these is Pearle Health Services, a retail chain which fits and sells lenses at 1,300 storefronts in 45 states and recruits optometrists directly from optometry schools.

Even though the shift is thought to have stabilized, the competition among retailers, who now number almost 10,000, and private doctors is bitter. In New Mexico, for example, a group of doctors refuse to prescribe lenses for patients who intend to buy them more cheaply in a retail outlet.

"It's incredible what goes on at the quickie places," said Michael A. Feldman, a Long Island optometrist. "What they're interested in is sales, and it really hurts our industry."

Private doctors, many of whom confine their work to contact lenses, say that despite strict Federal regulations governing the dispensing of contact lenses, retail operations neglect medical care in favor of quick service and low prices.

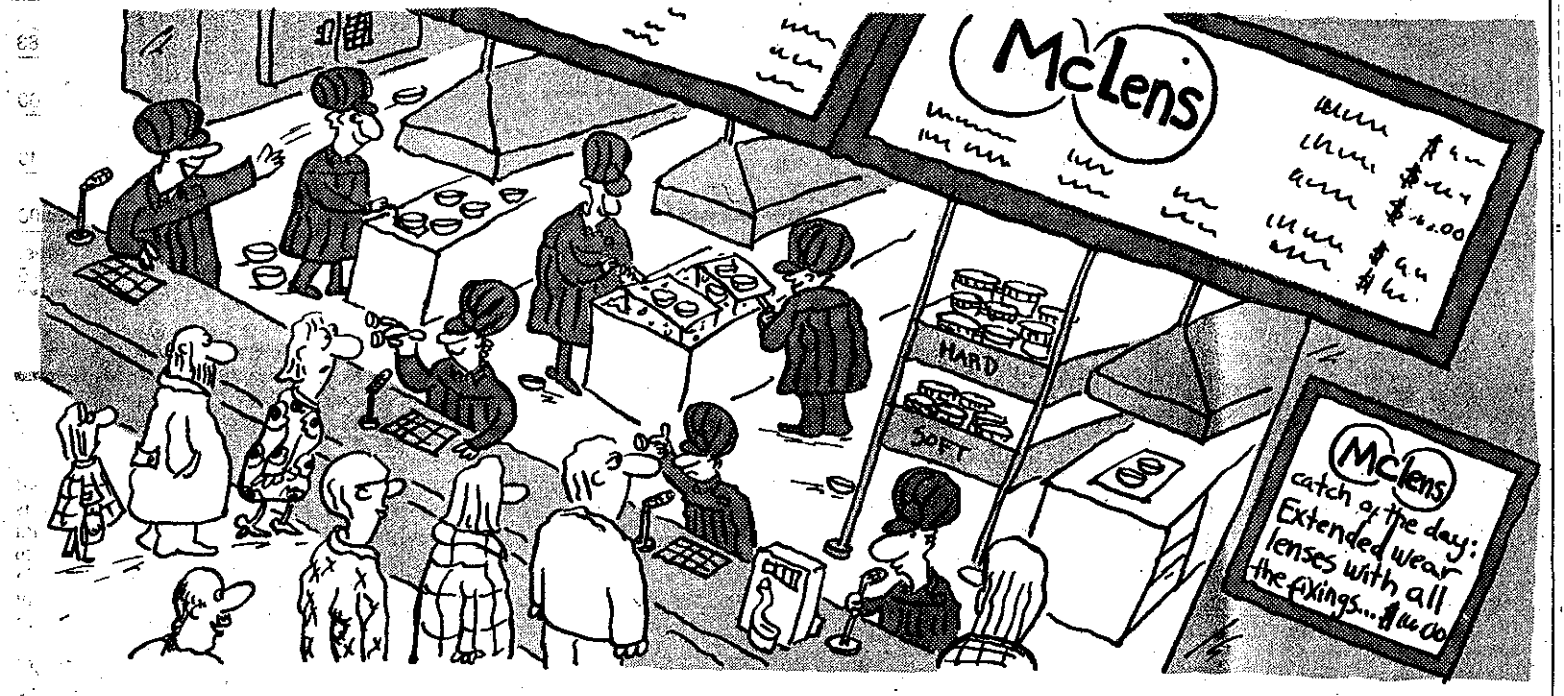
Complaints about the chains range from sales pressure for or against certain lenses to failure to clean sample lenses after each try-on. Some companies use aggressive advertising to draw in crowds. One Pennsylvania chain recently advertised in a Philadelphia newspaper a special on soft lenses for $1.99 a pair, but the price applied only to first-time, nearsighted patients who also paid $50 for an eye exam.

The high-volume operations like Pearle, Cole National, with almost 600 stores, and Royal Optical, with almost 500 stores, say they offer adequate care and low prices to most lens wearers — even specialty lenses are available from some services for less than $50 — and that private doctors use big mark-ups to make up for low volume.

"We're taking a major bite out of their profits and I think that's where the animosity comes in," said Michael A. Ames, the general manager of Dial-A-Contact-Lens in La Jolla, Calif., one of several high-volume telephone services nationwide. "We're probably blowing off a lot of their Ferraris," Mr. Ames said.

"We have had complaints, but there are probably complaints about doctors too," said Rhonda Klein Singer, the vice president and general counsel of the Better Business Bureau of Metropolitan New York. The bureau, which keeps records of complaints, says the number of complaints about retail operations in the New York area has been decreasing.

"For the average person it may be a money saver," said Ms. Singer. ■

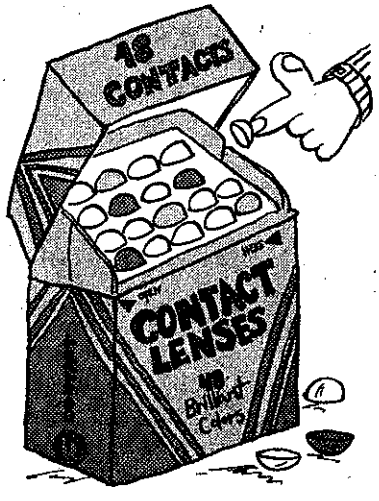


Taking Dark Eyes and Making Them Green or Blue

STARTING from zero five years ago, sales of colored contact lenses grew to $45 million last year. These include both tinted lenses, which can change the color only of light eyes, and Wesley-Jessen's opaque lenses, which use dots of color on a clear lens to make even brown eyes green or blue. They are thought to have buoyed sales of all types of lenses and accounted for about half of the industry's growth in recent years.

"When Wesley-Jessen started advertising in January '87, the whole market perked up," said Irving Arons, an optical industry consultant with Arthur D. Little. "All kinds of lenses increased in sales."

The potential of colored lenses is so great that many of the leading companies have colored lenses on their agendas and several are planning opaque lenses. But others doubt that colored lenses can revolutionize the industry the way soft lenses did in the early 1970's, despite the fact that 600,000 people now wear Dura-Soft colors, which have been on the market for only two years.



"I don't think those numbers are going to hold long term," said L. Dean Clements, a director of the Contact Lens Manufacturers Association. To be sure, sales of tinted lenses, first available in 1984, have been below expectations. Doctors and patients complain that the results, achieved by painting an iris on the surface of the lens, look unnatural. Wesley-Jessen, which introduced opaque lenses a year-and-a-half ago, is still the only maker of these lenses; nearly a third of its sales are to people who do not need vision correction. But most other big lens makers say they plan to introduce their own versions.

As sales of colored lenses level off in the United States, companies are looking to Asia to maintain growth. Bausch & Lomb recently entered into joint ventures in China. International Hydron has entered into joint ventures in both China and India. Wesley-Jessen is putting out feelers in the Japanese market, where projected growth is three times that of the United States.

"Imagine," said Fred Fritz, the vice president of marketing and sales at Wesley-Jessen, "One hundred and twenty million people, all of whom have dark eyes." ■

Massachusetts Institute of Technology has birthed more companies than any other university. Now it is finally starting to collect some of the payoff.

Patent profit

By Laura Jereski

LAST YEAR John Preston filed at least 100 different patent applications. This year he expects to file 150 more. Restless genius? Not quite. Preston, 38, heads the technology licensing office at Massachusetts Institute of Technology. His mission: to find commercial outlets for the inventions and innovations born in MIT's labs—and to make a little money for the university, besides.

Just keeping up with MIT's output is no small task. At $300 million for fiscal 1988, the celebrated Cambridge, Mass. school's on-campus research budget is 50% more than neighbor Harvard's. Add the $400 million or so at Lincoln Laboratories, the electronics center MIT runs for the U.S. government, and the fuel research at the nearby Whitehead Institute, a biomedical research affiliate, and MIT's research budget outstrips that of any other American university.

No wonder so many companies have been founded by alumni or professors, many based on technology discovered in the school's labs: at last count, more than 400 firms in Massachusetts alone, with revenues last year of $27 billion. These include not only such giants as Digital Equipment Corp. and Raytheon, but also some relative newcomers like Lotus Development Corp., Prime Computer and Symbolics, the artificial intelligence company.

And where was MIT? Standing idly by, neither helping the ventures get started nor getting much benefit from their success. Now John Preston, himself a cofounder of a software company, is changing that. Through his technology licensing office, MIT is beginning to work more closely with companies that will use its lab-bred innovations. And he wants the school to help set up companies based on new technologies.

One of the first things to be done was to get rid of two of the three lawyers running the licensing office set up in 1932 to file and manage MIT's patents. Says Preston, "They were great at protecting the scientists and lousy at marketing their inventions." No kidding. When he took over in mid-1986, royalty income had stagnated at some $2 million annually. For a good part of the past 20 years, most of this income had derived from two discoveries—synthetic penicillin and magnetic core memory for computers. Licensing had virtually ground to a halt.

By the end of 1987, Preston's first full year, licensing revenues hit $3.1 million from about 100 inventions, both new (high-temperature superconductors) and old (LISP, the software of choice for so-called artificial intelligence computers). With license fees ranging from 2% to 6% of net revenues, depending on the product, some $150 million of products manufactured last year—including expert software and new drug delivery systems to treat brain tumors—depended on processes developed at MIT. Only Stanford (with license revenues of $6.1 million), the University of California ($5.4 million) and apparently the University of Wisconsin (about $5 million) do better.

Preston is predicting royalty revenues of perhaps as much as $50 million in another five years. How? "We've changed the professors' mentality," says Preston proudly. "They've started thinking, 'If I can show commercial results, I'll have a better shot at raising my research funds.' They've changed away from pure scientific research."

Indeed, the school itself has changed. Now, when a really good technology comes along, Preston helps the inventor set up a new company—and often takes a small chunk of equity as part of the licensing fee.

Each invention is screened by a committee of six, which includes three engineers and three scientists. When this group is unsure, they turn to medium-size high-tech companies to see what they think.

Last year Preston's technology office acted as marriage broker between venture capitalists and the largest new startups in Boston: American Superconductor (initial capital, $4.5 million) and Immulogic Pharmaceutical ($3.25 million). The technology office owns roughly 10% of each company.

Underlying such opportunities is a change in federal law in 1980 that gave universities ownership of federally funded intellectual property. (Such property had belonged to the government.) Since then, industry contributions to universities have taken off. Between 1980, before the law changed, and 1986, research funds from companies nearly tripled, to $667 million. And MIT, of course, gets far more every year than any other school: $37 million in 1987 alone. Will MIT begin to fund its spinoffs directly or perhaps set up incubator parks to coddle them? Not likely, says Preston. "You have to let the free market decide which are the better ideas," he says.

But at least you ought to get a piece of the action. ■

Seth Resnick/Picture Group

MIT's John Preston
"We've changed the professors' mentality."