cont. from previous page

Joseph Califano gives commencement speech at U-M's Hill Auditorium

for scientific or government officials to avoid public scrutiny in tackling complex moral issues.

However, he told the graduates, "Decision-makers in science and medicine must learn the hard lesson that politicians have absorbed in recent years: Closed doors breed distrust — even if what happens behind those doors is perfectly legitimate."

Emphasizing that the difficult decisions should be made in the open and not left to "mere experts," he said, "If we cannot guarantee right decisions, we can guarantee that we decide in the right way. This means decisions made democratically through wide consultation, not by special elites.

"Perhaps (citizens) cannot share in the making of every big decision — but they should at least see them made."

While conceding that consensus decisions are time-consuming, Califano stressed the importance of avoiding hasty decisions.

Kansas Graphic-News; 12/19

Minimum Wage Rise To Hike Hospital Costs

PAOLA — Hospital costs in Kansas will increase between $40 and $45 million next year. This anticipated increase is attributed to the federally-mandated increase in the minimum wage from $2.30 to $2.65 per hour, effective Jan. 1.

Robert Johnson, administrator of Miami County Hospital, indicated hospitals are in a "no win" position. Hospitals are pressured by the federal government to contain cost increases. At the same time they are faced with increased costs legislated by the federal government over which they have no control.

WHILE HOSPITALS don't want to deny their employees an equitable wage, the increased costs have to be passed along to the customer.

Hospitals are especially hard hit when labor costs rise, according to Johnson. Costs of hospital personnel are double those of industry. Hospitals must be staffed 24 hours a day, seven days a week.

"Miami County Hospital is better off than most small hospitals," Johnson said. "Our wages are right at or a little above the new minimum wage level. For most small hospitals, the new minimum will necessitate an immediate and sizeable increase," he added.

WHILE THE MINIMUM wage law applies specifically to those at minimum pay levels, employee wage levels are increased as experience and training are increased. These persons also should have increases if they are to retain the benefits of prior wage increases. This produces a ripple effect in raising labor costs.

By 1981, the minimum wage will be $3.35 per hour. This is the highest jump, $1.05 over the next three years, since hospital employees were included under the minimum wage law 10 years ago. At that time, the minimum wage was at $1 per hour.

St. Louis Globe-Democrat; 1/11

Alcohol returns as No. 1 drug

By BARBARA BUMGARTEN

Most parents would rather have their kids drink than use drugs. Unfortunately, condoning drinking may prove to be a fatal mistake.

Alcohol is a dangerous drug. Nearly 8,000 young Americans are killed each year in accidents involving young people and alcohol. Forty thousand more are disfigured.

Even if teen-agers don't drink, chances of their being the victim of someone who does are frightening. It's the sobriety of the individual behind the wheel that matters. And no adolescent can guarantee "it won't happen to me."

"The young drinking driver is more susceptible (to accidents) because he has less experience both with drinking and with autos, as opposed to the older driver who has had experience handling both," said Stephan Hall, public education officer for the Colorado State Patrol.

The New Year is a particularly appropriate time for parents to sit down with their children and realistically discuss the dangers of drinking and driving.

HAVING FACTS about teen-age drinking may prove helpful.

A survey conducted by the National Highway Traffic Safety Administration indicates 50 percent of all youngsters 15 to 19 said they had been in one or more situations in the past month where alcohol was present. Here's some information about these teens as recorded in the survey:

- 40 percent of these were girls.
- 25 percent were 15 years of age or younger.
- These teen-agers were just as likely to do well in school and take part in out-of-school activities as those who didn't find themselves in situations where alcohol was present.
- Three out of five admitted to having been drunk one or more times in the past month.
- The group who had been in situations where alcohol was involved said it occurred in a variety of places, most frequently at a friend's home. Drinking also was said to take place at parks, beaches or other outdoor places; bars or restaurants; school functions; or drive-in movies. Much of it occurred in teen-agers' own homes.

THERE ARE a number of myths (some even believed by adults) about alcohol. Parents and youngsters should know the facts.

Once one is intoxicated, coffee, cold showers, aspirin or whatever remedies one tries will not hasten recovery.

"The only thing it takes to sober up is time," stated Hall. "Alcohol comes out of the blood at .015 percent an hour and there is nothing one can do to change this."

MANY PEOPLE believe that a can of beer is less intoxicating than the average drink of liquor. But a 12-ounce can of beer, one ounce of 100-proof liquor and a six-ounce glass of wine are equal in their effect on the body.

It is estimated by the federal government that 1.3 million teen-agers between 12 and 17 have very serious drinking problems.

"PARENTS WOULD be wiser to train their children at home about alcohol than to forbid it," Hall believes, "but if youngsters are going to take on a mature privilege, they should take on the responsibility that goes with it."

Hall stressed that it is extremely important for parents to set a good example.

He also believes that "overdoses of love" will help ease the pain in people's lives which he feels drives them to drink.

A booklet, "How to Talk to Your Teen-ager About Drinking and Driving," published by the U.S. Department of Transportation, offers points to help parents talk with teen-agers about drinking and driving. Parents need to:

- Honestly explore their own behavior when drinking and driving before talking with their teen-agers.
- Be honest in expressing their feeling and values, and encouraging the same from their children.
- Be calm, firm and consistent — and don't put the teen-agers on the witness stand or demand a confession.
- Keep to the point.
- Emphasize that they are not concerned with the car, but with the preciousness of the teen-agers' lives.

Naturally, sometimes teens may find themselves in situations where things are getting out of hand. Therefore, parents and their children need to design a plan of action for those occasions.

Stephan Hall recommends several possible solutions:

PARENTS CAN STRESS to their children that if they get drunk, or their driver is drunk, the children should call home and the parents will pick them up — with no penalty and no embarrassment.

Parents might also recommend their children consider making a sober driving pact in which they agree among their friends who is not going to drink that evening so that person can do the driving. Then rotate the responsibility.

Omaha World-Herald; 1/10

Age No Barrier to Child Abuse

By Dr. Saul Kapel

New York News Service

—Abuse of children is not restricted to pre-adolescents, according to a survey by University of Rhode Island graduate student Martha Mulligan.

She found that 26 percent of the freshmen at U.R.I. had been on the receiving end of physical violence from parents the year before entering college. Half of the adolescents fought back, even striking their parents.

Excellent Tool

—Groups of parents, educators, guidance counselors, indeed anyone interested in designing programs dealing with child development and family life will find "A Selective Guide to Materials for Mental Health and Family Life Education," compiled by the Mental Health Materials Center, 419 Park Ave. South, New York, N.Y. 10016 ($45), an excellent tool for evaluating and obtaining the many books, pamphlets, films and audio visual items devoted to this broad subject.

Deficiencies

—From 20 to 25 percent of all babies born in the U.S. are born with less than perfect health

cont. on next page

THE GREEN SHEET

News About the U.S. Department of Health, Education and Welfare

cont. from previous page

Congress, fearing public interference in the laboratory. At a hearing in Houston, Dr. Bert O'Malley, an endocrinology expert at Baylor College of Medicine, said, "The public is primarily involved through Congress in that the distribution of funds is done on the basis of what diseases are killing people."

Dr. Stanley Dudrick of the general surgery department at the University of Texas Medical School disagreed. "We have to stop asking just the researchers and go back to the people, give them the facts but ask them for input."

But Kennedy also challenged the research community itself to play a more active role in setting priorities.

Consider the trip to Houston.

He toured portions of the M. D. Anderson Hospital and Tumor Institute, an ultra-modern cancer center. He was impressed by an "air flow" unit where cancer patients with reduced immuni-

'We must ensure that our biomedical research effort remains relevant to the needs of the people.'

—SEN. EDWARD M. KENNEDY

ties because they are receiving chemotherapy are kept in isolated rooms so they will not be exposed to any bacteria. It is a depressing sight because the patients must stay in their glass-enclosed rooms, talking to relatives through two-way telephones. But doctors say this relatively new approach doubles the success rate of fighting cancer in these immuno-suppressed patients.

But at a meeting later with the hospital's top cancer researchers, Kennedy became impatient as the doctors seemed unable to focus on his questions about how they set priorities and how they interact with the public.

"We see an explosion of smoking among teenagers, especially young girls," Kennedy said. "Who's thinking about and planning for that?"

"I wish I could answer you," replied Dr. Robert Hickey, a director, during a luncheon in a plush cancer center conference room.

"Are you just following the grants?" Kennedy asked. "Do I go back to Congress and say they are pursuing x, y and z grants because they are available, or do you people tell us what you'd like to be doing, where you'd like to be going?"

Rocky Mountain News; 12/16

State delegation divided on Social Security vote

By CHARLES ROOS
Scripps-Washington Bureau

WASHINGTON — To the Colorado congressional delegation, the new multibillion-dollar funding bill for Social Security is a mixed blessing if it is any blessing at all.

Most of the Coloradans voted against the bill, which was passed in a conference committee version by both houses. It is designed to prop up financing of the ailing fund by raising Social Security taxes $227 billion from 1979 through 1987.

Voting "no" Thursday were: Democratic Sen. Floyd Haskell, Democratic Reps. Pat Schroeder and Tim Wirth and Republican Rep. James Johnson.

Democratic Sen. Gary Hart and Democratic Rep. Frank Evans voted for the bill.

Republican Rep. William Armstrong missed the vote. An aide said Armstrong was concerned about parts of the bill, but was unable to get back from Colorado to vote because of inadequate notice.

BEFORE THE VOTE IN the House on the bill itself, Mrs. Schroeder tried to jam the House machinery by leading a movement against a section of the conference committee report.

Her chief complaint was with one section put into the bill by the Senate and accepted by Senate-House conferees.

This section, she said, will mean that 150 provisional federal employees who work as judges, but have never proved they are qualified, will get lifetime tenure at $36,171 a year.

They may deserve it, she said, but how can you tell?

Those 150 persons are administrative law judges, appointed on a provisional basis to clear up a backlog of hearings in the Social Security Administration.

At the time of their authorization and appointment, it was understood they would have to prove their qualifications before gaining permanent status.

The bill passed Thursday by both houses automatically gives them lifetime status – at the next higher Civil Service grade.

IN TERMS OF GOOD GOVERNMENT and fair play, there was no reason to put them in the bill, Mrs. Schroeder said. She acknowledged there had been delays in upgrading some of the jobs, but said the Civil Service Commission was now prepared to deal with them.

A House staff aide described the action as "an unprecedented attack on the merit system" and as "an early Christmas present" for the 150 administrative judges – three of them in Denver.

Mrs. Schroeder got substantial support for her position, though many House members who joined in voting with her had broader objections to the bill.

The Democratic House leadership not only backed the bill, but insisted that there be no changes.

The House Ways and Means Committee chairman, Rep. Al Ullman, D-Ore., said passage of the whole measure, including the change in status for administrative judges, was necessary to preserve the efficiency and integrity of the Social Security fund.

In a preliminary test vote, the House leadership won, 170 to 145. In a later vote on the bill itself, the margin was about 25 votes.

In explaining his vote, Wirth said the bill will put an unfair tax burden on workers at lower pay levels.

The bill makes only short-term improvements in funding, Wirth said, and gives it no real stability.

JOHNSON VOTED AGAINST THE funding bill earlier when it went through the House and voted "no" on the Senate-House compromise Thursday, saying he can't endorse the sharp hikes in the tax which will hit workers and employers in 1979.

An aide to Haskell said the senator declined to serve on the Senate-House conference committee because he disliked both versions of the bill and felt action now was premature.

An aide to Hart said the senator simply felt something had to be done this year to begin replenishing the fund.

Topeka Daily Capital; 12/20

Defaults climbing on student loans

By SYLVIA PORTER

As year end '77 approaches, more than 344,000 young men and women who have received federally guaranteed student loans are in default — leaving the federal government with the job of collecting a huge half-billion dollars from debtors who have "skipped."

To collect the money, the Office of Education has hired 106 employes — and given these workers a staggering workload.

According to OE guidelines, each should be handling an average of 600 cases at any one time. In fact, the typical collector has a caseload amounting to more than 3,000 accounts, and this total is climbing.

Merely finding the debtor is more than half the problem. (The search for student loan defaulters is called "skip-tracing.")

To suggest the magnitude of the task, my Washington associate, Brooke Shearer, interviewed several loan collectors for this column. One, Judith Dickinson, a senior program official in the San Francisco regional office, described a case on her desk at that moment.

"This former student defaulted on his loan in July, 1970. The Washington office sent him a letter 17 days later. It was returned without a forwarding address. By October, the main office had traced him through his school. The school gave us two addresses, neither of them valid.

"In 1973, the case was transferred to our San Francisco office. At the time we had eight employes handling 50,000 cases, but we sent him three more letters. We got no response.

"In January 1975, we located his address again and sent two more notices. No answer. Finally, this October, we

Your money

sent him an additional letter at the address he used on his 1974 tax return. It worked.

"We received a cashier's check for the principal of his loan, $812, but he asked us to waive the more than $400 he owed in interest. He explained that he attended a trade school to learn to become an airline ticket agent, got top grades, but couldn't get a job.

"He felt the school had been a rip-off, and therefore, he shouldn't have to pay the interest on his loan. I doubt his request will be granted, but," she concluded, "we're considering it."

Why the massive student loan defaults?

—Dissatisfaction with the schooling they receive and subsequent unemployment — just two of the many reasons.

—Breakdowns in communication between students and lending institutions. A student may neglect to tell a lender if he drops out or moves; lenders may fail to contact the students, for although they are required "to exercise reasonable care and diligence" in locating students and collecting, the comparatively low interest rate on the loans (a maximum 10 per cent) and fact that loans will be made good by the U.S. government, reduces the lenders' incentive to pursue student defaulters.

Thus by the time a claim reaches a collector months, if not several years, may have passed since the default.

—Laws protecting an individual's privacy also compound the difficulties, say some collectors.

Cornell University
Ithaca, New York 14853

420 College Avenue, Sheldon Court
Department of Patents and Licensing
(607) 256-4945

EMA
ACK
NJL

Cm Nade
EIB
LBR
IGF
LCJ

PATENT BRANCH, OGC
DHEW

OCT 12 1978

October 6, 1978

Norman J. Latker
Patent Counsel
Department of Health, Education
and Welfare
Washington, DC 20201

Dear Mr. Latker:

Enclosed please find a copy of an article that recently appeared in the Cornell Chronicle.

Sincerely,

Joan Lockwood Parker

Joan Lockwood Parker
Technology Transfer Secretary

JLP
Encl.

Cornell Chronicle, 09/28/78

Patenting Is a Growing Idea at Cornell

FEATURE

For decades "patent" has been a dirty word among many university faculty in American higher education.

Things are beginning to change, however, at a number of the nation's leading research institutions.

Among the leaders of this relatively unnoticed revolution is Cornell, along with Stanford University, Massachusetts Institute of Technology, and the Universities of Wisconsin and Illinois.

Stanford, for example, announced last year that since 1970 its Office of Technology Licensing had distributed more than $750,000 to faculty inventors, their academic departments and the University general fund.

Cornell's own Department of Patents and Licensing has compiled figures going back nine years (when interest in patents picked up here) showing that the Cornell Research Foundation has received a total of $1 million from licensees of Cornell inventions. Most of the funds, $768,000, were paid to the inventors and to their departments for further research. The remainder was used for operating expenses of the University's expanding patent program.

Currently, CRF, a wholly owned subsidiary of the University, holds 92 U.S. patents and has applications pending in the United States on 24 others.

A question that arises is what is behind this gradual abandonment of the time-honored idea that the fruits of university research are part of the public domain?

An obvious answer, of course, is that given the financial plight facing higher education this kind of idealism goes out the window under the pressure of necessity.

The answer is not that simple, however, according to Theodore Wood, manager of the University's Department of Patents and Licensing, established in 1976. Before that time all University patent applications were turned over to Research Corporation in New York City, which performs this service for more than 300 institutions in the country. Establishment of the University's current program was based in part upon the recommendation of a study by the Cornell Class of 1922.

Speaking in his small office complex in 124 Day Hall, Wood said that in the 1960s certain departments in the federal government began to encourage universities to seek patents based on their research findings. While there never has been an official administration policy on encouraging use of the patent system, more and more federal departments are pursuing such a policy, Wood said.

Surprisingly, the greatest impetus has come from the Department of Health Education and Welfare. Norman J. Latker, patent counsel for HEW, has been a leading proponent of the patent system and the need for universities in particular to use it.

But why?

Latker and others, including Betsy Ancker-Johnson, former assistant secretary for science and technology, U.S. Department of Commerce, have argued publicly since the late 1960s that American business has fallen behind many European countries, not because it doesn't have new ideas for products but because too many of them never get developed and placed on the market. In their words American business is the victim of a growing "technology transfer gap" with most of the world's industrial nations.

They argue that by allowing new discoveries to enter the public domain immediately, private incentive to turn the ideas into marketable commodities is killed. It should be pointed out that a patented idea lasts 17 years in the U.S., then automatically enters the public domain.

As Wood says, "History shows that businessmen will seldom invest in an invention that is available to everyone."

Some argue that the "public domain idea" among faculty is a vestige of the pre-World War II university when the research effort on American campuses was relatively modest compared to today's standards. They also say it is related to "publish or perish" pressure. The patenting process can be drawn out and during that time the inventor feels constrained about publishing his or her research.

Sophie F. Capolongo, administrative aide in the Office of Patents and Licensing, displays a computer printout of Cornell patents to Theodore C. Wood, left, manager of patents and licensing in the University's Technology Transfer Program, and Thomas W. Mailey, who serves as manager of industrial liaison for the program.

With the influx of billions of federal dollars in the past three decades, American research universities have become a major source of ideas and information needed for the future growth of American industry. University contributions have been crucial in the success of the space program and America's world leadership in electronics and computers.

Shifts in government research support, the increased emphasis on patents and licensing and the inevitable growth in inter-relations with industry mark what appears to be a new era in the evolution of university research.

The question of whether patent and licensing will ever become a substantial source of revenue for universities is still open. The figures now don't indicate it will be, according to Wood.

There are other realities, however, according to Thomas W. Mailey, who works with Wood as manager of industrial liaison in what is called Cornell's Technology Transfer Program.

"We must be constantly aware," says Mailey, "that we exist to help inventors and move new ideas and concepts from research to industry. This does not mean that our total effort is towards making money—it means our orientation should be towards maximum exposure of good new technology resulting from research at Cornell."

Both Wood and Mailey feel their work is a new variation on the public service commitment of the university as the state's Land Grant institution.

Wood, who retired in 1970 after 17 years as a patent executive with International Business Machines, Inc. says his patent work at Cornell is the most challenging of his career, which began as an examiner in 1946 with the U.S. Patent Office.

The overall technology transfer program is under the direction of W. Donald Cooke, vice president for research, with the assistance of Thomas R. Rogers, director of the Office of Sponsored Programs.

But if you have any patentable ideas, Wood is the man to see.

Martin B. Stiles

Daniel S. Greenberg

WASH. POST
OCT. 17, 1978

'Disease-of-the-Month Club'

Among establishment health researchers, a mythical entity known as the "disease-of-the-month club" is on a par with escaped viruses, plagiarized research and canceled travel grants as an impediment to restful sleep.

In his 20 months as chief of health, education and welfare, cagey Joe Califano has perceived this publicly unrecognized bête noire of research. And, in a newly initiated campaign to remake federal health-research programs according to the Califano vision—with the stress on long-term planning, austerity and social utility—he has shrewdly offered the biomedical community a bargain: Cooperate with me, and, in return, research will, among other benefits, be insulated against the disease-of-the-month club.

For the biomedical savants to whom he recently presented this proposition, there's much appeal in this trade-off, since the "club" is to them as SALT is to Russophobes and double-digit inflation to pensioners, an abomination that pricks deep fears and unplugs combative hormones. What is the disease-of-the-month club?

It is the shorthand term for the often-successful tactic of whipping up public and congressional sentiment to compel the National Institutes of Health to pay some, or more, attention to a disease that does not much appeal to NIH's own scientific fancy. With a humanitarian flavor, then, it is a pork-barrel play for the government's health-research money. It is policymaking through the use of alarmist tactics, maudlin appeals and political muscle, rather than through cool appraisal of scientific value and "ripeness," which are the criteria that the biomedical high command prefers for deploying resources. As Califano understands, the club is anathema to the profession.

Referring to "the inevitable but not always desirable pressures that attend the distribution of substantial research dollars," he sympathetically reminded a recent assemblage of health scientists, "You're all familiar with the kind of disease-of-the-month pressures that attend the budget process within HEW and the Congress." None appeared mystified and none objected to the comradely alarm that he raised.

Nevertheless, some kind words are in order for the club, which, though almost always regarded with disdain, has actually served a useful role in the politics of medical research. For the process, which the establishment fears, and which Califano is nimbly exploiting, simply represents the application of democratic politics to the elitist business of biomedical research.

The club, such as it is, usually consists of people who, through personal misfortune, are concerned with a particular disease, and want their government to try to do something about it. Following the model of hog raisers, bomber builders and other successful agitators for government attention, they engage the services of public-relations specialists, pressure their elected representatives, and generally create a nuisance—until NIH, almost always reluctantly, finally yields and puts some scientists to work on the problem.

The track record of this process is written into many of the programs and even some of the titles of the institutes that together constitute the National Institutes of Health, and it's not a bad record. For example, it was only after parents of children with leukemia applied pressure through Congress that NIH turned attention to the difficult problem of suitable nutrition for patients undergoing treatment for that disease. In response to political pressure, the old National Heart Institute broadened its scope and became the National Heart and Lung Institute, and a couple of years ago it metamorphised into the National Heart, Lung and Blood Institute. What was formerly known as the National Institute of Arthritis and Metabolic Diseases is now the Institute of Arthritis, Metabolism and Digestive Diseases. In the same fashion, the former Institute of Neurological Diseases and Stroke is now the Institute of Neurological Diseases, Communicative Disorders and Stroke.

In some instances, the NIH leadership initially yielded to the changes as an inexpensive way to quell the din. But the inexorability of bureaucratic expansion can have virtues, too: For, once a disease gets on the letterhead, it's easier for research money to follow—and what's wrong with that?

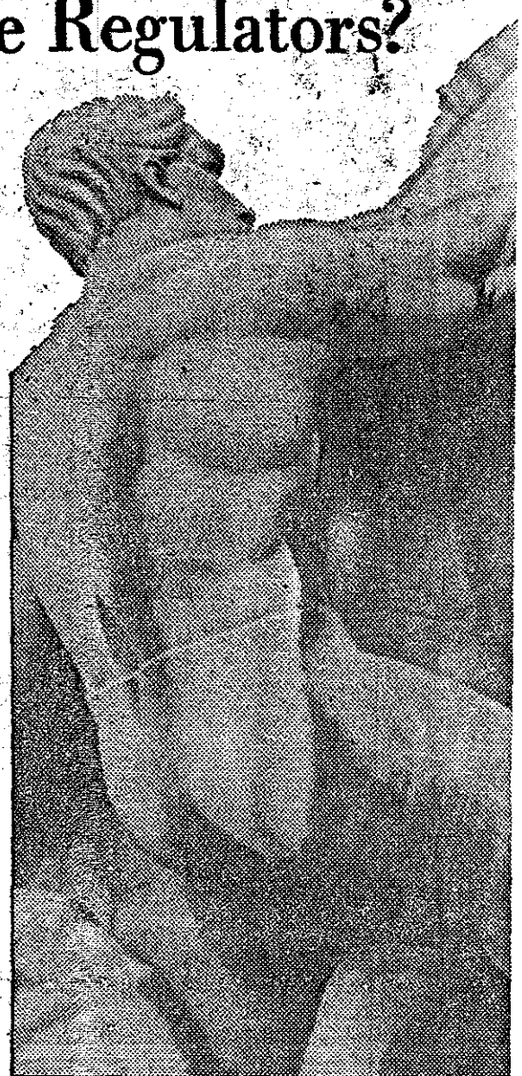
Cost-effectiveness worshippers—almost always unaffected by the ailments they deem unprofitable for research investment—are horrified by this emotional intrusion of politics into health-research affairs. But, as one special-interest health group, the American Narcolepsy Association—patient load a mere 250,000—recently pointed out to Califano: "We do not believe it is callous lack of regard for the needs of others which sometimes results in disease-of-the-month groups demanding special attention; rather, such efforts are the result of frustration with the existing system, which fails to give fair consideration to the needs of all and allocate research resources accordingly."

That's worth keeping in mind as HEW and the biomedical community plan the future of health research.

WASH. POST OCT 17 '78

Lloyd N. Cutler

Who Masters the Regulators?



Every school child learns about the separation of powers. The federal government has three branches—legislative, executive, judicial. Right? Wrong.

Oh yes, we forgot the regulatory branch. The ICC, the CAB, the FCC, the SEC, the FTC, the NLRB, the FEC, the CPSC and about a dozen other agencies operate under laws that make them independent of the legislative and executive branches. So there are really four branches. Right? Wrong, because each of these independent agencies is also independent of every other agency. So that makes about 23 branches? Careful, you may well be wrong again.

For there is a new theory abroad in the land that even regulatory agencies *within* the executive branch are also independent of the president and of one another. There are over 60 such agencies, many of them parts of a Cabinet department. According to this new theory, the president—the chief executive of the nation and the head of the executive branch—does not have the last word over what any of these agencies can do. Indeed, he cannot even have the first word. He is not supposed to intervene in their regulatory actions at all. Whatever you may have learned in civics class, the new theory denies that the president is in charge of the whole executive branch.

The new theory rejects any such unitary concept of the executive branch on both legal and policy grounds. The legal issue is now being tested in the case of OSHA's cotton-dust standards. It raises one of the most important constitutional questions of modern times.

OSHA is part of the Department of Labor. It was created by a 1975 statute to set standards for health and safety in the workplace. It proposed issuing a standard governing the permissible level of "cotton dust" in *textile mills*, where excessive levels have led to the widespread occupational disease called "brown lung." The proposed levels were challenged by the textile industry because they require expensive equipment and their technical feasibility is doubted. Charles Schultze, chairman of President Carter's Council of Economic Advisers, became concerned that the proposed levels and technical requirements would have an unduly inflationary impact, and he persuaded the president that certain modifications would provide a better balance between the nation's occupational health and anti-inflation goals. He wrote to Secretary of Labor Marshall, proposing these modifications with the president's approval. Secretary Marshall objected to the modifications, and in a meeting with both his Cabinet aides, the president worked out a compromise. That compromise was embodied in the final regulation, over the objection of the Textile Workers Union. The Union has now appealed OSHA's regulation to the courts on a variety of grounds. One ground is that the president's intervention was illegal, because the OSHA statute vests the power to issue the regulation in the secretary of labor, and the president could not lawfully instruct the secretary how to exercise his statutory discretion.

This case capsulizes a basic problem of our federal government today, a problem that has recently been examined by the American Bar Association's Commission on Law and the Economy, headed by one of the nation's most distinguished lawyer-statesmen, John J. McCloy. As the McCloy Commission noted, we have adopted a wide variety of economic and social goals—such as checking inflation, spurring economic growth, reducing unemployment, improving workplace health and safety, cleaning up the environment and closing the energy gap. We are only beginning to realize that many of these goals directly conflict with one another, and that even in a country as richly endowed as ours, all of them compete for the same limited resources. We cannot pursue them all in full measure at the same time. A critical task of modern democratic government is to make wise balancing choices among proposed courses of action that pursue one or more of these conflicting and competing objectives.

We have delegated each of our conflicting and competing goals to a different regulatory agency, sometimes even dividing a single goal (e.g., employment discrimination) among a number of overlapping and competing agencies. Each agency has limited responsibility for balancing a proposed action in pursuit of its primary goal against adverse impacts on the pursuit of other goals. Each agency asserts an independence from the political process, and from the other agencies, that weakens the national ability to make balancing choices, or to hold anyone accountable when choices are made badly or not at all.

Many of our regulatory agencies were created under laws that make them expressly independent of both the president and the Congress. While others like OSHA are merely part of an executive branch department, their governing laws vest the power to issue regulations in the secretary of the department rather than the president. To confuse matters further, some of these laws expressly require presidential review and approval of particular actions by the secretary, perhaps implying

---

The writer is a Washington attorney and a member of the American Bar Association's Commission on Law and the Economy.

that he is not authorized to modify or disapprove other actions.

As a result, many of the interest groups who support the single missions of particular regulatory agencies, as well as many members of Congress and others who mistrust an "imperial" presidency, regard presidential intervention in the regulations issued by executive branch agencies as illegal, or at least undesirable. Where Harry Truman was fond of saying, "The buck stops here," they prefer a regulatory system in which the buck stops nowhere. And for a variety of political reasons, presidents have in fact been loath to step into regulatory issues. Indeed, a number of President Carter's aides regard his recent encounter with cotton dust as politically costly to him.

These are the constitutional and policy issues crystalized by the cotton-dust case. They are critically important because the clash between Charles Schultze and Ray Marshall over the cotton-dust standards is typical of many far more significant regulatory clashes within the executive branch. One with enormous consequences is the proposed smokestack emission standard for coal-fired power plants. The conversion of existing and projected generating plants from oil and gas to coal, with minimum damage to air quality, is of course a major component of our national program to close the energy gap. Congress has passed a law delegating this task to EPA and the Department of Energy—two agencies within the executive branch—and providing that if after consultation the two agencies do not agree on the air-quality aspects, the EPA shall decide. So far they have not agreed. Suppose the president concluded that the Department of Energy's position, or some compromise, was more in the national interest than EPA's position. Could he and should he intervene?

In this lawyer's opinion, the president does indeed possess the ultimate constitutional power over the content and the timing of regulations issued by executive branch agencies, so long as the action taken is within the agency's statutory authority. As a matter of political theory and policy, the president ought to assert such power whenever he deems it necessary to make an important balancing choice among conflicting and competing national goals.

Article II of the Constitution vests the executive power in "a president." It does not authorize the Congress to distribute some of that power to the president's subordinates free of presidential control. Its principal reference to executive departments is to the power of the president to "require the opinion, in writing, of the principal officer in each of the executive departments"—language that implies he is not bound to accept any such "opinion." It is the president, not any of his executive branch subordinates, who is constitutionally empowered to "take care that the laws be faithfully executed."

The Constitution adopts Montesquieu's brilliant theory of the separation of powers among the principal branches of government. The basic argument for the theory is the need for each of the three main branches to check and balance the other two. That argument does not justify the indefinite number of sub-separations of power *within* the executive branch that are implicit in the notion that the Congress may delegate specific compartments of power to separate officers of that branch, and at the same time deny the president the power to supervise their actions. That is the antithesis of check and balance within one of the principal branches. It is equivalent to conferring independent legislative power on each congressional committee without ultimate review by either House or the two houses in Congress, or to conferring independent judicial power on each federal district court, without ultimate review by the Supreme Court.

When major balancing decisions must be made, only elected officials and their immediate staffs can provide the requisite overview and coordination, and stand accountable at the polls for the results. The Congress cannot perform these tasks by legislating the details of one regulatory decision after another; that is why Congress delegated much of this power to executive branch agencies in the first place. The president is the elected official most capable of making the needed balancing decisions as critical regulatory issues arise within his own executive branch, while the most appropriate and effective role for Congress is to review and, where necessary, curb particular presidential interventions.

Should the president decide to take up the gauntlet, he should do so openly. He should observe appropriate procedural safeguards of public notice and opportunity for comment. He should comply with any applicable *ex parte* rules that would apply to the agency itself. He should confine his actions to the relatively few truly critical occasions when a balance needs to be struck between conflicting and competing national goals.

While I am no politician, it seems to me that would be good presidential politics. In so doing, he would be on firm constitutional ground, and he would be taking a truly presidential stance. Even though we all belong to at least one single-interest group, I think the general interest is what the majority of us care about most, and that we will support a president who shows he is determined to go as far as he constitutionally can to strike the needed balance.

Effect of regulations on innovation probed

I&EC symposium speakers cite cases where inconsistent, undue government regulation is depressing industrial productivity, efficacy of R&D

ACS Miami Beach

An ever more intrusive government may have encountered a minor Waterloo in pursuit of the risk-free society. There has been concern that regulations, amendments, laws, guidelines, and the like have had a major, measurable, and so far depressing effect on industrial productivity and on the efficacy of research and development. Those suspicions, invariably denied by the regulators, always have been abroad among the R&D community. They were voiced again last week in Miami Beach at a Division of Industrial & Engineering Chemistry symposium on effects of government regulations on innovation in the chemical industry.

Until now there has been no way to make the case for either side except by an annual, general, economic balance sheet. Now some objective, quantitative measures have been made that illustrate the negative effects of overregulation. Even if there were no such measures available, the case against overregulation has been aided by legislation that implicitly recognizes the problem. It may be ironic, as one observer put it, that the government is again trying to overcome the effects of too much law by passing more laws.

There are many who speak with telling effect against such proliferation. One is Dr. Bruce Merrifield, vice president, technology, for Continental Group Inc., who notes that the big regulatory push began about 1960. Prior to that time there were few performance regulations, although a number of other kinds of regulations existed, particularly product safety regulations. Since 1960, at least 15 major legislative acts have appeared and must be dealt with by industry. The chemical industry is particularly affected.

Merrifield cites rising income as among the forces that have contributed to this growth of regulation. Rising incomes often result in demands for new social legislation and are usually coupled with the increased sophistication of engineering and science. In the drug industry, the effect of regulation has been to discourage innovation. Merrifield notes that it now takes a U.S. drug firm about eight years and $54 million to bring a new drug to the market place.

A great threat to chemical innovation, Merrifield says, is the inconsistency of government regulations administered by different and often administratively competing agencies. This inconsistency causes companies to withdraw financial support from projects at critical times and leaves managements unable to predict acceptability of products or processes in many cases. This leads to another related concern—namely, regulation of the innovative processes themselves. Thus, the overall effect of regulation is altogether pernicious. R&D, Merrifield notes, is being squeezed out by a growing proportion of nondiscretionary work made necessary by regulation in a total environment of a fixed, or in some cases a decreasing, resource pool.

The remedies for the maladies of overregulation, says Merrifield, include pre-enactment impact studies for all regulatory acts as well as redress of grievances that already have resulted from regulations. Merrifield's prescription for regulatory relief also calls for consistency within government and recognition that a risk-free world is impossible. It also would be appropriate, he says, to institute zero-based regulating along with zero-based budgeting to reduce the complications in the regulations. There is no doubt that some regulations are necessary. But having said that, he notes, many R&D administrators find it hard to live with most of them.

If you can't beat 'em, join 'em, seems to be the approach of Michael Michaelis, of Arthur D. Little Inc. A recent study completed by ADL for the government concludes that federal funding of civilian R&D should be formulated in a larger context of industrial innovation, and that federally funded R&D, of itself, is insufficient to bring about significant technological changes in the private sector of the economy. Michaelis claims that it was probable that the study eventually contributed to the official approval for a Cabinet-level review of domestic industrial innovation. The study is due to be made public in the spring of 1979.

In the meantime, Michaelis points to the recently enacted Federal Grants & Cooperative Agreements Act of 1977 (C&EN, July 10, page 19) as an opportunity to come to grips with the innovation-depressing effects of government regulation.

Three types of relationships are specified in the act. One is straight procurement by the government. The second is an assistance relationship that doesn't actually involve the government in work performance. The third is an assistance relationship that does involve the government in work performance. Assistance means that the government pays all or part of the costs of a project, and this could mean that industry can enlist the government in financing work.

Michaelis regards the act as a "sleeper" in the fight to turn around the dismal innovative record of U.S. industry in recent years. Productivity, he notes, is down 25% and the decline in patents issued to U.S. citizens and companies has come at the same time that patents to foreign groups and individuals have doubled. The call is now for "institutional arrangements" to stimulate innovation, he says.

Despite the appearance of the act in February 1978, there has not been a stampede to get in on the benefits. In fact, some industrial observers suggest that "apathy is rampant." This has been manifested most notably in the lack of response to a call by the White House's Office of Management & Budget for comments and participation in implementation conferences following the act's signing.

Of all the chemical industries, the drug industry is the most highly regulated. Dr. Jean DiRaddo, projects manager at the Center for the Study of Drug Development at the University of Rochester, notes that even the discovery process itself is subject to regulation. That probably makes pharmaceutical innovation unique among the technology-based disciplines. Control over the innovation of drugs is exercised by the Food & Drug Administration under authority contained in basic legislation enacted in 1938 and 1962 and supplemented by many other amendments and authorizations that have progressively tightened FDA control. Key items in the legislation are the New Drug Application (NDA) procedure, which requires safety tests before marketing of a new drug, and a requirement for informed consent for an Investigational New Drug (IND).

DiRaddo noted that most drug legislation is aimed at avoiding risks. FDA is required to prevent harm from drugs but it has no mandate to promote health or to maximize benefits obtained from drugs. It is not surprising, therefore, to learn that innovation is being inhibited by regulation.

But what is innovation, DiRaddo asks. Pharmaceutical innovation can occur because of the synthesis of a new compound with a new structure [or new chemical entity (NCE)], by the discovery of a new pharmacologic action, by modifying the structure of an existing drug, by pragmatic modifications of the forms of drugs in use, by the discovery of new therapeutic effects not predictable from models, and by chance. The problem is how to measure the amount of innovation produced by one or all of these forms.

In a project under way at the University of Rochester, DiRaddo and her associates are using the number of NCE's taken into human testing stages of development as an absolute measure of innovation. They consider this a valid measure, since it represents a firm's decision that a compound is worth further testing, as well as being the first time that an NCE is placed outside the firm. An NCE that is selected for human testing still may have unknown therapeutic properties but its pharmacologic and toxicologic properties are known already.

DiRaddo believes that an important contribution of the Rochester project is that it allows detection of the effects of policy changes in drug regulation about six years earlier than was previously possible. Six years, on the average, are required for the total of IND and NDA stages in FDA regulatory procedures.

Other measures used in the project are the national origin of NCE's appearing on the U.S. market and a comparison of patterns of marketed drugs in the U.S. and the U.K. from 1972 to 1976.

The Rochester project considered information on 1103 NCE's. A total of 859 were from 36 U.S. companies and 244 were from 10 foreign companies. The annual rate of NCE's tested in humans by U.S. companies rose from 70 in 1963 to 94 in 1965 and then declined sharply to a mean value of 62 for the period from 1966 to 1974. Constant changes in regulatory procedures make interpretation difficult, DiRaddo says, but there is little doubt that the declines in NCE's are attributable to FDA requirements.

In recent years there has been a strong shift of drug studies abroad. Between 1963 and 1969, only 8% of U.S. NCE's were first tested abroad. In 1973, this number rose to 34%, and to 47% in 1975 (incomplete data). The effect is particularly noticeable in larger companies.

The total time required for clinical investigation and approval of a successful NCE in the U.S. has risen from 31 months in 1966 to 82 months in 1975. A comparison with corresponding circumstances in the U.K. reveals that 2.5 times as many drugs are introduced in the U.K. as in the U.S.

More important than the numbers, DiRaddo says, are the clinical implications the data suggest. For one thing, delays in introducing certain cardiovascular drugs have resulted in a substantial increase in the mortality of patients in the U.S. A conservative estimate of this mortality is 10,000 lives per year. □

Monomer migration in polymers clarified

ACS Miami Beach

Migration rates of residual monomers may be linear functions of concentrations in amorphous polymers but not in glassy polymers below their glass transition temperatures. This summary of independent work described in a Macromolecular Secretariat symposium on chemical and physical lifetime limits of macromolecular materials may revise current thinking about whether certain concentrations of residual monomers in plastic packaging materials pose human health hazards.

Additional implications include effects of desorption of plasticizers or stabilizers on useful lifetimes of plastics, and partitioning of drugs between polymers and tissue fluids in drug delivery systems.

Dr. Isaac C. Sanchez of the National Bureau of Standards finds that partition coefficients of polyethylene oligomers between polyethylene and heptane solvent can be computed reliably from temperature, pressure, and density parameters of polyethylene, oligomers, and heptane, plus heats of mixing of oligomers in polyethylene and heptane. He uses straight-chain hydrocarbons from C_5 to C_{20} as model oligomers. Heptane simulates a fatty food.

Sanchez also has calculated partition coefficients between polyethylene and ethanol. Little information is published on this system for comparison, however. His further work will include esters and 3% acetic acid as solvents, polar additives, and other polymers.

When concentrations of residual monomers in such glassy polymers as polyvinyl chloride and polyacrylonitrile are very small, however, partition coefficients are not linear but rise exponentially with decreasing monomer concentrations, concludes Dr. Seymour G. Gilbert of Rutgers University. For many resin grades this finding may mean that at residual monomer levels of less than 0.1 ppm, there is zero effective migration from packaging into food contents.

Working with Dr. Joseph Miltz and Jack R. Giacin, Gilbert injected small, known amounts of vinyl chloride into vessels containing PVC and water or vegetable oil. He measured amounts of vinyl chloride in the water or vegetable oil at equilibrium and determined amounts absorbed by PVC by difference. PVC had been heated beforehand to reduce vinyl chloride to below 5 ppb.

Above 4-ppm initial vinyl chloride concentrations, partition coefficients rose as linear functions of concentration. Below 4 ppm, they rose exponentially. Gilbert explains his findings in terms of active site theory. In this theory, there are three types of vinyl chloride. One type is freely diffusible. A second type is bound to active sites but can diffuse. The third type is so tightly bound to active sites that it is nondiffusing. With relatively large initial vinyl chloride concentrations, a large proportion of vinyl chloride is diffusible. At smaller concentrations, proportions of vinyl chloride immobilized in active sites increase, and partition coefficients rise exponentially.

PVC containing 20% plasticizer gave similar results but had lower affinities for vinyl chloride. Gilbert says the presence of plasticizer reduces the number of active sites. He concludes that more vinyl chloride may be removed from plasticized PVC than from unplasticized PVC during processing. He also concludes that the amount of residual vinyl chloride that produces zero effective migration may be higher for unplasticized than for plasticized resin.

Gilbert, using inverse-phase gas chromatography, finds evidence for nonlinear adsorption of vinyl chloride as a function of concentration. In this technique, a gas chromatographic column is filled with resin granules, known amounts of monomer are injected into the chromatograph, and retention volumes are calculated from retention times.

Gilbert finds retention times and volumes increase as amounts of injected vinyl chloride decrease. By plotting reciprocal temperatures vs. logarithms of reciprocal retention volumes, he expects to find that activation energies of diffusion increase exponentially with decreasing amounts of vinyl chloride injected.

Similar exponential increases of activation energies of diffusion of acrylonitrile in polyacrylonitrile already have been found by Gilbert using inverse-phase gas chromatography. He concludes there exist residual acrylonitrile concentrations low enough that they are immobilized in active sites and thus nondiffusible.

Morris Salame of Monsanto also finds exponentially increasing activation energy of acrylonitrile with decreasing initial residual monomer concentrations. He measures diffusion rates from containers made from a glassy 30/70 styrene-acrylonitrile barrier polymer into 3% acetic acid or carbonated beverages. The polymer has a glass transition temperature of about 100° C.

When initial acrylonitrile concentrations are 10 to 15 ppm, the activation energy to move acrylonitrile molecules among resin interstices is 15 kcal per mole, Salame reports. At 3-ppm concentrations, activation energy is 20 kcal and rises to 30 to 40 kcal at concentrations below 0.1 ppm. The increase in activation energy results in a nonlinear relationship between migration rate and monomer content.

He measures acrylonitrile concentrations in 3% acetic acid or carbonated beverages at levels of less than 1 ppb by sparging solutions and analyzing sparged gas for the monomer by gas chromatography with a nitrogen detector.

Chemical & Engineering News
1155—16th St., N.W., Washington, D.C. 20036

Editor: Michael Heylin

Assistant Managing Editors: William F. Fallwell (New York), David M. Kiefer, James H. Krieger, Donald J. Soisson
Staff Editor: Ernest L. Carpenter
Senior Editors: Earl V. Anderson (New York), Wilbert C. Lepkowski, Howard J. Sanders
Associate Editors: Jeffrey L. Fox, Rebecca L. Rawls, Richard J. Seltzer
Assistant Editor: David J. Hanson
Editorial Assistant: Theresa L. Rome
Editing Services: Joyce A. Richards (Head), Marcia S. Montes (Editorial Assistant)
News Bureaus: New York: William J. Storck (Head), Stephen C. Stinson (Associate Editor). Chicago: Ward Worthy (Head), Joseph Haggin (Associate Editor). Houston: Bruce F. Greek (Head). Washington: Janice R. Long (Head), P. Christopher Murray (Associate Editor). West Coast: M. Mitchell Waldrop (Assistant Editor)
Foreign Bureau: London: Dermot A. O'Sullivan (Head)
Indexer: Nancy R. Gleboff
Graphics and Production: Bacil Guiley (Head). Leroy Corcoran (Manager). John V. Sinnett (Art Director). Norman W. Favin, Allen Kahan (Designers). Barbara Hayes, Linda Mattingly (Staff Artists)
Editorial Services: Arthur Poulos, Editorial Promotion; Marion Gurfein, Circulation Development

Published by
AMERICAN CHEMICAL SOCIETY
(202)-872-4600
Raymond P. Mariella, Executive Director

Subscription Service: Send all new and renewal subscriptions with payment to: Office of the Controller, ACS, 1155—16th St., N.W., Washington, D.C. 20036. All correspondence and telephone calls regarding changes of address, claims for missing issues, subscription service, status of records and accounts should be directed to: Manager, Membership & Subscription Services, ACS, P.O. Box 3337, Columbus, Ohio 43210; 614-421-7230.

On changes of address, include both old and new addresses with ZIP code numbers, accompanied by mailing label from a recent issue. Allow four weeks for change to become effective. Claims for missing numbers will not be allowed if loss was due to failure of notice of change of address to be received in the time specified; if claim is dated (a) North America: more than 90 days beyond issue date, (b) all other foreign; more than one year beyond issue date; or if the reason given is "missing from files."

Subscription Rates 1978: Printed or microfiche editions: nonmembers U.S. 1 yr. $17.50, 3 yr. $37.50; outside U.S. 1 yr. $27.50, 3 yr. $67.50. Air freight rates available on request. Single copies: Current $1.00. Rates for back issues and volumes are available from Special Issues Sales Dept., ACS, 1155—16th St., N.W., Washington, D.C. 20036. An annual index is available for $25 from Helen Adams, at the same address. Back and current issues are also available on microfilm and microfiche. For information, contact Microform Program, ACS.

Published by ACS from 20th & Northampton St., Easton, Pa., weekly except for the last week in December. Second class postage paid at Washington, D.C., and at additional mailing offices.

(For list of offices see page 67)

Letters

Gasohol as motor fuel

SIR: The remarks quoted by Dr. Lindquist (C&EN, Aug. 7, page 106) do not give a very balanced view of current gasohol possibilities. The economics and energy balance have been the subject of extensive study at the University of Nebraska (Dr. W. A. Scheller and others) and the situation is by no means static. Bear in mind:

1. Starting with corn grain, using traditional technology, there is indeed a net loss of energy in producing alcohol. However, the partial utilization of field wastes as fuel converts this into a modest positive balance.

2. The major energy requirement is in the alcohol plant, where it can be provided as coal or electricity.

3. There is ample scope for energy saving in the distillery, using vapor recompression and other heat economy techniques.

4. Alcohol can be produced from all kinds of low-value agricultural by-products.

There seems to be a possibility of producing at least a portion of our liquid fuel requirements from renewable resources (basically from sunlight) and it should be given a fair chance.

Concord, Calif. P. H. Blanchard

Tannin-containing substances

SIR: The item, "OSHA issues tentative carcinogen list" indicates that tannin is a Category I, confirmed carcinogenic substance, and that as a result exposure to it would be severely regulated (C&EN, July 31, page 20).

This should result in some interesting conflicts, especially if commercial products containing even trace amounts of tannin are to be regulated and handled as confirmed carcinogens. Tannins are widely distributed throughout the plant kingdom. The average individual probably ingests several grams of tannin each week. Coffee, and especially tea, is rich in tannin, as are also red wines, and to a more limited extent beer. Many, if not most, of the items offered in the produce section of the local supermarket contain tannins. Presumably canned goods derived from these items would also contain tannin. If the bureaucracy is right, we now have a choice: continue eating meat and run the risk of circulatory disease due to ingestion of cholesterol, or become vegetarian and run the risk of cancer due to tannin. If much of what we eat is not banned, imagine the Occupational Safety & Health Administration trying to regulate its production and distribution. Being a farmer may be dangerous to your health because of the crops being grown. In fact the soil itself may contain tannin from decaying vegetable matter.

Besides food, individuals come in contact with tannins quite often from other sources. Just consider the forest and products derived from it. The bark of many wood species contains appreciable tannin. Perhaps OSHA will prohibit the gathering of firewood and outlaw the use of Christmas trees. Those species normally used as Christmas trees are all rich in bark tannins. Deeply colored heartwood generally contains tannin, and these are the wood species also used in furniture. Can anyone imagine OSHA regulating all of the industries involved with wood, such as the construction industry, because the wood contains tannin?

Bureaucracies, such as OSHA, should either exhibit some competency or be made liable for their action. The overwhelming use of tannin-containing substances by mankind through millennia was evidently not even considered by OSHA when classifying tannin as a Category I carcinogen.

Herbert A. Schroeder
Associate Professor of Wood Chemistry, Colorado State University, Fort Collins

Letter to the Editor

C&EN encourages readers to contribute to this letters section. However, please keep letters reasonably short, 400 words or fewer. As we receive a heavy volume of letters, persons writing letters are limited, as a general rule, to one letter within any given six-month period.

Safety training

SIR: Safety training in our academic institutions has lagged well behind today's increased awareness of chemical hazard and the continuing promulgation of federal regulations.

I would like to suggest consideration of the idea that the American Chemical Society either recommend or require that all chemistry graduates (at all degree levels) receive at least two credits' worth of safety, hygiene, and toxicology as part of their curriculum.

Academic institutions, if left to their own devices, will be 10 to 15 years late in providing this basic and sorely needed training. They need to be encouraged gently, or perhaps more firmly, by tying the course into our accreditation requirements.

James A. Kaufman
Member, ACS Division of Chemical Health & Safety (Probationary), Wellesley, Mass.

More on innovation

SIR: Regarding the editorial "Innovation and national security" (C&EN, July 17) and a recent letter "General lack of concern" (C&EN, Aug. 14), I believe a more fundamental principle underlies this discussion: the ability to weather change. The key to survival in a varying environment is adaptation. Thus the capacity to adjust connotes security. A major threat, therefore, is capital-enhanced stagnation: accumulating available natural and social resources in standing machinery to the extent that innovation is curtailed.

In business, the rate at which a new industrial process can supplant an earlier one is inversely proportional to the magnitude of existing installed capacity. In addition to the capital expenditure for procuring and operating new facilities, the cost of conversion must include those segments of the old network (labor and equipment) to be retired. Hence, acquired capital represents inertia against change. Similarly, the sprawling bureaucracy of our government and other social institutions did not develop overnight. But the price of alternatives (though I am sure more efficient ones could be organized) increases with the complexity and manpower of the agency to be dismantled.

Another ramification involves various attitudes apparently fostered by capital-enhanced stagnation. "Protecting one's investment" has survival value in the short run. But relying on inefficient organizations and facilities merely because they exist, and change is more difficult, can be catastrophic. Eventually, institutions devote more effort to self-perpetuation (maintaining the status quo) than toward their assigned purposes. (Certain agencies of our government and military, I fear, have already reached this stage). An example of the above principles appeared in the recent news. The state of Ohio shelved plans to switch to environmentally cleaner low-sulfur coal because the high-sulfur coal is currently mined locally and thousands of jobs were at stake. (I do not advocate unemployment; however, the cost of change must include relocating these workers).

Unless one can predict future events with absolute certainty, over accumulated capital cannot be avoided. It can definitely be minimized, however, "Sunset laws" and "closed-cycle accounting" (cost seldom reflects the expense of disposal except in the case of deposit bottles) seem reasonable. On the other hand, a known set of social priorities would be useful to establish a system of values for ranking alternatives based on those aspects of a changing society which are to be preserved. After all, as the world changes, so must society—rationally or cataclysmically.

D. Wayne Berman

Pasadena, Calif.

SIR: I wish to congratulate you on the initiation of discussions on "Innovation and national security," (C&EN, July 17, page 25). I hope this is only the first of a series on this subject.

The views of Dr. John J. Ford deserve serious consideration by the technical community. Reductionism and bureaucracy have grown to massive proportions in large corporate research organizations with the resulting tendency toward suppression of innovative thought and action.

I have to wonder if you did not include the remarks of John C. Connor to illustrate one of the problems so precisely described by Ford. Connor repeats the old refrain of big business that they are taxed too much and this is hurting small business! If he is really interested in the independent inventor why does he not support a special subsidy for them, to be paid for by increased taxes on those large corporations whose research expenditures are low in relation to investment? By what logic does he arrive at the conclusion that the budget for the Department of Energy should be less than oil company profits? Perhaps DOE's expenditures should be even higher now to save us from economic ruin later.

I suggest that ACS sponsor a series of local seminars on innovation in the U.S., with special effort being made to obtain participation by nontechnical corporate executives and managers. Participation by independent innovators and by other technical societies should be encouraged, both in planning and in presentations. One year of hard work along these lines could produce invaluable data for the use of those already working to reverse the decline of innovation in U.S. science and industry.

Eugene F. Hill

Granada Hills, Calif.

The drug arecoline

SIR: Science/Technology Concentrates (C&EN, July 24, page 19) referred to two recent papers in *Science* and in the process perpetuated an error. The drug arecoline was incorrectly referred to as "arecholine" in one of the original papers and in the concentrate, thereby implying a relationship to choline that does not exist.

Arecoline is not a choline derivative but is the chief alkaloid in seeds of the areca palm. Arecoline does not "act by increasing concentrations of acetylcholine in the brain," but is thought to stimulate directly certain types of acetylcholine receptors.

Indianapolis Ray W. Fuller

Dilemma of toxic risks

SIR: Frank J. Weigert, in his letter, "Determining toxic risks" (C&EN, July 24, page 4), is one of the first to speak out for more logical mathematical modeling of the risk from low concentrations of carcinogens. For a variety of compelling reasons, economic and environmental, our thinking should begin to move along the lines he outlines instead of in the opposite manner advocated by regulatory agencies.

The dilemma is particularly apparent in the energy area, where carcinogens are involved in both nuclear and fossil fuel plants. The BEIR report on radiation, a massive compilation of human epidemiology and animal experimentation, arrives at the conclusion that the response to incremental dosages is exponential; that an algebraic increase in radiation above background produces a percentage increase in the probability of cancer. In mathematical terms, $P = Ae^{kD}$, where A is the background response, and D the exposure above background.

This is also the approach of the Rasmussen report (WASH-1400), which has been severely criticized by antinuclear people, who prefer the more "conservative" linear model. This, despite its scientific meaninglessness, is the one used by most working biometrists. On the other hand, research on chemical carcinogens, sponsored by the Energy Research & Development Administration, Environmental Protection Agency, and Occupational Safety & Health Administration, is being fitted into models which fit their political needs for closer regulation of the workplace and environment, and of energy sources which compete with nuclear energy. One such model [Crump, Guess, and Deal, National Institute of Environmental Health Sciences (preprint); Hartley and Sielken, *Biometrics*, **33**, 1 (1977)] is $P = 1 - e^{(c\sum_{i=1}^{k}(a+bD))}$, where c is a function of duration of exposure, and D the dose rate from k sources. Such models will have a slope greater than the linear model and may be convex upward. To paraphrase W. C. Fields and the old temperance "mellerdramas," they overemphasize the importance of the fatal first exposure, not to Demon Rum, but to some chemical which has served society well.

A table (see table below) showing the relationships of hypothetical dosage response curves which are congruent at $P = 0.10$, $D = 20$, and $P = 0.50$, $D = 100$, for the four models discussed may be instructive. It will now be seen that Weigert's proposal, with probably the best logic, is by far the least conservative at very low dosages. But what disturbs me far more is that ERDA is allowed to play by one set of rules, while the rest of us poor mortals have to go along with EPA-OSHA thinking. This means that for carcinogens of equal potency, we have to clean up over four times as much!

Winslow H. Hartford

Associate Professor (retired), Chemistry & Environmental Science, Belmont Abbey College, Belmont, N.C.

Approximate hypothetical probability of cancer by models

Dosage above background	Weigert	BEIR (exponential)	Linear	Crump, Hartley et al.
100	0.50	0.50	0.50	0.50
10	0.022	0.018	0.050	0.067
1	0.0001	0.0016	0.0050	0.0069
0.1	$<10^{-6}$	0.00016	0.00050	0.00069
0.01	$<10^{-9}$	0.000016	0.000050	0.000069

9/1/6

...funds to eligible former stu... closed, but the company ... payment ...

File
WASH. STAR Editorials
Nov. 8, 1975

Ralph Nader

'The Bigger, the Better?'

For over 100 years the slogan, "the bigger, the better" has guided the business community.

Even today, few executives would question the validity of such a slogan. Banks with assets exceeding $30 billion, oil companies with sales over $30 billion annually and insurance companies with millions of policyholders are believed to be big because they are better for consumers and the country.

ARE THEY? Let's look at the bigness issues a little more closely:

1. Smaller companies can do a better job for the consumer than the giants are doing in the same industry. This is true, for example, in the pricing of life insurance or servicing by truck companies. Small businesses, whose owners know they can win under fair competition, are unable to fight the political and predatory market practices of their opposing goliaths.

2. Companies can become so large that government cannot allow them to fail. While small business is perfectly free to go bankrupt, big business can go to Washington — for a bailout. Apart from the more sensational welfare case of the Penn Central, big corporations are in Washington all the time asking for handouts on the grounds that if they don't get them they will go broke and damage the economy.

3. Giant corporations very often mean giant monopolies or giant monopolistic practices, which fleece consumers out of billions of dollars, as detailed by the Senate anti-monopoly subcommittee over the years. Frequently big business forces small business to go along with their anti-monopoly violations.

4. BIG corporations, historically without much of an innovative record, just as historically have lunched off lone inventors or small firms. A Department of Commerce study in the mid-'60s showed that individuals were the source of most inventions that helped build the economy, not the fabled corporate laboratories.

In 1964, Donald Frey, vice president of Ford Motor Co., noted that auto suppliers, not the big auto companies, were the prime source of innovation.

5. Big corporations gravitate toward massive technologies because it is more profitable for them and more expensive for consumers. Recently, big technology is more likely to induce tax concessions or government subsidies.

In the quest for energy adequacy, why develop the abundant agricultural wastes and residues or other solar energies when there are more complex, expensive and government supported technologies like nuclear power around?

6. BIG COMPANIES can resist more strenuously the displacement of their existing technology by a more abundant form of new technology that is cheaper for the consumer. AT&T has preferred underseas cables at the expense of satellites; the three television networks long opposed cable TV development with its dozens of channels.

7. Big companies can control government and abuse significant political power more easily. Du Pont in Delaware, Union Camp in Savannah, Ga., and U.S. Steel in Gary, Ind., are only a few of the company states or company towns where bigness becomes virtual government. It is hard to think of small business overthrowing South American countries.

8. Conglomerate companies can afford to ignore one consumer sector if they can profitably shift to other consumer sectors, compared to firms rooted entirely in a smaller community. In such a case, only small business can fill the gap.

9. Large corporations encourage widespread community rootlessness by requiring constant moving of families between branch offices or plants.

10. Big companies are more likely to be inefficient than smaller-scale alternatives. Prof. Joe Bain has shown how, in several major industries, it is plant size, not company size, that determines efficiencies. The steel industry is a case study of that point. One giant publisher recently contracted for a series of books to a tiny publisher because it was cheaper than doing it in-house.

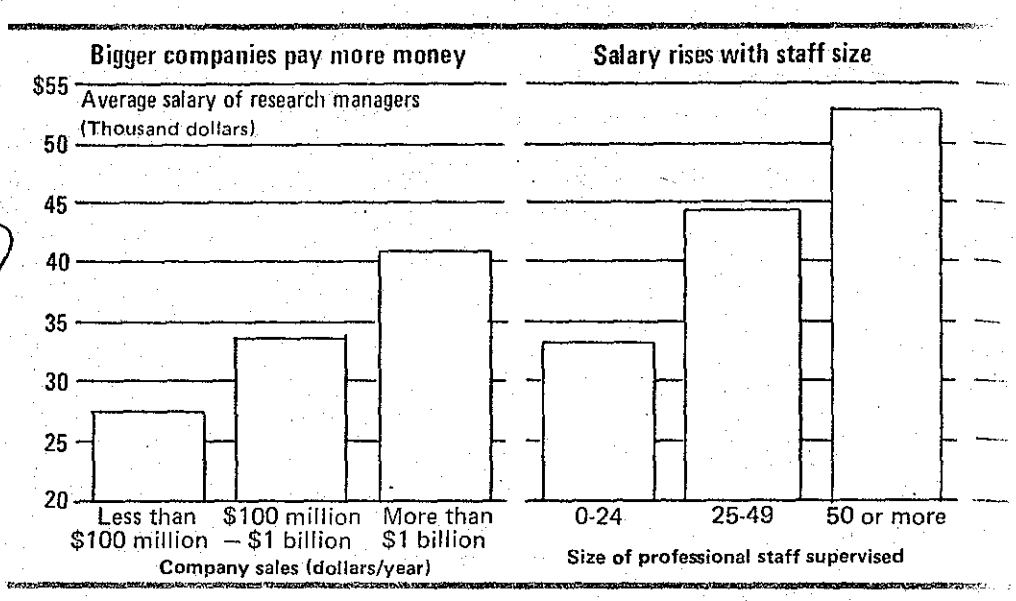
THE WHOLE question of efficiency needs a fresh review in other contexts as well, such as the side effects, maintenance costs, or injuries to consumers.

There need not be a reverse dogmatism in favor of all small enterprises to justify a critical examination of business bigness in our economy. Or to justify asking what such bigness is doing to our society's preferred values of individual initiative, responsibility and freedom from the giant organizations' conforming pressures.

CW Report
by Gordon M. Graff

File w/ additionals (See pgs. 30 & 34)

Researching the world of R&D managers



He is 47 years old and has been with the same company for the past 16 years. Since he left school with his highest degree in 1957, he has risen to direct a staff of 28 degreed chemists and chemical engineers. Last year he made a salary of $36,500, racked up a bonus of $4,800 and, more likely than not, took part in a stock-option plan. He finds it particularly hard to find qualified people for his organization, and he feels that excessive federal regulation has stymied creative and innovative research.

This is a profile of the research manager today, as revealed by a *Chemical Week* mail survey taken last month. It shows, by and large, a well-paid administrator who is hemmed in on several sides by internal and external constraints that make his job challenging and perplexing.

To avoid the pitfalls of comparing widely disparate sectors of the chemical process industries, *Chemical Week* sent out 117 survey questionnaires only to those readers identifying themselves as research and development managers in the "chemicals and allied products" segment of the CPI. Of the 63 questionnaires returned, 60 were used in the final tally. (Three were disqualified because the respondents no longer served in a managerial role.)

Wide Spectrum: As individuals, the respondents covered the age, salary and responsibility spectrum. The youngest manager was 27; the oldest, 72. The lowest salary reported was $20,000/year, while one manager received $75,000. The sizes of the professional staff (those with B.S., M.S. or Ph.D. degrees in chemistry or chemical engineering) supervised by the respondents ranged from one to 210.

As for degrees, 29 of the 58 managers who reported their educational background had Ph.D.s. Another 14 had only masters degrees; and surprisingly, 15 of the managers never went beyond bachelors degrees. Some of the respondents received their highest degree as long ago as 1938, while one graduated from school as recently as 1973.

Exactly twice as many of the managers (38) said they would be adding professionals to their staffs within the next year as those who responded that they would not (19). And of the 32 who listed the anticipated number of openings for professionals in their organizations this year, the average number of new openings reported was three.

It was anticipated that the current era of relative belt-tightening would be reflected in lower figures for the reported percentage of R&D funds alloted to new product and process development in 1977, compared with 1967. While this was indeed the case, the difference was not significant: 39.1% in 1977, as opposed to 41.5% in 1967.

The expected trend was more evident in

What's bugging research managers

"U.S. leadership in technological innovation is in trouble because U.S. business is managed by 'priority planning, selective investment, cash cows,' etc., which are really euphemisms for the old 'quick buck,' short-sighted management that has failed before."

"Top management is geared to short-range research at the expense of long-range, innovative research for which the immediate return is only a dream in someone's mind. A better balance is needed."

"Except for tax incentives, the federal government should be kept as far as possible from the operation of private industry."

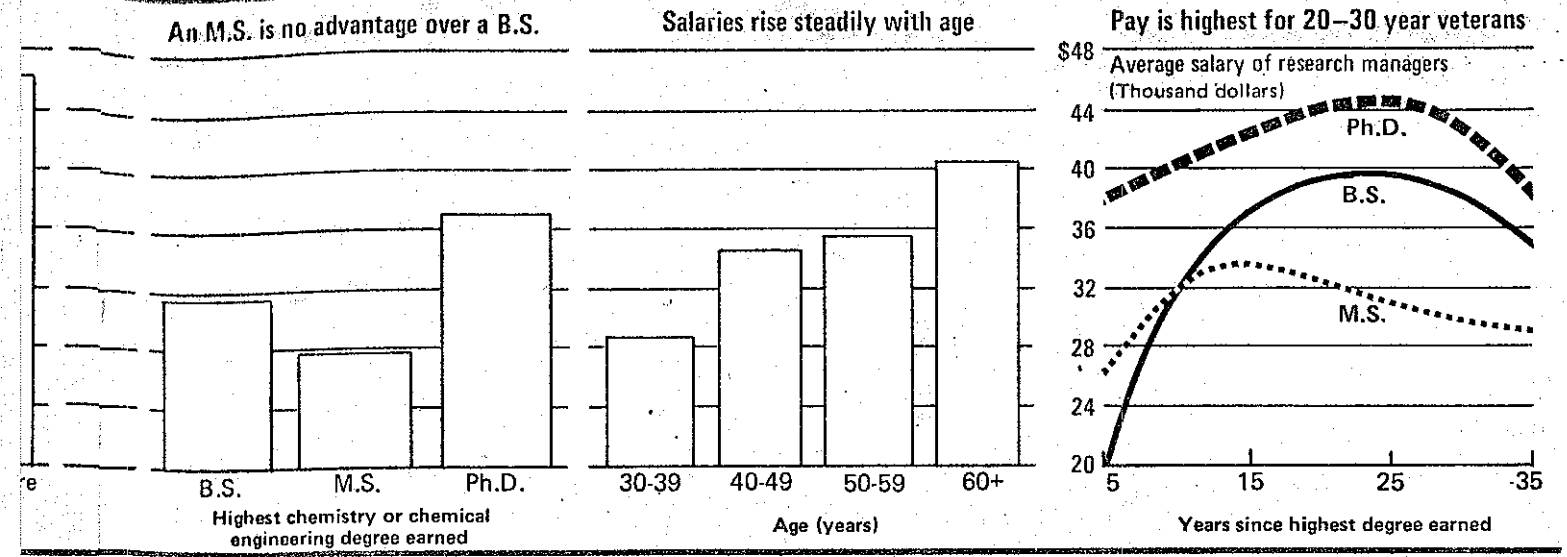
"Government regulations in the chemical industry are characterized by too much nit-picking and confusion."

"Industry needs to work more with government instead of confronting it."

"The chemical industry should stand up and respond more to the regulatory agencies, rather than letting them be swayed more and more by environmentalist groups."

"Shoot the Naderites and the anti-industry consumerists so that our value can be appreciated."

"The language and spelling of college graduates are atrocious. Their main problems are poor report writing and unclear recommendations. They tend to write reports like a mystery story."



responses to the question: "Is it easier or harder to obtain research funds in your company now than it was in 1967?" Among the respondents, 27 said it was now harder, 15 said it was easier, five said it was about the same, and nine said they didn't know.

Despite the key positions they hold, not all research managers are brought in on corporate decision making involving broad matters—for instance, major marketing or production decisions. While 38 of the managers responded that they were brought into decision making in these areas, 22 reported that they were not. And while 41 of the respondents thought there is adequate liaison between their departments and other departments in their firms (such as marketing and production), 19 felt there was insufficient communication within their firms.

Art vs. Science: How do research managers decide which projects to proceed with, considering the numerous available options? Surprisingly, only 25 of the managers who responded to this question said they used formal analytical tools such as risk analysis in determing which projects to undertake. The remaining 32 said they relied on "hunches," "intuition" and other nonobjective factors. Even in evaluating the success of their research programs, only 28 of the R&D directors said they used objective parameters, while another 26 reported the use of other indicators.

Eye on Education: By nearly a two-to-one margin, the R&D directors turned thumbs down on the effectiveness of U.S. chemical education today. Only 19 of the managers queried said they thought today's schools are preparing their chemistry and chemical engineering graduates adequately for careers in industrial research; 34 others rated the schools as inadequate in this respect.

For the question: "Do you feel industrial research can play a meaningful role in solving such national problems as energy and pollution?" the lion's share of the responses (55) were in the affirmative. Only one respondent felt otherwise. There was considerably more division, however, on the companion question: "If yes, is industry fulfilling that role as well as might be expected?" Among the responses received for this query, there were 21 in the yes column, 34 in the no column.

Asked to rate their problems from a list of choices, the managers put "a shortage of qualified people" and "no clear goals from top management" at the top of the list (*see table*).

Among external headaches, government regulations seemed to be the most vexing. A large chunk of respondents, 46, replied positively to the question: "Do you feel that rules and regulations of government agencies are seriously hindering new

"Most of the projects that graduate students work on have no connection with the real world. Most university research is a waste of money and time."

"Toxic data should be provided on all new products by their manufacturers."

"Excessive government regulation leads to less risk-taking and a sense of 'let's stop with what we already have.'"

"Companies should consider national needs as well as the current small effects of federal regulations on private industry."

"Intensive research is needed in recycling and to locate new sources of energy, with nonpollution of the environment paramount."

"Universities should be funded to do the basic research that is more difficult for industry to perform."

"Most new college graduates have zero idea of what R&D in industry does."

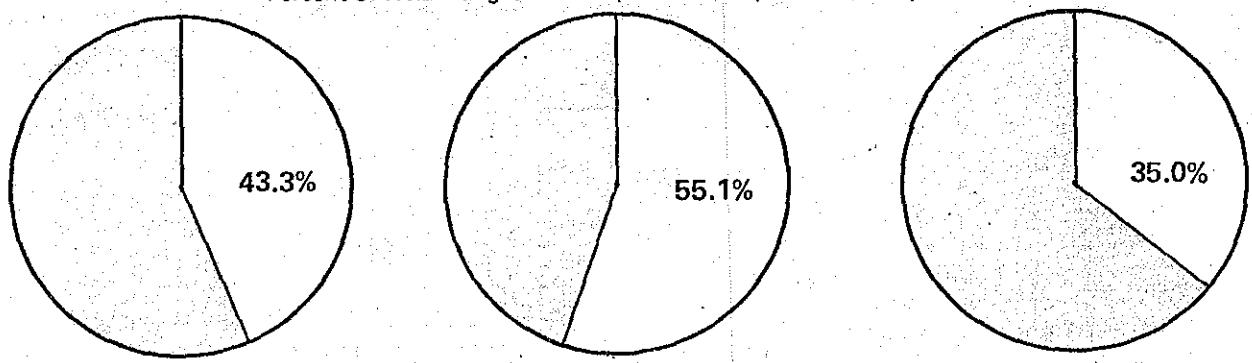
"New-product development has been slowed to a crawl by new and demanding carcinogen-mutagen testing requirements."

"Every researcher should have lots more projects and ideas than dollars. The problem is to determine the better ideas to work on."

"Industrial R&D can be aided by rigid exclusion of the media from news of research results until the results have been proved."

Big companies spend least fraction of R&D dollar on new product development

Percent of R&D budget for new product and process development



product and process development in the U.S. chemical industry?" Only 13 of the directors felt that the government presents no problems in this area.

When asked what the government can do to aid private R&D in risky and speculative areas, less than half the respondents chose any of four suggestions included in the questionnaire and few offered alternative proposals (*see table*).

The leading choices, however, were tax incentive plans, either for R&D in general or for research in specific high-priority areas. And research managers tend to look askance at quasi-public institutions which would sell technological discoveries to industrial bidders.

Taking a Closer Look: In order to obtain a clearer focus on the world of today's research manager, it helps to break down the raw data into more refined categories. For example, there is a clear relationship between the average salaries of research managers and the size of the company they work for (*see chart*). Frequently, group leaders in companies with annual sales in excess of $1 billion earn more than research directors for entire companies whose sales are less than $10 million.

Bonuses, like salaries, covered a wide range—from a low of 2.7% of annual salary to a high of 28.6%. Stock options are a less common feature than bonuses, but a significant number of R&D managers said they participate in such programs.

Salaries are strongly pegged to the size of the staff supervised by R&D managers (*see chart*). For example, those directors supervising a professional staff of fewer than 25 reported, on the average, a salary of $33,100/year. But the average annual compensation for those supervising a staff of 100 or more was $57,600.

An interesting exception to the general rule—higher degree means higher pay—was noted in the tabulation of the salary vs. degree data. While Ph.D.s, as expected, were on top of the heap in the salary department, compensation of those whose highest degree was an M.S. lagged behind that of managers who never received more than a B.S. (*see chart*).

One explanation for the difference might be found in the number of years that have elapsed since the degree was obtained. While B.S. and M.S. directors took their bachelor's degrees about the same number of years ago, the B.S. level managers tended to go immediately into corporate research, while the M.S. directors went to graduate school, spending anywhere from one to nine years there. During this time, their B.S. colleagues in industry got a jump on them in salary and promotions. And after the M.S. recipients got out of graduate school, their higher degrees did not offset the disadvantages of lost time spent pursuing those degrees.

But the experiences of M.S. directors in the survey are not typical of M.S. chemists as a whole. Numerous studies have shown that M.S. chemists tend to make, on the average, more money than B.S. chemists. In contrast, by 15 years after receiving their respective degrees, M.S. managers in the survey were found to earn less, as a group, than B.S. level directors.

It comes as little surprise that the salary of a research director rises with his age (*see chart*). The tally of salary vs. age shows a sharp upward leap from the mid-30s to the mid-40s, with a much more sluggish rise from the mid-40s to the mid-50s. The peak salary—$50,000—was recorded in the "65 or more" age category, but this is somewhat deceptive, since the ranks of research managers start to thin noticeably after age 60. This seems to be due either to voluntary or involuntary retirement.

For research managers under 60, the highest average salary—$40,200—was reported in the age 55-59 bracket. The message of these statistics seems to be that the few research directors who are allowed to remain active into their 60s and beyond can expect to make even more money than the already well-paid managers in their 50s, who, however, are present in much higher numbers.

There is no such steady rise in salary when it is tabulated as a function of years since the highest degree earned. The comparisons show the existence of definite salary peaks for all three degree levels (*see chart*). For B.S. and Ph.D. recipients, the peak pay tends to occur about 25 years after graduation. For M.S. directors, however, the peak is reached earlier—at about 15 years.

Those respondents who reported receiving their highest degrees 35 years ago earned less, as a group, than those who left school with a degree 25 years ago.

Stressing the Bottom Line: Turning away from the personal characteristics of research directors to their professional experiences, it is clear that finding funds for their projects is one of their key concerns. While the bountiful days of the 1960s have long since vanished, research funds are still widely available. And formulas for dividing up the research dollar by type of goal (new products and processes, for instance) have scarcely changed.

What has changed over the past 10 years is the ease of obtaining funds. Today's research director must make a good case for the money to initiate and continue work on his project—a much stronger case than 10 years ago. And increasingly, the criteria used by senior

corporate officials to dole out R&D funds involve the question: Will it produce a marketable product within the short term?

This hard-nosed policy has not met with everyone's satisfaction and sparked some pungent comments from a number of research managers (*see box*). When asked why they think it is harder to obtain R&D funds from top management now than it was 10 years ago, research managers cited a variety of reasons, but certain distinct patterns were evident.

One manager summed up his answer to this question succinctly: "Greater cost consciousness." Another respondent, who was echoed by many of his colleagues, said he believed management's somewhat tight-fisted R&D funding policy is due to "little concern for long-term (one year or more) programs, plus requirements of new government regulations" covering health and the environment.

"Management is too cautious," observed another director of research. "It is willing to fund process improvement projects more so than fundamental research." Wrote another: "Increased government red tape makes it more difficult and expensive to develop new products." One manager cited the Toxic Substances Control Act, noting that "we're doing more defensive research to defend our current products."

Not all the constraints on R&D funds were seen as originating outside. Some directors cited lower company earnings in recent years and increased operational costs in general as additional factors limiting the flow of funds.

Among the research directors who reported that it is now easier to get R&D funds than 10 years ago, the comment of one is typical: "Our company's present business plans are oriented toward growth." In short, firms striving for long-term growth have generally made R&D funds easier to obtain, while those seeking to improve next year's balance sheet are taking a coldly practical view of R&D funding.

Predicting Success: Many of the companies that are stressing short-term payout in their R&D programs are asking their research managers to come up with an objective way of assessing the probability of success for new projects. As a result, some research directors are applying various qualitative and quantitative yardsticks to their programs. Many of these assessments fall under the general category of "risk analysis."

When asked to be specific about just which methods they use to predict the likelihood of success for their projects, the R&D directors cited such currently fashionable techniques as management by objective, discounted cash flow, return on assets, and return on investment. Some claimed to have elaborate computer programs for taking into account the multiplicity of variables that go into the success equation. Others say their companies have internal numerical systems in which a research proposal must get a certain rating in order to get off the drawing board.

Some research managers claimed that their projects are reviewed by top management every year. ("We use annual technical audits of research projects," wrote one.) Others were willing to disclose their numerical criteria. Reported one director: "Our projects must be market driven with at least a 75% chance of success. The return on investment must be greater than 40%."

Among the respondents who said they did not use a formal system for deciding which projects to go ahead with, one reported that "attempts to employ risk analysis have not been too successful." Another candid director said R&D funding decisions in his firm are made as a result of "the basic whim of the president."

Evaluating the success of past projects is often a criterion for deciding whether to supply the cash for related ones in the future. Many directors reported that their projects are subjected to a formal review of results by senior management. One R&D manager said that the return on investment of a program is the main input management uses to evaluate its success. Wrote another: "We use post-audit computer analysis, break-even analysis and payback return" to gage a project's success ratio. Some of the evaluation techniques reported are long-term in nature. "We use the tracking of sales and net profits over the years attributable to our R&D efforts," wrote one respondent.

How Good Are Graduates? By and large, the research directors gave the universities and colleges low grades in preparing their chemistry and chemical engineering graduates for the real world. When asked how school curricula could be made more responsive to the needs of business, the managers responded over and over again: "greater emphasis on the practical, less on the theoretical."

Specifically, as one respondent wrote: "There should be solid courses for chemists in industrial chemistry and the economics of business." Another wrote that students "need to be taught the role and purpose of a business. I'm afraid many of the professors teaching technology overlook this."

There are some fields in particular where the respondents felt that today's graduates are insufficiently versed. For chemistry students, wrote one, "there should be more exposure to industrial chemistry such as polymer chemistry and practical chemical engineering, as well as an emphasis on problem solving." Some said they thought chemistry graduates don't know enough about chemical engineering, and vice versa. A number of the respondents again cited polymer chemistry as one area in which chemistry graduates are insufficiently trained.

Another theme that ran through the reponses dealing with problems of chemical education was the noticeable inability of many of today's graduates to write a logical, coherent and grammatical English sentence. Typically, one director suggested that school curricula should include "additional training of chemists and chemical engineers in effective oral and written communication."

As for the suggested means of bringing a greater awareness of business problems into chemical education, there were a variety of proposals.

One manager said that graduate students planning industrial research careers should be required to attend special seminars on the nature of business, and of industrial R&D.

For undergraduates, suggested another manager, there should be an internship program in the senior year in which students would work in an industrial environment under a sponsor or supervisor. And one respondent said that industry should provide summer jobs for aspiring industrial researchers attending school, and the schools themselves should sponsor cooperative work-study programs as part of their curricula.

Tackling National Problems: While the vast majority of research managers said they feel private industry can play a meaningful role in solving such national problems as the energy shortage and pollution, most indicated that industry can hardly be expected to act out of pure altruism. They called for some form of economic incentive from government to make research in these areas worthwhile.

Typical of the comments on the role industry can play in tackling the energy shortage was the opinion of one R&D manager: "The benefits of alternative energy sources have not been elucidated from an economic standpoint. Industry could provide a workable and affordable

CW Report

Shortage of qualified people tops managers' list of problems

Problem	Managers ranking problem as No. 1 concern	Percent
Shortage of qualified people	17	33.3%
No clear goals from top management	13	25.5
Lack of communication with marketing group	10	19.6
Shortage of funds	7	13.7
Other	4	7.8
Total managers responding	**51**	

solar heating and cooling system if given an incentive."

As for pollution, one director called for "emphasis on pollution problem solving through chemistry and engineering and not solely through compliance with government regulations."

There were frequent criticisms of the government's existing policies vis-à-vis industry. Wrote one R&D manager of public energy and pollution control policy: "The government is confused on where it is going, when, why and at what cost. It doesn't recognize the economics of industry. We need to get more industry people in Washington." Another respondent asserted that "government red tape stops a lot of work that could be done."

Repeatedly, the managers called for a working partnership between industry and government—but one that preserves the profit incentive for industry. For example, one director suggested that basic discoveries made at government agencies in the pollution and energy area could be developed by joint research programs at those agencies involving government and business. Another asserted that "tax incentives would help funnel additional funds to energy research. The end goal must be justified by economics."

At present, said many of the researchers, there is inadequate dialogue between government and industry on the energy and pollution problems. "We need to communicate better with government," wrote one. Specifically, another research director called for technical representatives from the business community to inform Congressional committees dealing with energy and pollution legislation about available problem-solving technology in industry. Congress would then be expected to provide the economic incentive for implementation of new proposals.

And industry should also try to get its message across to the public at large through a more vigorous public relations and advertising campaign, suggested another respondent.

Regardless of government actions, there are a number of things the business community can do unilaterally to alleviate the massive burdens of pollution and the energy shortage, asserted several of the researchers. "Companies should pool their resources to solve major problems" in the energy and pollution area affecting all of them, suggested one director.

One idea proposed by another manager was a national panel composed of representatives from government and industry. Its function would be to identify areas in energy and pollution where research input is needed and to make recommendations about how industry and government can work together to solve them.

Not all the researchers blamed the government for past lack of progress in solving national energy and pollution problems. For example, one research manager—distinctly in the minority—suggested that past efforts of business to tackle the industrial pollution problem have been less than sincere. "Companies need to make a more dedicated effort to reduce pollution than mere conformation to present standards," he wrote.

Bucking Bureaucracy: While a hefty margin of the research directors agreed that excessive government regulations are hindering development of new products and processes in the chemical industry, their reasons for this situation and their proposed solutions differed widely.

Such comments as "ambiguous rules, too much paperwork, needless delays," and "too rigid and often unreal" characterize the attitude of many toward the current maze of federal, state and local regulations controlling everything from worker safety and waste dumping in streams to development of new cosmetics and drugs.

"Compliance with many regulations makes some processes uneconomical. Higher management has become more concerned with not offending OSHA, EEOC, etc., than with innovative research to develop new long-range processes,"

Research managers see tax incentives as spur to private R&D

Type of government incentive	Number who favor proposal*	Percent
Direct tax incentives for all industrial R&D	27	45.0%
Tax incentives for certain types of research (e.g., energy and pollution control)	26	43.3
Changes in antitrust laws that would allow cooperative research programs between different companies	22	36.7
Quasi-public institutions to carry out research in such areas as solar and fusion energy and medical technology. Developments would be sold to industrial bidders.	12	20.0
All of the above.	4	6.7
None of the above.	2	3.3
Other.	4	6.7

*60 questioned

complained one director. Wrote another: "OSHA, NIOSH, TSCA 'overkill' regulations are taking too much effort from constructive R&D. Everything points to a severe cutback in R&D output as TSCA implementation gets underway in 1978."

Regulations of federal agencies, wrote one manager, are "making it extremely difficult for small companies to survive. . . . The government keeps changing the rules and/or interpretations of them." Another echoed the complaint of ambiguous rules: "They contain cluttered language, with no clear guidelines to interpretation or intended objective." Still another researcher referred to "overlapping regulations between agencies."

Seeking Incentives: What can be done to enable industry and government to work together, instead of at loggerheads? Of the nearly half of the respondents who felt that the government should provide some incentives to private industry to engage in new and speculative research (such as novel energy sources, environmental management and basic medical sciences), most favored some form of tax relief for industry (*see table*).

Several researchers took the trouble to write a big "No!" next to the proposal for quasi-public institutions that would license discoveries to industrial bidders. "Definitely not!" wrote one researcher next to the proposal. "Private corporations use money and manpower more effectively." Wrote another respondent next to the suggestion: "They're too expensive, bureaucratic and nonproductive."

Many of the respondents offered suggestions of their own for government incentives to encourage private R&D in risky areas. "The government should stick to funding research at academic and medical research centers," wrote one R&D manager. "Government-controlled energy research will cost much more than it will ever return," he added.

One unusual proposal came from another research director: "Let the government help sponsor research by buying shares in newly formed businesses, thereby allowing for industry management and control."

Another manager called for a "change in most government agency policies towards patent licenses" in favor of "allowing exclusive licenses or significant lead time to justify development cost." One researcher went so far as to suggest that all basic research be done only in universities under government sponsorship.

Finally, one director probably reflected the thoughts of many of his colleagues when he suggested the ideal spur to private R&D: "Removal of unnecessary government regulations would do more than anything!" He didn't define "unnecessary," however. And some of the most hard-boiled critics of government indicated that some public regulation of industry is probably desirable.

Desirable or not, government rules and regulations will continue to be a fact of life for the research manager. And coping with them will likely be a major outlet for a research director's ingenuity and resourcefulness in the future. Just as in the past, R&D managers have withstood such ordeals as staff cutbacks, budget squeezes and soaring development costs, most seem to feel that they will be able to rise to this latest challenge.

File w/ editorials

other views

The world has a future—a great future

Perhaps one thing that has helped me has been an abiding sense of optimism. History teaches that it's been the optimists who have adjusted best to the changing tide of events—even though, paraphrasing Browning: "The reach has often been longer than the grasp."

What disappoints me most about today is that a distasteful spirit of "negativism" seems to permeate much of our society and the world we live in. . . .

It is not my nature to embrace such a depressing, fatalistic philosophy. So, if I may, I would like to leave with you the notion that all is not lost. . . . The problems we see today are not unlike the ones seen by those that have gone before us. The challenge to solution was just as great to them as our challenge to solution is to us today.

You would think that nearly four centuries of life in America has been no more than a series of alternating wars and panics. But let's stop and think. What did each of our past calamities have in common? Simple. We survived them all, and life in America has kept improving, generation after generation.

But let's come back to today. The Cassandras of 1977 are saying that all is lost; the end is near; after all, stocks have gone nowhere but down for a decade; we have inflation, capital shortages, unemployment, international competition, dwindling raw-material resources, industrial poisoning, declining growth, an energy crisis and other man-made problems. Uncertainty has been created in the minds of businessmen, investors and most of society as well. A return to the 1930s, we are told, is just around the corner.

Worldwide, our 1977 Cassandras are even more apocalyptic. And to all this, I say, "hold it." Let's step back and look things over from another vantage point.

Sure, in the United States, the unemployment rate is the highest since World War II; but since 1973, we have put well over 6 million additional people to work.

Sure there is a growth dilemma. We need growth. Some say we can't live with it and pay the penalty. Others say we can't live without it. The fact is that the cost of stopping growth would be disastrous. What we must do, and can do, is guide growth and, if necessary, control it.

There is an almost universally held belief in this country that industry and its products are major causes for a growing endangered species list.

The point to note, I think, is that man, with his institutions such as business and industry, is a recent visitor to this planet and had nothing to do with the extinction of the millions of species that preceded him. Nature is still a prime determining factor. In fact, man has not to date been successful in eliminating one single insect species. . . .

It is obvious that many of our problems today would not have existed in a primitive society, but neither would our present levels of accomplishments and well-being. . . . Up until recently, the predominate efforts and incentives of our nation were clearly directed toward the fulfillment of our basic requirements. . . . Was it bad that our society would be the first to reach freedom from materialistic wants? And is it bad that we are the only nation in the world which can completely feed its people and do so with only a small fraction of its resources? Aside from the obvious benefits to us, we have built a model to show the world what can be done with technology and free enterprise.

We do have problems that are not cyclical. Of these, our biggest are energy, raw materials and food. These are longer-term problems and so much the better because we'll need time to solve them. And solve them, we will.

In the final analysis, I have to conclude that there are no absolute shortages of resources—whether they be energy, raw materials, food or water. The shortage that does exist, if we allow it, is faith in ourselves and our ability to meet change; and above all, an optimism that keeps us going forward to cope with adversity and overcome it.

In closing, I would like to leave you with the feeling that all is not lost. The world has a future—a great future—as it always has had.

—Werner C. Brown
Chairman of the Board
Hercules Inc.

(Excerpts from remarks at the Palladium Medal Dinner, American Section, Société de Chimie Industrielle, Nov. 16, 1977)

You meant to get Washington moving,

By James A. Perkins
and Robert E. Sessions

This article — a 1951 publication which rings as true today as it did then — shows that the frustrations of government service are one of the eternal things of this world.

James Perkins, then with the Carnegie Corporation, now is chairman of the International Council for Educational Development. Robert Sessions was then a marketing and management consultant.

Adapted from "Public Administration Review," with permission of the American Society for Public Administration.

So you went to Washington, and took a job with the government? Stout fellow! You've been here nearly a year now, so let's compare your experience with that of others who have been "through the mill." How do you stand on the four inevitable steps of your development?

We will start with this question. Did you have a program of your own, perhaps not spelled out in detail but at least an idea of what you planned to accomplish during your Washington assignment? You did? Splendid! Now, did you believe that you have sufficient savvy to put it across? You did? Excellent! Did you believe that others in Washington have failed because they didn't or don't really understand the right way to get things done, or because they have not been able to state their mission with sufficient clarity and precision? You did? Ah, yes.

You obviously went through stage number one, which is called

The Eager Neophyte

The Eager Neophyte is a man with a mission, who believes that success only requires a rational explanation to essentially rational people, and that he was called none too soon to unravel the tangle or to get the program off dead center or to lend the encouragement of contagious enthusiasm to those who are jaded and frustrated by many small and petty failures.

Why are you blushing? How on earth did I read your mind so well? Let's recall how it went. The first week you, the Eager Neophyte, started your job, you were full of enthusiasm, breathing the exhilarating air of a place where things happen. You had a variety of conversations with your superior, your colleagues, and your staff, if any. As you went to bed your first night, two impressions were uppermost in your mind: it was ridiculously easy to see what needs to be done, and you were the man to do it. Fresh blood was all that was needed — a new approach, free from the rigmarole of red tape and bureaucratic inertia. With a sense of high resolve, you drifted off into a peaceful sleep.

Some eight weeks later your head was once more on the pillow. The same bed, the same pillow, but the frame of mind was hardly recognizable. Anger, frustration and despair had replaced the high resolve. Your sensible ideas had met with opposition. Your memorandums that so clearly state what needs to be done had no discernible effect whatsoever. Indeed, as the days passed, you became aware of evil influences at work — unreasonable people who push alternative programs that are based on entirely different and erroneous ideas of what is good for the country. And, what is worse, it is these other programs that secured the attention, and you rapidly became a voice crying in the wilderness of the Washington bureaucracy.

Indeed, as the days passed, you became aware of evil influences at work — unreasonable people who push alternative programs based on entirely different and erroneous ideas of what is good for the country. And, what is worse, these other programs are the ones that secured the attention, and you rapidly became a voice crying in the wilderness of the Washington bureaucracy.

After a night of fitful sleep you would wake up saying to yourself — what on earth am I getting so excited about? After all, my agency is only one of a great many in Washington, and I am in only one of the six bureaus of this agency. Furthermore, I'm in one of the six divisions of this bureau and, if the miserable truth must be told, I'm a subunit chief in one section.

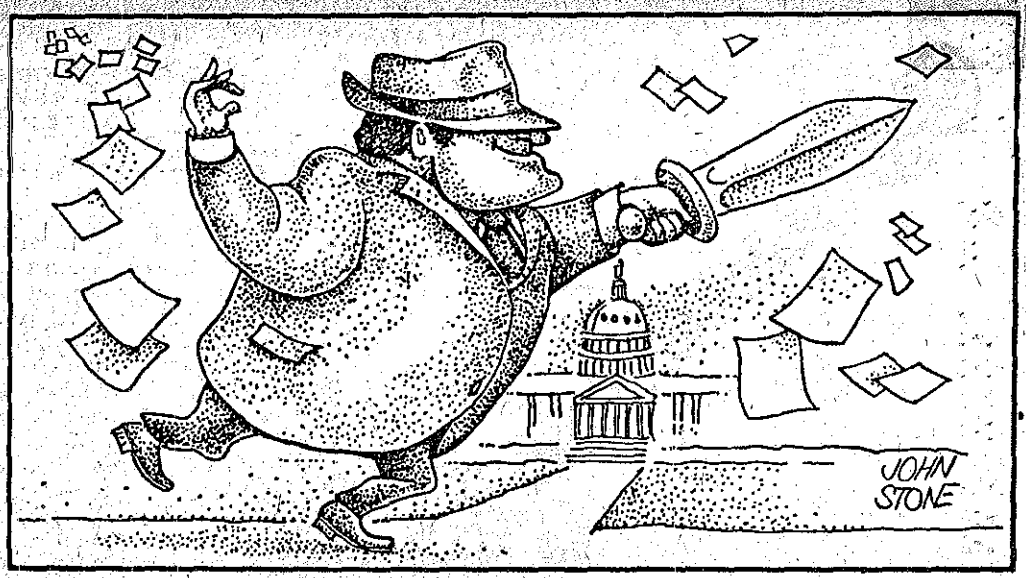
OK, so I'll do my little job as best I can, write my memorandums and reports, and make my recommendations. If my colleagues and superiors don't see the merits of my ideas, it's no skin off my nose. It's just their tough luck for being so stupid.

When you arrived at this happy state of mind, you moved into stage two —

The Polyp

The polyp, you know, is that very small animal that produces a grain of coral as a

but the change is in yourself!



full day's work. And you, too, were happy to produce your little grain of coral, neither asking nor caring where your effort fit into the total scheme of things — nor even worrying too much if there is a scheme at all.

You look annoyed and unbelieving! Yet I tell you that as sure as day follows night, the Polyp follows the Eager Neophyte. But you are a vigorous young man in the best of health with red blood in your arteries and your quota of blue blood in your veins, I should judge that you would have been likely to remain a Polyp for about six weeks.

Then one day, quite out of the blue, you erupted, violently. The eruption, in all probability, took place in some committee meeting where you suddenly realized that the discussion had once more reached a dead end. Before you knew it, you were on your feet and the hot words came pouring forth. You roasted the committee individually and collectively for their petty minds and petty "politicking." You demanded, with appropriate invective, that a decision be reached and promptly. You followed this up with a blistering memorandum to your superior, and you said to yourself, "All right, if you have to play rough to get anything done, I was not left wing on the ice hockey team for nothing. If they want to play dirty, so can I."

In this frame of mind you delivered yourself of a series of sulphurous letters, you became the terror of committee meetings, you would shout and bang the table, and you would leak information to the right columnists so that the public could hear the obstructionism (i.e., the opposition) with which you were faced.

In short, you were well into stage number three—

The Baited Bull

The frustrations you had nursed to your bosom as a Polyp came surging forward and you had yourself one whale of a time. But the human body and nervous system cannot stand this pace indefinitely. Depending on your metabolism, you at some point may have begun to slow down. You ran out of lurid language. Your fist became sore from pounding the table. You discovered that you were only shocking the Eager Neophytes and entertaining the Polyps and that your voice was getting rough and rasping from trying to drown out the other Baited Bulls. You were tired out.

But you did not become a Polyp again. Instead, you more likely became detached and objective about it all. You even became objective about yourself, and suddenly one day you may have, or perhaps you will yet, fit the different steps of your evolution into a concept of strategy. You will see the desirability of faith that is the essence of the Eager Neophyte. You will realize that the Polyp contributes the concept of the art of the possible. And you will understand that the Baited Bull has shown the necessity of fighting hard on some carefully selected fronts.

You will try to incorporate the best of each of these stages into a pattern, and when you succeed you will have arrived, my friend, at the last and final stage, that of

The Elder Statesman

No, no one can go directly there. Sorry, it is necessary for everyone actually to experience each stage in proper sequence — only then can one attain the proper objectivity and comprehension of the Washington scene.

The important thing is to make sure that you progress. Some have been known to remain in one stage for the rest of their lives. Eager Neophytes are a dime a dozen, and Washington is full of permanent Polyps. A few have the stamina to be consistently Baited Bulls. But for those who have finally become Elder Statesmen, Washington is their oyster — perhaps it will be yours, too.

Patent Rights Provide Vital University Funds

Los Angeles Daily Journal 9/16/77

Inventions produced by medical researchers at Stanford provide an important source of income used to support academic functions.

According to Niels Reimers, manager of the Office of Technology Licensing, license and patent royalty payments exceeded $1 million last year. Most of the money, he said, is used in support of research and "to reduce the ever-increasing cost of education."

Reimers and his associate, John Poitras, are responsible for determining the marketability and patentability of inventions, negotiating licenses, and securing patent rights.

Research comprises a vital part of the University's functions. Within the medical school alone the volume of government-sponsored research was $28.6 million for fiscal year 1976. The University's operating budget for that year was $80 million.

Inventions in medical fields, such as the Optacon reading device, which translates printed matter into the tactile stimuli of Braille code, have had significant impact on medicine and have garnered for the University nationwide attention. But the benefits of medical research cannot be realized unless inventions make it to market. Since the University is an educational and research institution, it can publicize its inventions, but it can not produce or sell them. The transfer of technology from the clinical laboratory to the marketplace must be done by outside sources such as the government or private industry. This process is detailed in the current issue of Stanford MD, the journal of the Medical Alumni Association.

Government grants constitute a major portion of research development and funding, but actual production is usually handled by industry. The University gives companies the right to make, use, and sell its inventions by granting licenses in return for royalties which are determined as a percentage of sales. Often the negotiated license is exclusive for a period long enough to enable the company to recover its investment.

The Office of Technology Licensing has negotiated nearly 50 agreements for developing and marketing its inventions since its inception in 1970. Six inventions related to the medical field are now producing earned royalties. For example, Stanford has arranged an exclusive license with the Hewlett-Packard Corporation to develop and produce a coronary care unit (CCU) monitoring system.

This systm provides a continuous computerized monitoring of electrocardiograms (ECGs) of up to 16 patients. It analyzes the ECGs and alerts the staff to abnormalities

patent rights. Patents provide an additional competitive advantage by ensuring exclusivity in development and production for 17 years. Patents also provide an additional source of income for the University. Last year patent royalties totaled $300,000. The government has realized the importance of patents, not only in furthering research but also in protecting its own inventions.

According to Clive Liston, patent and copyright manager in the University's Sponsored Projects Office, the government's policy is one of "defensive patenting." The SPO is responsible for disclosing inventions to the government and determining the rights and obligations of inventors.

One result of the government's defensive patenting policy is the institutional agreements which Stanford has with the Department of Health, Education, and Welfare (HEW) and the National Science Foundation. These agreements ensure that Stanford has the first option on any invention which results from agency supported research.

"HEW has one of the best patent policies," says Reimers. "They really want to see that research gets out."

The strongest earned royalty income source from the Medical Center at present is the fluorescence activated cell sorter (FACS). Developed in 1971 by Dr. Leonard Herzenberg, professor of genetics, and his associates, the FACS separates cells on the basis of the fluorescent label they carry by passing a liquid stream of cells through a laser beam. The device has been patented, and is used primarily as a research tool.

Patents rarely create monopoly situations. "A good patent stimulates further research," says Reimers. "It is simply one way of accomplishing an objective."

Patents are not suitable for every project. Many inventions are not patented because they would not make enough in royalties to cover the time and expense of filing (an average of $2,000 is now required to file and follow a patent through to issuance) or because they fail to meet patent criteria.

Patents do not guarantee production. Sometimes a company which has been developing an invention will decide to let its exclusive license lapse, even though the patents on it by then have been secured.

Reimers estimates 1 project in 100 survives the development phase to enter production, and those that do often take years to reach the market.

File Editorials

Science and law

Howard T. Markey, Chief Judge of the U.S. Court of Customs and Patent Appeals, gave an address earlier this summer on science and the law before the New Jersey Patent Law Association. Here, verbatim, is a small part of what he had to say. The full text of the address, which marked Markey's receipt of the Jefferson Medal, is published in the June 1977 issue of the Journal of the Patent Office Society.

Like all good marriages, that of science and law is not formed of identical partners but of different partners complementary to each other. The differences, though profound, are not fatal. Science seeks knowledge of facts; law seeks justice which may rise above and beyond the facts. Justice may be tempered with mercy; a fact may not. Science can tell us the amount of shoe leather consumed in a given march; law is the music we march by. Science is a metronome for the melody of the law.

Science rests on the material; law on the moral, ethical, and philosophical. Science teaches us what we can do; law tells us whether we should. Science seeks certainty; law deals with the uncertainty of the human will. Science emphasizes the general; law the particular. Scientific proof is standardized; legal proof varies with probabilities. Science determines; law compares. Science finds fixed relationships; law establishes rights and duties. Science analyzes and predicts phenomena; law clarifies and controls conduct. Science describes; law prescribes.

The things of science are only those which can be observed. The things of law, like justice and mercy and truthfulness and reasonableness and honesty and compassion and responsibility, cannot themselves be seen.

The laws of science, like gravitation or Newton's laws of motion, are inviolable. The laws of humanity can be broken. Hence we prosecute the outlaw and not the falling rock.

Science weighs, counts, and measures matter; law defines and protects the values a society holds dear.

Man has learned to build on knowledge and experience in the fields of science and the application of science we call technology. He has not yet learned to do so in morals and ethics, where every baby starts from scratch. Yet there is hope, for with every new baby our troubled race gets a new start. And to the extent that law rests on morals and ethics, not just on force, we may someday begin to build an ethical structure of grandeur and excitement equivalent to that of science. To do so requires an understanding of the relationship between law and science beyond their differences.

As in every good marriage, the partners need each other. The relationship of need finds law needing to employ the empiric methods of science, where they fit, in a lawyer's world so dependent on and infused with science. And science needs law to aid in determining the monumental ethical questions it now confronts and which it cannot answer empirically, like the use of experimental drugs and procedures on human beings, genetic experiments like those with recombinant DNA, modifications of the environment, the effects of "social engineering," treatment of laboratory animals, and the relationship of science to politics.

As in human marriages, each partner brings an influence on the other. Science and technology move the law toward new fields and the need to change and grow. The law tames, controls, and channels science and technology.

The blindfolded lady of justice, like many wives of dynamic men, has been a helpmate and a softening influence on her scientific partner from the time man crawled from the swamps until he walked on the moon. When the lady's counsel has been ignored, the purveyors of perverted science have ended by burning humans in furnaces and by making lampshades of human skin.

Only the law can deal with threats to life, liberty, and the pursuit of happiness, like those which lie in the technology of computer data banks and electronic surveillance devices. In a broader sense, unless law controls science, man will become, in Thoreau's phrase, "the tool of his tools."

Thus science and law must be treated as legitimate lovers, not as living in sin. □

Wash. Post
10/10/77

File w/ editorials

Rowland Evans
And Robert Novak

A President Unlikely To Change

Jimmy Carter, the miracle worker of 1976, is now marked by critics as the political incompetent of 1977 whose compulsive industriousness has produced a swirl of confusing objectives and made him an easier prey for the vultures in Washington's power centers.

That a crisis now exists cannot be denied. The hope of Carter insiders that the President's popularity would survive in the countryside while his status fell in Washington was shattered by the NBC poll putting his approval rating at 46 per cent. What makes this descent alarmingly different from past presidential crises is that it comes from no war, no economic collapse and no major scandal.

Rather, its source is deep inside the methods and procedures of the Carter presidency. Although the President's popularity will surely rally, he is liable to stay in trouble so long as he conducts his office as he does now. Thus, the most distressing fact in Washington today is that there is no signal yet pointing to any significant changes in the way Jimmy Carter functions as President.

Although many Democrats blame Carter's problems on the profusion of leftist appointees pushing policies not compatible with his own, the criticism comes equally from left and right. Indeed, part of his troubles may derive from a deficit, not a surplus, of ideology. Not linked to a philosophy other than an obsessive work ethic, the President has forged ahead with overambitious programs, both domestic and international, many parts of which relate to no overall theme.

Voters expected a President bringing calm and stability. Instead, confides one middle-level administration official, "they got a Lyndon Johnson overachiever" just as the presidency was entering a dangerously weakened state induced by Vietnam and Watergate.

The inevitable defeats suffered in the collision between a massive program and an independent Congress with the bit in its teeth are compounded by the fact that Carter not only is an outsider but came here boasting about it. Lacking real friends in Congress intimately tied to his fortunes, the President was set upon by congressmen acting like vultures sniffing blood from 1600 Pennsylvania Ave.

There are also vultures in his own administration. No recent administration has evidenced less personal loyalty to the President within the departments. Officials at the assistant secretary level, picked by heads of departments in Carter's "Cabinet government," owe their loyalty to the Secretary rather than the President and show no hesitancy about criticizing the President. Lobbying on Capitol Hill, usually a source of White House power, is also diffused with the departments.

In this situation, the President himself—whose political assessments on the road to the White House seldom have been matched in shrewdness—might be expected to assess the situation and change it. Some senior aides believe the prodigious output of domestic and foreign initiatives must be slowed.

But like the sorcerer's apprentice, Carter is too busy to stop the process. A few insiders say his schedule is too fully booked to think seriously about his presidency. Aides proudly point to his appetite for official reading. He has devoted 26 full hours to studying the defense budget, and more such time is being set aside. He spent much of last week going over 200 pages packed with tax-reform data.

Such total immersion would be unimaginable for statesmen such as Otto von Bismarck, Winston Churchill or Charles de Gaulle. "Jimmy sees things that any assistant secretary shouldn't see," one administration official told us. Carter is so deep in details that he seems compelled to push forward, further overloading his circuits.

The answer by many friends is to broaden his staff—"to get some aides in there with a little gray in their hair," in the words of one Cabinet member. Yet it may be unrealistic to believe that newly recruited aides could succeed where old ones have failed in changing what very well may be Carter's set style.

The hard reality is that both the overambitious legislative program and the work habits are pure Jimmy Carter. The blunt assessment of one administration official—"he's not a statesman, he's an engineer"—may be too harsh, but it points to the problem.

Some of Carter's supporters outside the administration believe his first imperative is to slow the mad pace and offer voters the impression of calm and orderliness they had expected from

Backing Off Basics

Many Concerns Stress Product Development And Reduce Research

Vexed by Sharp Competition And Federal Regulation, Firms Seek Fast Payoffs

Will U.S. Exports Be Hurt?

By MITCHELL C. LYNCH
Staff Reporter of THE WALL STREET JOURNAL

BOSTON — The "R" is slipping from R&D, and many scientists, economists and foreign-trade specialists figure that spells trouble.

They discern an ominous change in the nation's scientific posture: Industry is curbing slow-payoff, basic research aimed at finding new products and instead is favoring hard-nosed, quick-payoff development of existing technology.

If this trend continues, some experts fret, the U.S. eventually could lose its standing as both the world's most innovative country and the biggest exporter of high-technology goods. Others worry that scientists aren't getting the elbowroom to, say, come up with synthetic fuels to replace petroleum. The problem has spread even to universities, long considered the birthplace of basic research.

"I don't hear many of my industrial contemporaries talking about exciting new major discoveries that they think will shake the world," sighs N. B. Hannay, head of research at Bell Laboratories, an arm of American Telephone & Telegraph Co. Thomas A. Vanderslice, who oversees research at General Electric Co., also is concerned. "There are trends that, unless corrected, could lead to a rapidly maturing crisis," he says.

Real Outlays Stagnant

The switch in R&D emphasis has taken place at a time when the total of such spending in the U.S. has turned essentially stagnant. American companies are spending more money on R&D, of course; one private study found that industry expenditures on R&D last year rose more than 11% from 1975 to $16.2 billion. However, the higher outlays have barely kept pace with inflation. "Strip away the higher costs, and you don't have much of an increase in the real amount of R&D being done today," says Michael Boretsky, senior policy analyst at the Commerce Department. And Otto Eckstein, who heads an economic research firm near Boston, says spending is lagging behind the pace that would be expected during a rebound from the 1974-75 recession.

Perhaps even more ominously, R&D spending in the U.S. is beginning to slacken in comparison with the rest of the world. [illegible] study estimates that the Raytheon Co. is blunt about it. "Very definitely we have gotten away from long-term general research," a spokesman for the big, diversified company says. "All the research we now are doing is applied research with well-defined goals, better focus on business objectives, and a promise of payback within a reasonable period of time."

Reasons for Switch

Executives and economists alike attribute the new, quick-payoff approach to R&D to the still-high rate of inflation, the shortage of capital funds during the current slump in the stock market, sharp competition here and abroad for existing high-technology markets, and uncertainty about government regulations and policies.

"During periods of uncertainty, companies aren't in any mood for high risks," says Alan Greenspan, a former chairman of the President's Council of Economic Advisers. "Uncertainty is plaguing the investment community, and it is far more pervasive than it was a decade ago." Under these circumstances, for example, "it is no wonder this country hasn't done much research into synthetic fuels," Mr. Greenspan says. "The payoff is too far down the road."

Richard E. Heckert, senior vice president who oversees R&D at Du Pont Co., specifically cites the impact that federal policies are having on coal-gasification proposals. "Who the hell is going to develop expensive coal processing when natural gas is selling at half its real market price?" he asks. With gas prices held down by federal regulations, Mr. Heckert says, industry is concerned about "whether it could even get a buyer for any higher-priced synthetic fuels." And George Gols, chief economist at Arthur D. Little Inc., a research and consulting firm, suggests that there is a deeper problem, "that industry, in the long run, doesn't really believe that fuel is going to be much more expensive or scarce."

Du Pont itself, whose $353 million R&D budget last year puts it among the biggest in industry, has realigned its program drastically. In recent years, the big chemical company has dropped about 22 of what it considers "new adventures" in R&D and is working on only two or three. Indeed, only 22% of Du Pont's R&D budget went to basic and new-venture research last year, compared with 38% in 1972. In the same four years, spending for what Du Pont calls "improvements for existing businesses" climbed to 78% from 62%.

This new policy means "much lower risks and much higher rewards," Mr. Heckert says. In a way, he adds, the company has given up "looking for another nylon or Dacron," two synthetic fibers that were developed by Du Pont researchers and marked major breakthroughs. Du Pont isn't searching for more extensions of plastics and synthetics because "there aren't any simple combinations left," Mr. Heckert says. "There are only so many ways you can mix around the basic molecules."

In the long run, companies like Du Pont might prefer to license technology developed by other companies, Mr. Heckert indicates.

Indeed, many companies clearly are irked because foreign manufacturers have proven adept at picking up U.S. technology through licensing agreements, improving it and then exporting high-technology products

Prof. Davidson adds that he wouldn't be surprised to see foreign manufacturers make big inroads in the U.S. markets for office copiers, electric typewriters, outboard motors and electric organs. (Using a Hammond Organ Co. license, Yamaha of Japan already has begun exporting a competitive electric organ, the professor says.)

Zenith's Layoffs

U.S. companies often lose their technological lead because, Prof. Davidson says, they are so preoccupied with keeping their share of the current-technology product market. Other observers say much research work merely involves a hunt for ways to make current products more cheaply or an attempt to accumulate so many patents in a given field as to hamper potential competitors.

A few days after Prof. Davidson was interviewed, Zenith Radio Corp.—almost as though on cue—announced that it is laying off 25% of its work force, including a large number of researchers. The reason: competition from Japanese TV-set makers. The Research Department is being brought into the Product Development Department, a Zenith spokesman said. Research projects that "aren't directly related to the immediate product line (color-television sets) are being eliminated," the spokesman added. "We're dropping some research projects where the payoff was 20 years from now. They weren't making a contribution to our needs now."

Many corporate executives, economists and academics also complain that government regulation and red tape are strangling basic research in the U.S. Foreign governments, in contrast, nurture industrial research, U.S. businessmen say.

These governments have less-stringent antitrust laws and, in fact, often urge domestic companies to share technology and production operations. For example, under pressure from Paris, the Peugeot S.A. auto maker last year acquired control of Citroen S.A., another French auto maker, which was in deep financial trouble. Peugeot's job was to bring Citroen under its wing and create one streamlined auto-making operation. The U.S. Justice Department's Antitrust Division, on the other hand, prohibits American auto makers from even exchanging information or knowhow, much less combining production operations.

Drug Regulations

Foreign governments also impose fewer regulations that slow the introduction of new products. This difference is most apparent in the pharmaceuticals field.

Du Pont's Mr. Heckert says that in this country the average corporate cost of bringing a new drug from the laboratory to the pharmacy is $10 million. "Think about introducing 50 of them," he says sardonically. To get Food and Drug Administration clearance for a muscle relaxant called Dantrium in 1972, the Norwick-Eaton Pharmaceuticals division of Morton-Norwich Products Inc. submitted to the agency 456 volumes of technical material, with each volume two inches thick—literally a ton of documents.

An FDA spokesman says the average new-drug application today takes up about 70 volumes of technical material. And the processing of such applications can take years. One reason is a bureaucratic problem: An FDA employe risks little by delaying an application, but he can get into [illegible] by clearing a drug that later is im-

Walter E. Goldblith, provost of the Massachusetts Institute of Technology, puts part of the blame on what he calls "a nightmare" federal funding system. Compared with the looser block grants of bygone years, money now is doled out only for tightly controlled projects, Mr. Goldblith says. By insisting on multifarious reports and other forms of accountability on basic-research projects, Washington has "fragmented the study of nature until it has become meaningless," he complains. "Scientists? Our people have had to become more like accountants," Mr. Goldblith snorts.

It is difficult to determine the extent to which this basic-research lag is hurting the nation's trade figures. However, technology clearly is important to U.S exports. The Commerce Department says that while the U.S. was incurring a $5.88 billion deficit in merchandise trade last year, its exports of technology-intensive manufactured goods were outrunning such imports by $26 billion.

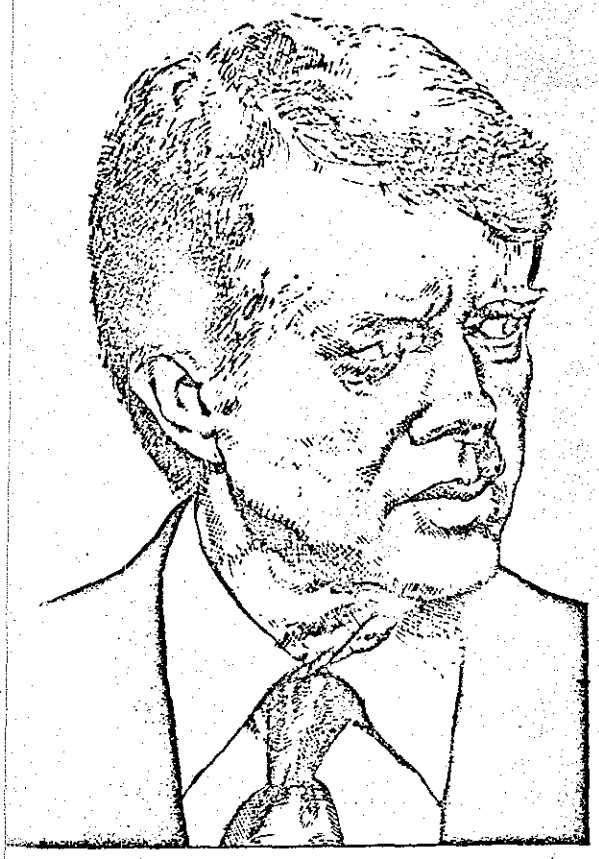
"What alarms me is the trend we're seeing now and what effect it may have on our trade picture later," says Edward M. Graham, a professor at MIT's Sloan School of Business. "Right now it's a problem not quite a crisis."

"Unfair" Comparisons

But not everyone is alarmed. Some economists, including Mr. Gols of Arthur D. Little, say research comparisons with, say, the late 1960s are "unfair" because the government and corporations then were spending huge amounts of money on research related to defense and the space program.

Frank Press, President Carter's science adviser, agrees. "A certain amount of deterioration is inevitable," Mr. Press says. "The first thing we have to realize is that the boom years of the 1960s have passed." Furthermore, he warns that the statistics are "still too imprecise; we need to break down the figures sector by sector to find out where the problems really are."

To Mr. Press, the answer isn't a flood of federal funds into basic research. "We have to be careful," he says. "We don't want to overload the system."



Carter and Ford detail their ideas on science and technology for C&EN

9.1/6

Where do the Democratic and Republican Presidential candidates stand on the vital issues affecting science and technology? Both candidates have a record of being supportive of science and technology: Jimmy Carter as governor of Georgia, Gerald Ford as President of the U.S. However, neither candidate has spoken out in much detail in the campaign so far on how science and technology would fare in his Administration.

C&EN believes the reader needs to be better informed on the candidates' positions. So, to determine the candidates' views and plans for science and technology, C&EN assistant managing editor and Washington bureau chief Fred H. Zerkel submitted the same set of questions to Gov. Carter and President Ford. Here are their unedited replies:

What level of research and development funding would your Administration recommend? How would it be divided among defense, space, and civilian sectors? Should national R&D funding be linked to some percentage of gross national product? And what is an appropriate balance of federal funding for basic research, applied research, and development?

FORD

I have stated repeatedly that I believe that a strong national effort in R&D is critically important to strengthen the economy and our defense and to improve the quality of life for all people. One measure of this belief is my 1977 budget, which included requests for $24.7 billion in federal funding for R&D. This represents an 11% increase over 1976 for R&D as compared to an overall budget increase of 5.5%.

I will continue to support vigorous, forward-looking federal R&D programs, but it is too early in the preparation of my 1978 program and budget to predict the levels of funding for R&D. It is important, in this connection, to recognize that the federal government does not have a separately determined "R&D budget," as such, and that the level and distribution of federal funding depend on many factors.

Applied research and development is carried out as a means to assist in achieving a variety of important federal and national goals and objectives; e.g., new weapons systems to deal with new threats to our security, or working with the private sector to develop new energy technologies to reduce our dependence on foreign oil.

The series of factors that must be considered in deciding on the level of funding for various applied research and development programs include: (a) the relative importance to the nation of a particular problem or objective, (b) the appropriate role of the government versus the private sector in dealing with the problem or achieving the objective, taking into account the nature of the private sector R&D effort under way or expected, and (c) the relative contributions expected from R&D and from other actions to achieve the desired ends.

In the case of basic research, there are insufficient incentives in many cases for private industry to invest enough to meet national needs. Thus, a strong federal effort is essential to assure that the nation will have the necessary new knowledge that underlies future advances in science and technology. There is no precise way to determine how much national investment there should be in basic research, but my Administration has examined trends in federal support of basic research and has undertaken to assess the potential impact of these trends on the

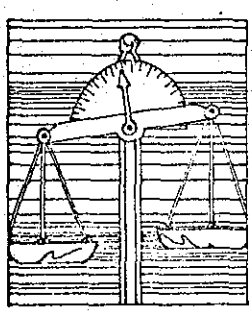
status of the U.S. effort. Based on our analysis, my 1977 budget proposed $2.6 billion for basic research—an increase of 11% over 1976 estimates. This level of funding would reverse the steady decline—in constant terms—in federal investment in basic research which has occurred since 1967.

It is not practicable to predetermine the spread of federal R&D funding among defense, space, and other civilian objectives; the spread among basic and applied research and development; or the appropriate percentage of the gross national product that should be invested by the nation in R&D. These can and should change with changes in national priorities or changes in the other factors, such as those cited earlier, which affect decisions on the level and distribution of federal funding for R&D.

CARTER

The federal budget for R&D should not be reduced, but is unlikely to be expanded dramatically because of resource constraints. Nevertheless, there is a great opportunity to rebalance expenditures in such a way as to stabilize the long-term commitment to the basic research foundations on which all technology rests, to increase the priority given to research in fields likely to be of long-term economic importance, and to give proper attention to environmental, health, and other civil concerns, including applied research important in global problems. This can be done at the expense of some development and demonstration programs and other direct federal operations that should better be carried out with private funds.

The level of national R&D effort, public and private, should be growing with the economy. In recent years it has in fact been falling, as economic growth has sagged and the federal government's R&D strategy has fallen into disarray. This trend must be reversed. But it is wrong to tie R&D expenditures to a fixed fraction of any macroeconomic indicator, for R&D is a microeconomic activity. It is a means to an end, and the level of investment follows the ability of organizations to use it effectively. Thus, at the national level attention must be given to creating the conditions that encourage high-risk, high-payoff industrial activity, and that motivate both public and private sector institutions to do the research that will best protect the long-term future of the country.



What specific areas of R&D would your Administration emphasize? De-emphasize? And how would you rank in priority R&D efforts needed to solve national problems such as energy, environment, and health?

FORD

I will continue to emphasize basic research and those areas of applied research and development that (a) can make a significant contribution in achieving important national objectives or solving critical national problems, and (b) are appropriate for federal R&D investment—either alone, such as defense, or in partnership with the private sector, such as in energy technology development.

This approach to determining relative emphasis is reflected in my 1977 budget proposal wherein I identified a number of high-priority areas for increased federal investment—including energy, defense, basic research, agriculture, and health—while continuing major R&D efforts in space, environment, natural resources, transportation, urban development, and other areas.

As indicated in my response to question No. 1, future funding levels will be determined in relationship to national priorities and the other factors cited.

I will continue to give priority attention to energy, environ-

ment, health, defense, and other areas of national importance, but each area must be examined separately to see how and to what extent R&D can make a contribution and what the appropriate roles of the government and private sectors are.

I also would like to point out that the relative level of funding for a particular R&D program does not necessarily reflect the relative importance of the objective or problem, or the contribution ultimately expected from R&D. For example, the funds required to build a large demonstration-scale plant for a particular technology (e.g., synthetic fuels plant or nuclear reactor) are much larger than the funds that can be spent usefully in pursuing in an orderly fashion R&D on a concept that has not advanced to a large demonstration phase (e.g., solar electric power generation).

CARTER

As indicated above, R&D emphasis is of two kinds: policies and incentives for private R&D and direct investment by the federal government. The federal government should use both approaches to providing a stronger economy and national capability to manage risks, protect the environment, and accomplish the other needed goals. In some areas of federal R&D investment the problem is not inadequate funds, but poorly managed programs. Internal priority shifts are necessary.

There are a number of areas in which specific R&D efforts need strengthening. Examples include earthquake prediction, arms control research, and research to provide a more quantitative basis for determining risk to human health and well-being from substances and environments (such as noise) of many types. In many areas of federal regulatory activity, there are lacking the kind of hard quantitative data on the basis of which to make sound regulatory policy.

A few areas of science and technology need a new commitment of national attention. One example is the scientific basis for the enhancement and improvement of nutritional quality of food supplies for all the world's people. Here the primary need is to share what we know. In defense and space R&D we must ensure that our efforts are of very high quality, and sustain the levels of technical leadership that are essential.

What programs or policies would your Administration recommend to ensure continuity of funding for science and technology to prevent peaks and valleys in technical training and employment as well as a sustained real growth in the nation's science and technology effort? Should such programs be different for the industrial and academic communities?

FORD

The most important factor in ensuring continuity of national funding for science and technology and preventing peaks and valleys in training and employment is the maintenance of a strong and growing economy—an objective to which I am very firmly committed. This will provide an environment for real and sustained growth in the U.S. science and technology effort so that the research and the inventiveness of our scientists and engineers can be translated into new knowledge, and new goods and services for the benefit of all.

With regard to federal investments in R&D—which investments play a critical role in the national scientific and technological effort, I will make a special effort to avoid sharp changes that can contribute to peaks and valleys in employment. I appreciate fully the need to minimize or avoid major dislocations that can result from federal actions in scientific and technological activities and in other sectors of the economy.

R&D funded through mission agency programs such as Defense and the Energy Research & Development Administration, together with actions to sustain economic growth, should provide strong stimulus for R&D efforts in the industrial sector.

With respect to the academic community, I believe the federal government has a special role to play in ensuring adequate support of basic research—the largest portion of which is conducted in the nation's colleges and universities. My concerns both for basic science and for ensuring the continued vitality of research in universities is reflected in my 1977 budget, which proposed an increase of 11% above 1976 estimates for federal support of basic research. This included an increase in basic research funds of about 25% for the National Science Foundation, which has long had a primary role in providing funds for basic research in academic institutions.

CARTER

Rapid fluctuations in demand for R&D are particularly difficult to accommodate. Such fluctuations are wasteful of a priceless national human resource. On the industrial side the essential requirement is a stable economy with low unemployment. R&D is a risk investment, and is made when companies have confidence in the future. Incentives for private investment in R&D should emphasize the power of R&D to permit innovation. When a business downturn occurs, countercyclical encouragement to innovation can help provide the basis for long-term strength in the economy.

In academic research, fluctuations in support result from the impact of economic cycles on government revenues, and thus on resources for public investment, and changes in the program content of federal agencies funding research. Since the federal government has direct or indirect responsibilities in both areas, federal leadership is needed to stabilize the research base in universities. The director of OSTP [Office of Science & Technology Policy] must work with OMB [Office of Management & Budget] to ensure that the aggregate impact of all federal R&D programs is well managed.

Should the U.S. have a coherent overall science and technology policy? Should there be a Cabinet-level department of science and technology in addition to the new White House Office of Science & Technology Policy to provide centralized funding and management of the federal end of the national R&D effort? Or is the existing federal science apparatus adequate?

FORD

As a general rule, coherent overall policies for particular areas of activity are desirable, but the specific meaning of the phrase is very important in the case of science and technology.

To illustrate, I would be very concerned and strongly opposed if a coherent overall policy implied that we should have some centrally developed master plan by which we would attempt to set priorities and funding levels for our nation's many-faceted scientific and technological effort.

I believe that the unsurpassed strength and accomplishments of the U.S. scientific and engineering communities can be attributed in large part to the pluralism and the flexibility that have been achieved through a decentralized approach. We look primarily to the private sector for the innovation that carries our new knowledge and inventions forward to useful products and services. The successful innovation we have enjoyed could not possibly have resulted if we had centralized planning.

I understand most experts agree that the U.S. achieves much more for its R&D dollars than many foreign countries—such as the Soviet Union, which has centralized R&D planning—even though other countries spend larger percentages of their GNP on R&D.

Particularly because of the advantages of diversity, pluralism, and flexibility, I have serious reservations about the idea of a department of science and technology. Furthermore, many of our mission agencies such as the Department of Defense, Health, Education & Welfare, and the Department of Transportation must be able to use R&D as one means to achieve their assigned missions. It would be unrealistic and unprofitable to have a single centralized agency manage these agencies' R&D efforts. There may, however, be some areas of federal R&D that could benefit from consolidation.

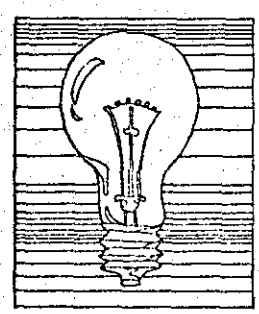
The same law that establishes the Office of Science & Technology Policy in the White House, as I proposed in June 1975, also establishes a President's Committee on Science & Technology. The committee is charged with studying and reporting on the overall context of the federal scientific and technological effort, and it is specifically charged with studying the concept of a department of science and technology. I look forward to the results of that study and I will consider seriously any recommendations made in the area of science and technology organization. Any organizational changes in this area would, of course, need to be examined in the broader context of overall government organization.

CARTER

Certainly, the U.S. government should have a coherent overall science and technology policy. The lack of a mechanism for generating such a policy in the past four years has sown waste and confusion across the national scientific scene.

The question is, how much pulling together of technical agency activities is desirable? The "mission-oriented" agencies should certainly continue to operate laboratories and fund or cost-share R&D outside government as the prudent, efficient, and responsible way to carry out their missions. Such technical programs should not be separated from their end purposes and drawn together.

It also may be desirable to give more central authority and resources to agencies concerned with the health and vigor of the national scientific and technological enterprise. Finally, there are some glaring weaknesses in the present structure, for example in the ability of the federal agencies to contribute to the civil economy, or to carry out commitments that derive from foreign policy.



In what ways do you see the federal government able to play a role in technological innovation? Further, what role, in terms of tax incentives, patent policy, and the like, should the federal government play in relation to R&D in private industry?

FORD

The federal role should be to further technological innovation in sectors of the economy in which private developments are inadequate to meet special needs. For example, there are overriding national benefits from a strong defense system and from attaining additional security against the potential disruption from energy embargoes.

If privately financed R&D is not sufficient to provide the new technologies needed for a higher level of security, or for the achievement of broad national goals then federally funded programs should be put in place. But where the private sector is producing new goods and services at a rapid rate for consumer use and for national needs, there is little or no justification for federally supported R&D.

This is not to deny a role for tax incentives and patents.

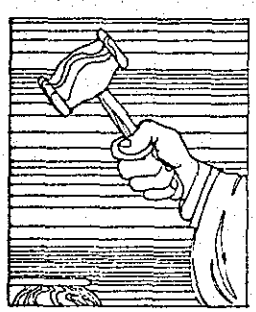
Where there are serious market imperfections, such as inability to obtain ownership rights to one's own inventions, then taxes and patents can be used to provide necessary corrections. These should be used as supplements to make markets work better, not as substitutes for private initiatives.

CARTER

First, the federal government should set a good example, by using its own purchasing power to encourage innovative products and services that can increase the efficiency of government. The small program on Experimental Technology Incentives (ETIP) in the National Bureau of Standards has demonstrated the power of this approach.

Next, attention must be given to the special circumstances surrounding the most fertile ground for innovation, the small, technologically oriented firm financed with venture capital. It has been over a decade since the "Charpie Report" looked into this question, and still many of its recommendations lie unimplemented. The area should be looked at again to see what must be done in the present business and technology climate.

Another area requiring attention is federal patent policy, which all too often either reduces the incentive of private investors to attempt to exploit the results of federal R&D in commercial markets, or simply prevents the firms with the most technical capability from wishing to participate in federal programs. Finally, tax, trade, and antitrust policy must be managed so they encourage R&D and innovation.



Should a sort of "science court" be set up to adjudicate scientific and technological issues? Further, what should (should not) be the role of the federal government in the setting up and perpetuation of such an apparatus?

FORD

I understand that the "science court" concept has been suggested as a means for establishing scientific facts, or lack of facts, in the case of issues of national concern that become very controversial.

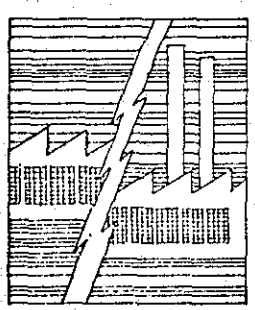
The concept was reviewed by the two scientific and technical advisory groups (led by Dr. Simon Ramo and Dr. William O. Baker) that I established to help prepare for the new Office of Science & Technology Policy. Those groups recommended that the concept be considered further and that an experiment with the science court be pursued. Recently, the concept of a science court also was considered during a two-day meeting sponsored by the Commerce Department, National Science Foundation, and the American Association for the Advancement of Science, which was attended by some 250 concerned citizens representing a wide range of viewpoints. This meeting also led to a recommendation that the concept receive further consideration.

Whether a "science court" will provide a better basis in fact than the means currently used is yet to be demonstrated. The National Science Foundation and the Department of Commerce now are seeking ways of assisting in a test of the concept on an experimental basis.

CARTER

If by "science court" we mean competent institutions that make objective evaluations of scientific evidence, uncertainty and risk, undertaken in the open for public view, I would support the idea.

There is a clear need for better and more public policy determinations and the development of institutions for making the basis of such determinations clear.



Should individual chemical companies or other corporate entities be permitted under the antitrust statutes to cooperate and coordinate their R&D programs in the solving of national problems such as energy or environment?

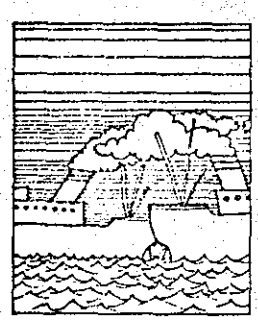
FORD

Under existing pollution control laws and antitrust laws, it is possible for two or more firms to join together to do certain kinds of cooperative research. The Department of Justice reviews proposals for such cooperative efforts on a case-by-case basis and where it finds no anticompetitive purposes or effects will provide the companies involved with its conclusion not to bring any federal antitrust action.

I would favor such cooperative research efforts in nonproprietary areas where it is approved by the Justice Department and where it increases the chances of hastening the finding of solutions to common problems, improves the utilization of resources, and does not interfere with the innovation that sometimes requires multiple approaches to the same research objective before a solution is likely.

CARTER

This would have to be considered on a case-by-case basis. In nonproprietary research, if cooperation is necessary and would have a beneficial effect on competition I would consider it. However, in no case would I approve of this approach if it had the effect of eliminating or decreasing competition in the private sector.



What role do you see U.S. R&D playing in solutions to U.S. balance of trade problems? Should there be close government control over export and licensing of U.S. science and technology, in general, and in sensitive areas such as nuclear equipment and technology, in particular?

FORD

For a number of decades now, an important part of U.S. trade exports has been based on the technical superiority of our products. Aviation sales and products using advanced solid-state circuitry such as computers are examples. In addition, we lead in agricultural exports.

The "R&D content" of our exports has been higher than those of most other industrialized nations. Indeed, to continue to expand our trade with other countries, U.S. industry must develop new and better products each year and put these products into exports. But this has to be done without giving away new technology to be used by others in weapons systems. The licensing procedure of the Export Administration (Department of Commerce) is designed to prevent this, without at the same time holding back legitimate commercial exports. A Presidential task force with an assignment to improve Export Administration procedures has been examining the agency's operations and will report to me soon.

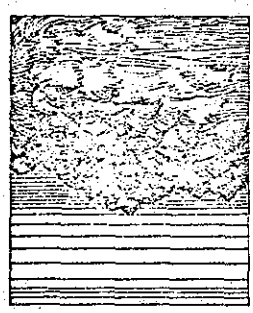
In the case of sensitive areas such as nuclear equipment, technology, and fuel, we must take special precautions and have close government control. Our objective is to control the international spread of the capability to develop nuclear explosives. I recently have directed that a thorough review be undertaken of our nuclear policies and options, particularly with respect to exports, reprocessing, and waste management.

CARTER

U.S. foreign trade performance is, above all, a measure of the internal strength of the U.S. economy in comparison with the economies of our main trading partners. In this comparison the figures since 1968 are serious cause for concern. U.S. improvements in productivity lag the rates in Japan and many European countries. The percentage of the work force engaged in R&D continues to rise in those countries; it has been declining in the U.S. since 1969.

More and more frequently we have seen major inroads by foreign competitors in areas of traditional strength in the U.S. (But the right policy for the U.S. is not to copy the policies of foreign governments, but is to take steps to strengthen the competitiveness of the domestic U.S. economy.) This strength is greatest in the areas of most rapid technical progress. Agriculture, civil aviation, and computers are all examples.

There are circumstances, especially in technology of military significance and in critical materials areas, in which a government policy concerning exports and imports is justified. Our government should react with appropriate firmness to other governments that intervene to our disadvantage. What we should do is adopt those domestic policies—in education, science, economic policy—that are most likely to keep U.S. industry ahead, and give careful attention to the dislocation of the labor force that accompanies rapid technological change.



There is a growing feeling that some of the current legislation and regulations to implement enacted legislation aimed at curbing pollution, safeguarding the environment, and so forth, is either too heavy-handed or cast in such broad terms as to be either meaningless or too subject to arbitrary interpretation. What is your view?

FORD

I believe that we can go a long way toward achieving our environmental, energy, and economic development goals at the same time, if we proceed deliberately and carefully.

However, I agree with the view that some current environmental laws and regulations have lacked a reasonable balance, and I have acted to achieve a better balance. For example, I have urged Congress to extend the Clean Air Act deadlines for meeting automobile emission standards so that we can have a better balance among our clean air, energy, economic, and consumer price objectives.

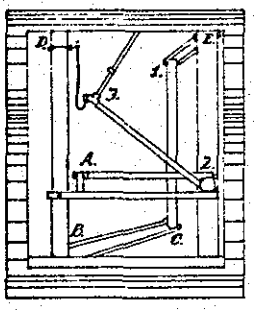
I also have been concerned about the impact of environmental regulations but, in some cases, the regulations have been issued by the regulatory and enforcement agencies in direct response to explicit provisions of the law or to comply with court interpretations of the law. Many of the environmental laws were put in place quickly and with good intentions. Now that better information is available, the laws and the regulations should be corrected for the long-term benefit of all our society. As illustrated above, I am seeking such corrections.

In general, our pollution control programs should achieve a balance among the benefits and costs of improving environmental quality and benefits and costs of industrial and commercial development. In the past two years, we have come closer to striking a socially acceptable balance than before. At my direction, the Environmental Protection Agency (EPA) first initiated "Economic Impact Statements" and then I ordered "Inflation Impact Statements," to provide a basis for assessing social benefits and costs of each particular rule-making. In some cases, EPA was prevented by law from basing decisions on these assessments. But where possible, EPA has gone a long way in making decisions that reflect a balance between the benefits of improved environmental quality and costs to the economy.

CARTER

There is no doubt that a few federal regulatory programs produce few real benefits to the public while exacting a cost to the economy. However, properly managed and structured, regulation not only should meet its purpose of protecting the public interests but also provide incentives to innovation.

Too often the rules are hard to interpret, government policy is too unpredictable and unstable, compliance is indifferently enforced. The most serious shortcoming of regulation is that it often fails to relate the social and economic costs of the goals to objective measures of benefit. Indeed, often the reduction of risk in one area is achieved at the expense of enhanced risk in another. Improvements in the regulatory process would come from reorganization. Above all, more objective scientific fact determination is needed, so policies can be soundly based.



What views do you have on reform of the U.S. patent system, particularly as it affects individual inventors or wider licensing of U.S. technology? Are existing federal programs to transfer technology developed at government expense to private industry or other sectors of the economy adequate? What further efforts in this area might you propose? And how would your Administration view exclusive licensing to industry of federally owned patents? Should there be some form of compensation to the government and should government-employed inventors of such licensed technology receive some form of compensation?

FORD

The U.S. patent system on the whole is working positively toward the rapid development of new technologies. However, the changing nature of applied research has raised questions about the adequacy of the patent system, which has changed only slightly since early in the 19th century.

My Administration has submitted comprehensive legislation that would rid the patent system of many of its existing problems without sacrificing the indispensable stimulus to invention now afforded by that system. The proposals are designed to assure that the patents issued are more valid and contain greater disclosure of the technology involved. Also, the proposals seek to improve the administrative procedures in the patent and trademark office so as to permit a simple and straightforward search for new patents.

This and other patent reform measures have been under consideration in Congress for some time, but none has been enacted.

The number of government-owned patents that have been licensed for use in the private sector is less than 5% of the total. Measured against the performance of the university community, whose licensing rate exceeds 30%, the federal technology-transfer record is poor. Although this situation has existed for decades, my Administration is doing something about it. First, a high-level patent-policy task force has now reported to me and to Congress on sweeping recommendations for making optimum use of government-funded innovations. Second, we already have begun (with encouraging results) to *market* government-owned inventions, instead of letting them sit idly on the shelf while waiting for someone to ask about them.

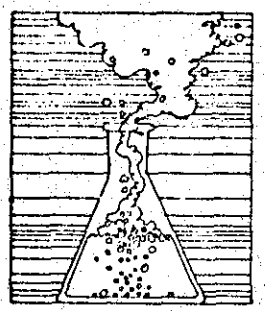
Government-owned inventions which are licensed for use in the U.S. stimulate employment and create revenue in the form of tax receipts. In some cases it may be appropriate to charge a royalty for such domestic licenses. Foreign licenses, on the other hand, generally should be issued on a royalty basis.

The principal goal of federal investment in R&D should be to maximize the benefits to the public of the new technology that results. In some circumstances, this end may be served best by giving exclusive rights to those in the private sector who will take the necessary steps, make the required investments, and exercise the required diligence to disseminate the benefits of the technology expeditiously and effectively. The university experience indicates that this is a valuable and often indispensable tool for actually transferring technology into the market place.

CARTER

I realize that the present U.S. patent system has some severe difficulties in regard to inventors, users, and recipients of technology. I have not yet made a detailed study of the system, but I plan to do so in the near future. Until that time, I would like to withhold any judgment on this matter.

Your suggestion on private licensing of government-owned patents is provocative. If it can be determined that such a system would encourage and increase competition in the private sector, I would be willing to consider it. I would have to study the matter of consideration for government-employed inventors from a personnel management perspective.



How do you view the current level of effort in the Environmental Protection Agency and the Occupational Safety & Health Administration to regulate toxic chemicals? Should the effort be increased and, if so, in what fashion?

FORD

The Toxic Substances Control Act, recently passed by Congress, establishes a new framework for much of the government's activities with respect to toxic chemicals. I have supported enactment of such legislation, although I continually urged that unduly burdensome premarket notification requirements be eliminated from the bills because they were overrestrictive and of little value in protecting the public health.

As in the case of all new laws such as this one, we will have to proceed carefully and seek to assure that the costs of complying with it do not exceed the benefits gained.

CARTER

We must do more to guarantee each and every American the right to a safe and healthy place of work. More than 600 toxic chemicals are introduced into our workplace annually. There are currently more than 13,000 already listed. Nearly 100,000 working people die each year from occupational illnesses and accidents. More than 17,000 disabling injuries have occurred in our nation's mines. This terrible toll cannot be tolerated.

I believe the basic concept behind OSHA is excellent. We should continue to clarify and expand the state role in the implementation of health and safety. OSHA must be strengthened to ensure that those who earn their living by personal labor can work in safe and healthy environments.

The Occupational Safety & Health Act of 1970 should cover all employees and be enforced as intended when the law was enacted. However, early and periodic review of the act's provisions should be made to ensure that they are reasonable and workable. I would look favorably on developing means to provide technical assistance and information to employers to encourage compliance with the act.

The control of occupational hazards can save many workers each year who die prematurely because they are exposed to toxic chemicals, dust, pesticides, unsafe machinery, and other dangerous conditions. Nationwide efforts in this area should continue until our working citizens are safe in their jobs.

Federal Alert— *new regulations*

This listing covers regulations appearing in the Federal Register *from Sept. 8 through Oct. 7. Page numbers refer to those issues.*

PROPOSED

Food & Drug Administration—Changes status of 10 ingredients that are used in cold remedies from requiring a prescription to over-the-counter sales; comments by Dec. 8 (Sept. 9, page 38312).

Allows use of Red Dye No. 4 in externally applied drugs and cosmetics; comments by Oct. 26 (Sept. 23, page 41854). Continues provisional approval of 52 color additives, including ferric ferrocyanide, zinc oxide, and bismuth citrate; comments by Nov. 22 (Sept. 23, page 41860).

Allows use of triglyceride mixture of caprylic and capric acids to be used as surface finishing agent, formulation aid, lubricant, and in dietary foods; comments by Dec. 3 (Oct. 4, page 43754).

Requires new labeling for estrogens, to include account of cancer risks associated with estrogen use; comments by Nov. 29 (Sept. 29, page 43108).

Nuclear Regulatory Commission—Phases out over the next 10 years the government's program to compensate the public in the event of a serious reactor accident; comments by Oct. 20 (Sept. 20, page 40511).

Patent & Trademark Office—Strengthens patent examining and appeal procedures: permits patent owners to bring new prior art to the office through reissue applications, assist examiners by providing them with patentability statements in all applications, modify appeal procedures to authorize oral arguments by examiners; comments by and hearing on Dec. 7, in Arlington, Va. (Oct. 4, page 43729).

FINAL

All agencies—Spells out plans to involve consumers in their decision-making processes; effective immediately (Sept. 28, page 42761).

Department of Transportation—Sets forth packaging, labeling, and placarding requirements for air, water, and surface transportation of hazardous materials; effective immediately (Sept. 20, page 40613).

Environmental Protection Agency—Designates for five years the Gulf of Mexico as ocean dumping site for incineration of chemical wastes; effective immediately (Sept. 15, page 39319).

Postpones implementation of its program to phase out use of lead additives in gasoline; effective immediately (Sept. 28, page 42675).

Food & Drug Administration—Bans use of Red Dye No. 4 in maraschino cherries and ingested drugs; effective immediately (Sept. 23, page 41853).
Bans use in cosmetics of aluminum stearate, bentonite, calcium silicate, calcium stearate, gold, kaolin, lithium stearate, magnesium aluminum silicate, magnesium stearate, and zinc stearate; effective Oct. 26 (Sept. 23, page 41855).

Bans use of carbon black in foods, drugs, and cosmetics; effective immediately (Sept. 23, page 41857).

Denies Abbott's petition to reinstate use of cyclamates in food; effective Oct. 4, objections by Nov. 3 (Oct. 4, page 43754).

NOTICES

Environmental Protection Agency—Announces availability of draft environmental impact statement on proposed cancellation of chlordane and heptachlor pesticides (Sept. 9, page 38206).

Asks public input on what sort of information should go into toxicology test reports that are submitted in support of pesticide registration applications; for example, should the director of the laboratory performing the tests sign and approve all reports; comments by Dec. 6 (Oct. 5, page 43921).

Federal Energy Administration—Requests expressions of interest and comments on private sector participation in commercial energy projects under the International Energy Agency; projects can include pilot plants for oil shale or tar sand development, and natural uranium exploration; comments by Oct. 15 (Sept. 13, page 38818).

Nuclear Regulatory Commission—Sets forth safety and environmental aspects of using mixed uranium-plutonium fuels in light-water reactors; comments by Nov. 4 (Sept. 20, page 40506).

Levine thinks we also need to focus on the "third party problem." While the company that made the know-how sale might use the proceeds to regenerate its own technology, other companies in the same industry might be adversely affected by sales of products made with the know-how. If these companies, he observed, had patent protection, they could enforce their patents. But, with no patent protection available, "technology owners in an industry who are not at the bargaining table in a negotiation with the Soviets" may have their technology invalidated without payment.

Consequently, Levine feels strongly that the U.S. Government should take the initiative in negotiations with the Soviets to protect American technology interests.

Levine concluded:

[Text] If the businesses of the United States engage in a series of one-shot technology know-how sales, our economy will very quickly have traded all it has to trade in the way of high technology. If this occurs, where will the benefit to our economy be? Its leadership will have disappeared and we will move closer toward fulfilling Lenin's forecasts for capitalism.

We will not be left with a good feeling toward East-West trade, or trade with developing nations, but instead the feeling of disappointment which comes from knowing you have made a bad bargain.

If, on the other hand, we have exchanged our technology for some form of market share, for some ongoing participation in the Soviet and Eastern European and developing country markets, we will have a continuing economic exchange which is beneficial for continued, long term trade and technology exchange.

The U.S. Government must play a leading role and can and must take action on this issue. The potential consequences are momentous for the future of high technology industry in the U.S. as well as for vigorous and successful international trade. [End Text]

Innovation

John A. Welsh, Director of the Caruth Institute of Owner-Manager Business of the School of Business Administration, Southern Methodist University, described "Conditions for the Successful Exploitation of a New Idea."

Patent lawyers, Welsh said, are in the unique position to meet with the people in our world who have new ideas of sufficient quality and novelty to be worth protecting. Attorneys may be better equipped to advise and counsel these inventors if they have a coherent picture of the complexity of exploiting a new concept.

There are three major components to the milieu of entrepreneurship, Welsh said. Principal among these is the individual, the entrepreneur, who makes it happen. The other components, he continued, are a viable business concept and capital. A viable business concept, he noted, is described in terms of the consumer's perceived values in the new concept or idea. There are many forms of capital, including sweat, credit, good wishes and favorable comments. Sooner or later, however, some class "A" capital is required, "the kind which we use to buy groceries."

Welsh thinks the successful entrepreneus is a particular kind of a person traveling along a time-line. There is a segment of this time-line which is conducive to entrepreneurial success. Only the right person at a particular segment along his career path (e.g., when confronted with a special job opportunity, or some major disappointment that motivates him to change his plans) is likely to create and sustain a new business enterprise.

While some inventors may deserve the label "entrepreneur," some clearly do not. Welsh suggests the profile of the successful entrepreneur looks like this:

1. GOOD PHYSICAL HEALTH

In a small business there is no depth of management. The leader must be there.

2. A BASIC NEED TO CONTROL AND DIRECT

Entrepreneurs typically are unable to deal with authority over them. They would rather direct their own structure poorly than be part of anyone else's structure. They are frequently unable to function in traditional situations and structures.

3. SUFFICIENT EMOTIONAL STABILITY

Successful entrepreneurs are able to handle their anxieties and bear up under the pressures of the business and their personal problems.

4. MODERATE INTERPERSONAL SKILLS

Entrepreneurs drive themselves and their organization, think clearly, are usually mentally ahead of their associates, are impatient, and aren't built to have the tolerance and the empathy necessary for team-building interpersonal behavior. They run their own show and delegate very few key decisions. They are more concerned about accomplishments than feelings.

5. SELF-CONFIDENCE

Entrepreneurs have bountiful self-confidence in what they believe to be possible when they are in a position to control and direct. Conversely, their self-confidence fades to uncertainty and insecurity when they are not in control.

6. STRONG DRIVE

Entrepreneurs seem to have a never-ending sense of urgency to get things done. Inactivity makes them impatient, tense and uneasy.

7. SUPERIOR CONCEPTUAL ABILITY

Entrepreneurs have the raw intellectual ability to identify relationships among functions and things in complex situations. They see clearly what has to be done more quickly than most of their associates.

8. BROAD THINKING OF A GENERALIST

Entrepreneurs are constantly aware of the general overview. This broad view and breadth of knowledge tends to enhance their superior conceptual ability.

9. VERY REALISTIC

Entrepreneurs accept things as they are and deal with them that way. They may or may not be idealistic, but, they are seldom unrealistic. They want to know the status of things at all times.

10. LOW NEED FOR STATUS

Entrepreneurs are concerned with the achievement of functions and things of a productive nature. They seem to have a high tolerance for confusion and chaos while striving toward achievement. The symbols of success are usually relegated to the lower end of their list of priorities while building their organization.

11. MODERATE RISKING

Entrepreneurs are often thought of in terms of the risk they assume. Like any prudent businessman, however, they know that high risking is gambling, not business. They are not gamblers.

Welsh believes that when the successful entrepreneur has been found to be weak in one or more of these characteristics, another individual can be identified who is strong in the entrepreneur's weak characteristics and who occupies a position of significant influence with the entrepreneur.

In summary, he noted, the composite profile of the successful entrepreneur and those who influence his or her behavior has a large measure of each of the characteristics listed here.

Counselors, consultants, and advisors should realize that the entrepreneurial client has difficulty adapting to structore or diverting any significant degree of control, said Welsh. While the entrepreneur respects experts for their achievements, their advice and lecturing may very likely be viewed as substantiated information. Counselors would be wise to couch their advice and guidance in forms which the entrepreneur perceives to be self-discovery. If counselors need to receive recognition or credit for their efforts, they may be happier dealing with non-entrepreneurial individuals.

Duty of Disclosure

John F. Lynch, of Houston, provided some perspective on "Living With the Duty of Disclosure."

Culpability for improper conduct in patent prosecution arose out of equitable principles, Lynch observed. Early cases did not attempt to define a standard of conduct, but treated allegations of impropriety in the context of "unclean hands." It was not until 1944, beginning with Hazel-Atlas Glass Co. v. Hartford Empire Co., 322 U.S. 238, 61 USPQ 241 (1944), that the courts expressed concern that patents be free from fraud and inequitable conduct and attempted to define a standard of conduct.

In 1945 Precision Instrument Mfg. Co. v. Automotive Maintenance and Machinery Co., 324 U.S. 806, 65 USPQ 133, expressed the "uncompromising duty" standard and in 1949 Kingsland v. Dorsey, 338 U.S. 318, 83 USPQ 330 imposed on attorneys a duty to act with the highest degree of candor and good faith.

For many years, he noted, while some cases surfaced, essentially the issue of inequitable conduct remained dormant. However, Walker Process heralded the "inequitable conduct explosion." That case (Walker Process Equipment, Inc. v. Food Machinery and Chemical Corp., 382 U.S. 172, 147 USPQ 404, 1965), he said, held that fraudulently obtained patents would form the basis of a Section 2 Sherman Act violation.

1876
1976

Biomedical sciences: the past 100 years

Alfred Burger, University of Virginia

It has been just over 100 years since the first instructional laboratory of physiological chemistry was established in the United States. Russell H. Chittenden, who had studied at the University of Heidelberg under Prof. Willy Kühne, took charge of the new laboratory, established at the Sheffield Scientific School at Yale University in 1874. "They were very modest quarters at first," Chittenden later wrote, "for the movement was an experiment and the authorities obviously felt it unwise to risk much in a venture that might prove unsuccessful."

Contrary to this early fear, physiological chemistry blossomed in the U.S. and throughout the world. With atomic, thermodynamic, and kinetic theories essentially in hand by the turn of the century, scientists could discard the nebulous, mystical descriptions of vitalism, and conceptualize the molecules of life in the same terms as inanimate matter. Out of physiological chemistry grew what we today call biochemistry—a dynamic discipline bent on explaining the nature and interactions of men, microbes, and plants. Contributing to the mushrooming nature of the science have been improving experimental techniques in analytical, physical, and organic chemistry which continue to provide the tools needed for probing biomolecules.

For example, the study of photosynthesis goes back at least as far as the 1770's when Joseph Priestley observed that green plants could improve the air spoiled by animals and flames. But an understanding of the complex biochemical pathways involved in photosynthesis did not come until the 1940's when the use of nuclear reactors made artificial radioisotopes available for tracer studies. The development of chromatographic techniques greatly facilitated following and isolating the tagged molecules participating in the photosynthetic process. Similarly, increasingly sophisticated spectroscopic techniques are helping to unravel the scheme by which light quanta are absorbed by chlorophyll and converted into potential chemical energy.

Following the fate of molecules participating in photosynthesis has been one of the exercises characteristic of biochemistry. Biochemists have not been satisfied with merely describing the chemical and physical properties of isolated molecules. Instead, the nature of their science has required that they constantly ask, "Where did the molecules originate? To what are they transformed?" And, "How and why are they transformed?"

In seeking answers to these questions over the past century, biochemists have come to understand many of the principles involved with energy transfer in the cell, the role of cellular structures such as membranes and ribosomes in cellular function, the importance of stereochemistry in life processes, and the basic mechanism by which hereditary information is coded. Greater insight has been gained into processes such as the Krebs cycle, glycolysis, electron transport and oxidative phosphorylation, biosynthesis, contraction and movement, and the maintenance of concentration gradients across membranes.

Central to the study of many of these processes, and to the general growth of biochemistry, has been the elucidation of protein chemistry. Early investigators probing the molecules of life were confronted with not only determining the units of protein structure, but understanding how these units were linked together, and then applying

Squibb chemist synthesizes a central nervous system agent for subsequent preclinical testing at the drug firm's animal research farm

this knowledge to explaining biological activity. Emil Fischer and Franz Hofmeister proposed as early as 1902 that proteins were polypeptides. However, it was not until the 1930's that incontrovertible evidence proved this belief to be true.

In 1938 Max Bergmann and Joseph Fruton showed that the enzyme pepsin could catalyze the hydrolysis of synthetic peptides, thus implicating the peptide bond in protein structure. And in 1953 Frederick Sanger announced the amino acid sequence of the protein hormone, insulin. Sanger's work offered definite proof of the peptide theory. Since this landmark effort, many amino acids have been sequenced. Moreover, x-ray data have offered insight into the three-dimensional structure of proteins. By 1958, John Kendrew was able to report the crystal structure of whale myoglobin, and in 1969 Dorothy Hodgkin and her colleagues solved the structure of insulin.

Much of the impetus for studying protein chemistry has arisen from the recognition of the importance of enzymes in life processes. John H. Northrup conclusively established the protein nature of enzymes in his work with pepsin and trypsin between 1930 and 1935. Yet, only a century ago the term "enzyme" did not exist. Willy Kühne coined the word in 1877 to distinguish soluble ferments from the microorganisms associated with fermentation.

Today scientists routinely try to explain the functions of enzymes in terms of molecular structure. The understanding of enzyme action and procedures for isolating and handling these proteins have developed to the point that enzymes are used regularly in food processing, medical applications, analytical instruments for testing substances such as glucose, and in preparing drugs, amino acids, sweeteners, and other materials. New techniques for stabilizing enzymes outside their cellular environment and allowing their re-use promise to open up even more practical applications for these biological catalysts.

Certainly, of the various areas upon which biochemistry impinges, some of the greatest advances have been made in the field of nutrition, particularly in vitamin studies. In 1926 the Polish biochemist Casimir Funk concluded that deficiencies of certain nonamino acid nitrogen compounds in yeast and rice polishings were responsible for beriberi. Funk took the Latin word for "life" and suggested that these chemicals be called "vitamines."

One by one, an impressive array of vitamins came to be recognized, including vitamins A, D, E, K, C, B_1, B_2, B_6, niacin, biotin, folic acid, and B_{12}. And in many cases, especially with the water-soluble B vitamins, an understanding of their chemical function also appeared. Even before its discovery as a vitamin in 1937, nicotinamide was recognized as being important in an enzymic conversion of glucose. By 1948, the participation of several other vitamins in enzymic reactions also was recognized.

Undoubtedly, much of the enthusiasm surrounding biochemical investigations has involved the possibility of applying research results to improving health. To a great extent, biochemistry had its origins in medical schools, and it is through the interplay of medicine and chemistry that a good deal of biochemical history can be traced.

Indeed, the past third of a century has witnessed a glistening parade of miracle drugs and an unparalleled revolution in the treatment of many major diseases. Some of these advances arose from the development of improved therapeutic methodology, diagnosis, and technique, but by far the greatest saving of life and renewal of healthy living has been achieved by the use of chemicals to prevent, treat, and cure diseases. Numerous contagious and infectious diseases and parasitic infestations have lost their historic hopelessness and epidemiological horror. Many functional disorders that could either not be cured at all or required surgical intervention now can be treated and often cured by medication. Surgery itself, a dirty art a hundred years ago, has become a reliable and aseptic science through the use of anesthesia and antibiotics. Hospitals for mental and behavioral diseases have become true treatment facilities after emerging only 25 years ago from a medieval state of restrictive centers. Many mental patients have been stabilized by drugs and returned to active life as productive members of society. Infant mortality has been reduced spectacularly all over the world; in fact, this reduction has become one of the principal factors in the increased average life span of mankind.

About 30 frequently encountered inherited errors of metabolism have been recognized as molecular diseases and several of them have become treatable by enriching or depleting the diet's chemical that is at fault. Beyond that, many functional diseases now are regarded as chemical aberrations due to decreases or sometimes rate increases of enzymically catalyzed bioreactions. If cofactors of the decisive enzymes are involved, manipulation of these conditions can heal the biochemical lesion. Missing enzymes cannot yet be replaced directly in disease and aging, but the restoration of their biosynthesis offers a possibility for future therapeutic repairs.

These triumphs constitute the most positive applied results of chemistry in our lives. Although many sciences have contributed to the discoveries made so far, the real miracles in the growth of medicine have occurred through medicinal chemistry, biochemistry, and pharmacology.

One glance at the mushrooming volumes of *Chemical Abstracts* devoted to biochemistry and the medicinal and genetic sciences offers convincing proof that the search for new roles of chemistry in medical theory and practice has not abated. Many old problems still go begging. The action of salicylate was discovered by Stricker and MacLagan in 1876, the year the American Chemical Society was founded. Together with the perennially favorite acetylsalicylic acid, sodium salicylate is still used to suppress the clinical signs and improve the histological picture of rheumatic fever, although the salicylates do not cure the disease and are beset with frequent side effects. The first plausible explanation of the biochemical mechanism of the anti-inflammatory action of salicylates had to wait until J. R. Vane, only five years ago, postulated that they inhibit the biosynthesis of the inflammatory prostaglandins PGE_2 and $PGE_{2\alpha}$ (*1*). This is only one of hundreds of examples of unsolved or poorly understood problems that haunt chemists and biologists and worry physicians who must make do with available drugs, although they are obviously far from the best.

From superstition to drug synthesis

Even today one can find primitive peoples in remote areas of Central and South America, in Mexico, parts of Siberia, and Haiti where the healing of the sick is still based on botanical brews. The recipes range from salads of sacred mushrooms to less savory stews of roots, leaves, barks, and fruits of diverse plants and trees that were venerated for their generation of vital forces. The same experimentation that liberated organic chemistry from the vital force concepts of previous centuries has shed light on the therapeutic folklore of primitive and medieval herbal legends (*2*).

Many ancient therapeutic plants were extracted in the laboratories of apothecaries, and pure active principles were greeted with the same enthusiasm that is still accorded pretty crystals at the end of a chemical operation. The pure drugs afforded pharmacologists their first opportunity to study homogeneous substances in biological test systems. Structure elucidation by piecing together bits of evidence from degradation studies took one or several lifetimes. Ultraviolet, infrared, and nuclear magnetic resonance spectroscopy were a century away. Mixtures were separated by countless manual fractionations; chromatography and mass spectrometry were daydreams. Melting and boiling points were ultimate criteria of purity. Yet these primitive and inexpensive methods led by tortuous paths, through decades of work, to some of the triumphs of determination of complicated structures. Today, one may mourn the expenditure of talent and time in these studies. With modern instrumentation, decades of effort could have been saved and accuracy improved by several magnitudes.

As synthetic organic compounds became more abundant, active drugs were discovered among all structural types, both of natural and synthetic origin. Hormones and vitamins joined botanical products among natural substances. The last lingering shreds of teleological philosophical views were torn when synthetic analogs of many natural products were found to be more active and often more specific than their natural prototypes. This discovery was extended even to several hormones that had been held sacrosanct as the most active materials one could encounter for a given physiological purpose. With the discovery that nature was not as perfect or purposeful as had been assumed, extensive series of molecular modifications of every interesting "lead" compound were undertaken. In complex structures with a given spectrum of biological activity, the barest structural segments that would still possess all or some of this activity were elaborated and modified further.

Edgar Fahs Smith Collection photo

Paul Ehrlich

Emergence of medicinal science

As tens of thousands of new compounds were tested and hundreds introduced into medicine, the quest arose for unified concepts to explain their mode of action and perhaps to take some of the empiricism out of drug design. A 50-kg woman or a 70-kg man can be affected profoundly by 5 to 7 mg of some drugs, that is by amounts of only 10^{-7} of their body weight. Such drugs must react with biochemicals of similar low concentrations—that is, with primary biocatalysts that act at these and greater dilutions. The most ubiquitous of these biocatalysts are the enzymes, and at an early date many drugs were recognized as enzyme inhibitors by in vitro confirmation. Since diseases may be caused by derangements of multiple complex enzyme systems, it is not always easy to invoke inhibition of one enzyme as the cause of a drug's action in vivo. Moreover, many drugs have been viewed as competitors of substrate molecules at the enzymes' catalytically active domains, but drug molecules do not often resemble known substrates. In such cases, allosteric modification of the enzyme, with the drug molecule bonding to a region not concerned with the substrate, has been hypothesized. Such attachments unrelated to the active site are supposed to deform the substrate-specific site and make it unavailable for reaction with the substrate. Similar views have been suggested for drug receptors, some of which are believed to be enzymelike proteins, perhaps integral components of definite cellular locations (*3*).

Nucleic acids also have been identified as targets of primary drug bonding, the drug molecule intercalating with their helical portions or affecting nonhelical segments in such a way that transcription to protein and enzyme assembly is impeded.

Great ideas arise almost always in the mind of one gifted individual who can synthesize basic concepts from the interpretation of facts in converging doctrines. That is what Paul Ehrlich (1854–1915) did for medicinal science. Starting as a practicing immunologist, he translated the ideas of his field into the language of chemistry and microbiology. He erected the biochemical, metabolic, and toxicological explanations of the mechanism of action of drugs in such a measure that they needed only to be modernized and expanded to incorporate current knowledge. In a structurally relatively limited series of aromatic arsenicals and dyes, and with a sometimes naive picture language, Ehrlich and his associate, Alfred Bertheim, developed the principles of biomedicinal chemistry, briefly expressed in today's terminology as follows (*4*).

A chemical must reach its target (the receptor) and must not be absorbed prematurely on serum proteins or at tissue membranes (sites of loss). It must not be metabolized and excreted prematurely, but should disappear from the body after its mission has been fulfilled. At the receptor, a drug molecule should fit snugly enough sterically to withstand competitive and metabolic removal until its inhibitory task has been accomplished. If a chemical administered for therapeutic purposes is not in the right molecular or ionic state for such action, it must be changed to the active state by enzymic alteration or by ionization before reaching its target. A drug must have a large therapeutic ratio—that is, its maximum tolerated or minimum toxic dose must be an acceptably large multiple of its minimum effective dose; in other words, it must be relatively safe.

However, Ehrlich recognized that absolute safety was unattainable, although he expressed the hope that some day a drug like a "magic bullet" without systemic toxicity would be found. But as soon as magic is invoked, one calls on unreasonable dreams, and it is not surprising that no 100% safe drug ever has been encountered. Ehrlich also found that one cannot rely on beginner's luck and that the first prototype compound for a given biological activity rarely is the optimal drug in a series of structural congeners. Of the 1000 to 1100 compounds synthesized and tested in his research, only about six reached clinical utility. In more recent times, only one out of 5000 to 20,000 has become a clinically use-

ful agent, and the rate of attrition of drugs is faster than it used to be. Few major drugs retain their full use for more than 15 to 20 years.

During the first decade of this century, several other significant medicinal experiments took place that also were to become prototypes for most drug discoveries to this day. They were the degradative examination of the structure of cocaine which resulted in the aminoalkyl ester-type local anesthetics such as procaine (*5*), and the determination of the essential structural features of the adrenal medullary hormone, epinephrine (Adrenalin, *6*). The elaboration of the ester-type local anesthetics opened the way for the contemporary amide-type drugs for the same purpose, and for the similar derivation of synthetic anticholinergics (antispasmodics, antiulcer drugs, mydriatics) from the solanaceous plant alkaloid, atropine. The epinephrine studies heralded the introduction of adrenergic (sympathomimetic) drugs such as ephedrine (*7*), amphetamine (*8*), and isoproterenol (*9*), to name just a few. With the identification of acetylcholine (*10*) as the neurohormone of parasympathetic (cholinergic) nervous transmission, it became possible to synthesize both cholinergic drugs and inhibitors of acetylcholine-sterase, the enzyme that destroys excess acetylcholine by hydrolysis. Some of these inhibitors have become valuable insecticides, and others are used in the maintenance therapy of neuromuscular disorders, especially myasthenia gravis.

Screening for "lead" compounds

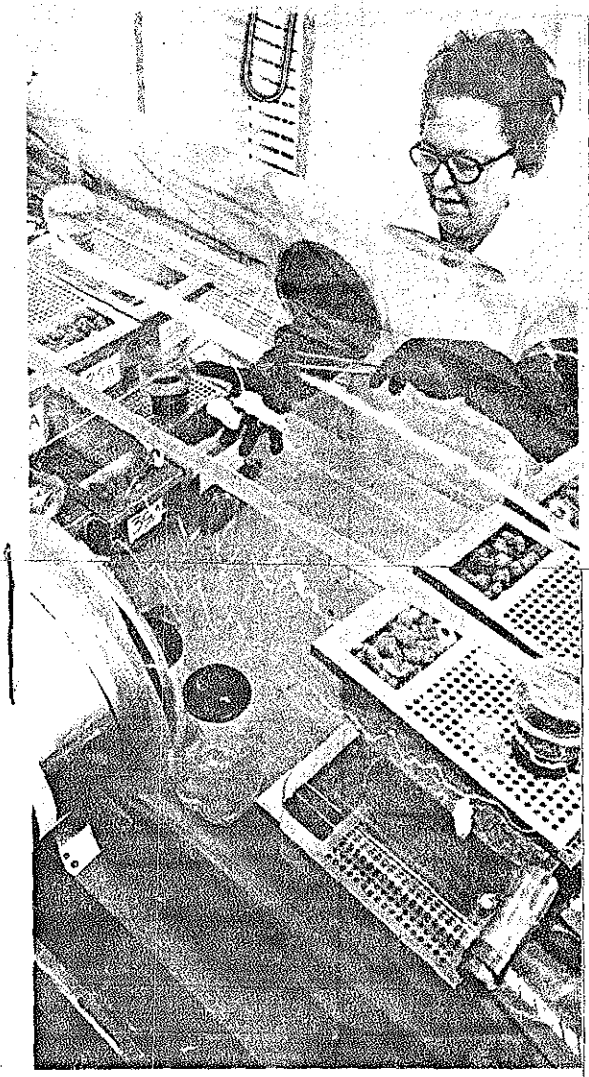
The success of biologically screening potential drugs depends not only on simple, rapidly reproducible methods, but on the significance of the method for estimating the value of the test substance in a therapeutic situation. That means the test method must be sophisticated enough to represent the clinical conditions as much as possible. In retrospect, many screening programs should not have been undertaken because the test methods did not fulfill the conditions just mentioned. Unfortunately, the current state of biological science fails to provide background and practice for such methods; yet, medical urgency spurs crash programs not having an adequate experimental foundation.

The chemical contribution to screening projects used to be uninspiring. If an ethyl ester of an acid was found to have a desirable biological activity, the methyl, propyl, isopropyl, butyl, *sec*-butyl, amyl, etc. esters were prepared and tested duly and dully. The venturesome would try a thioester or -ether, or exchange one azaheterocycle for another, provided synthetic expediency permitted such a luxury. A group leader in the pharmaceutical industry used to supervise rows of technicians as they performed condensations of amines with every accessible acyl chloride to form amides for biological screening. When young organic chemists decided to join medicinal-chemical laboratories, their theoretically oriented professors asked them whether they would not prefer to dig ditches. Nevertheless, screening has uncovered so many unexpected and often unexplainable "leads" that one would be loath to abandon the process, despite its wastefulness and the inherent lack of reason behind it.

Serendipitous drug discoveries have been diethylcarbamazine and isoniazid. The piperazine derivative, diethylcarbamazine, was designed purposefully as an analog of the analgetic meperidine by chemists at the Lederle Laboratories of American Cyanamid. Because a relatively large research sample of the compound had been prepared, the drug was screened in other tests which interested Lederle biologists at that time. Anthelmintic activity especially was examined since piperazine is active against worm infestations. Diethylcarbamazine turned out to be an active filaricide, killing filarial worms at drug concentrations well tolerated by the infested human host (*11*).

The second example, isoniazid, was studied by chemists and biologists at Hoffmann-La Roche, E. R. Squibb, and in Germany around 1950. Isoniazid has been credited with emptying tuberculosis sanitaria and putting an end to tuberculosis as a classical epidemic disease ("consumption"). Isoniazid had not been intended as a drug but was only an intermediate in the synthesis of 4-pyridinealdehyde thiosemicarbazone, which had exhibited a measure of antituberculous activity in experimental infections. When the delivery of this compound was delayed, synthetic intermediates containing 4-pyridinecarbonyl groups were tested and isoniazid was found to possess superior activity (*12*).

A much more effective plan for screening is based on keen biological observation. Sometimes a compound tested for a given activity elicits side effects unrelated to the test at hand. For example, an antiinfectious drug might lower the blood pressure or blood sugar of test animals. By suitable molecular manipulation, one may be able to develop drugs for lowering blood pressure, or that are active in diabetes, without any of the original antiinfectious activity. This amounts to the discovery of a "lead" in such unexpected conditions.



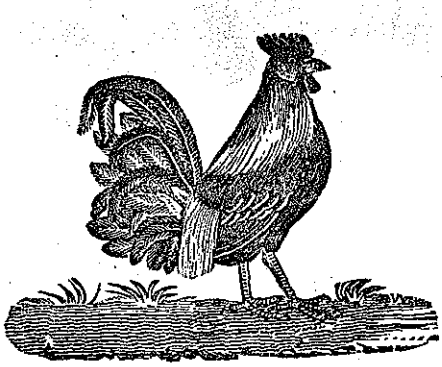
Eli Lilly worker uses white mice to screen activity of new compounds

Drug design by molecular modification

From 1920 to 1930, perhaps 6000 compounds were examined as potential antimalarials in an experimental avian plasmodial infection. This effort yielded quinacrine (Atebrin), a clinically effective and useful agent. Quinacrine was derived vaguely from quinine, the oldest antimalarial agent known. A few years later, 10,000 commercial and experimental dyes from collections of the fiber and chemical industry were screened as antibacterial chemotherapeutics. It was reasoned that

Agricultural research a boon to all Americans, not just farmers

Few individuals, even the farmer himself, realize the many contributions that agricultural research, mostly carried out at agricultural research stations, has made to the daily activities of all Americans. Although the farmer has benefited tremendously from this agricultural research work, its impact has been much broader than just the farm. Today's chicken, for example, is a far cry from its counterpart a hundred years ago. Just in the past 30 years, agricultural research has shown how to produce a pound of chicken with half the necessary feed required earlier and to grow the chicken to maturity in only



about half the time. And a vaccine developed in the Virginia Agricultural Experiment Station to protect poultry against Newcastle disease is estimated to have a worldwide value of about $1 billion.

Agricultural experiment station scientists discovered the role of minor elements, such as zinc, copper, cobalt, and molybdenum, in plant and animal nutrition. They discovered Dicumarol (bishydroxycoumarin) to control blood clotting in humans and streptomycin to treat tuberculosis and other diseases. They defined the significance of amino acids in our diets—they discovered vitamins.

In two agricultural experiment stations—the first one in the U.S. in Connecticut and in the Wisconsin Experiment Station—scientists and chemists were studying animal feeds. These studies, first carried out on cows and hogs, had moved to rats, which were traditionally the farmer's worst enemy. In fact, at the Wisconsin Experiment Station, researcher Elmer V. McCollum had to battle the station's administration before he could continue his studies. Just two years after McCollum started his work in 1907, the Connecticut Agricultural Experiment Station independently started its own studies. Chemist and station director Thomas B. Osborne, son-in-law of Samuel Johnson (see page 159), carried out his research with Lafayette B. Mendel of Yale, whom he had invited to join him.

Osborne and Mendel started out with a pure protein, starch, lard, and salt mixture, but were unsuccessful until they included whole milk powder and finally just the milk's sugar lactose and minerals. Further experiments pinned down the essential role in growth played by the amino acid lysine. Continuing experiments showed that "a substance [in butter] exerted a marked influence on growth." These words reported the discovery of what would later be called vitamin A. Independently, McCollum and his associate, Marguerite Davis, at Wisconsin were making the same discovery.

Further investigations by Osborne and Mendel showed that their "substance" was also present in cod liver oil, which found wide use in Europe after World War I to save the eyesight of thousands of children. In Wisconsin, meanwhile, Davis and McCollum were determining a second type of essential nutritive factor, which turned out to be vitamin B. It was this factor, present as a contaminant in Osborne and Mendel's earlier protein-free milk diet, that was responsible for the success of that diet in their earlier feeding tests. This work of Osborne, Mendel, Davis, and McCollum would develop in just a few years into the vitamin theory of nutrition.

dyes with high affinity for fibers might stain and thereby affect bacterial cells, hopefully without acting on the cells of the host. Azo dyes containing a sulfamyl group para to the azo linkage appeared to fulfill this requirement (*14*). Actually, the host organism reductively cleaves the azo group to sulfanilamide, which in turn became the "lead" compound for thousands of experimental and the few clinically useful systemic antibacterial sulfa drugs.

In 1932 Hans Erlenmeyer of the University of Basel began his classical studies to put molecular modification on a scientific basis (*15*). Realizing that chemical, physical, and biological manifestations of a compound are different expressions of the inherent molecular properties of the material, he introduced Irving Langmuir's (1919) concept of isosterism into medicinal thinking. This idea referred to the outer shell electrons of a compound, and for organic molecules took on an overtone of steric shape. Two compounds that had virtually identical physical properties such as melting and boiling points when mixed with each other were termed isosteric. Such compounds often exhibit a similar biological behavior.

Here, then, was a way of predicting the likelihood of biological analogy on the basis of physical properties. Soon the boundaries for drug design imposed by similarities of outer shell electrons became too narrow if one wanted to branch out beyond these classical confines. Therefore the "same type of biological activity" was incorporated into the definition of isosterism, but this introduced many biological variables as soon as compounds were compared by gross pharmacological observations.

The concept of nonclassical bioisosteres (*15*) tried to adapt predictability of biological response based on chemical structure with varying success. The nonclassical bioisosteres did take account of analogous molecular orbitals and analogous biochemical responses in definable reactions, preferably in vitro. The latest definition by Corwin Hansch of Pomona College (*16*) regards bioisosteres "as compounds causing identical biochemical or pharmacological responses in a standard test system. The system might be an enzyme, membrane, mouse, or man." This definition disregards chemical structure altogether, and even if compounds act alike in "mouse or man," totally different biological responses might be involved with a similar overall symptomatology. In vitro or in simple isolated cell and organ preparations, compounds with quite simple structures indeed become comparable. In a few cases, compounds with irreconcilable differences in outer electron shells act alike in a biological test and here their biological similarity has been based on isolipophilicity.

As Hansch points out, "We must break away from heavy reliance on the traditional symbols of organic chemistry. These have served the synthetic chemist well, but they are a terrible hindrance to progress in relating structure to activity. They convey a static message with meaning for architects; there is no dynamic message for those who are interested in rate processes." This is not quite true because a structural formula tells an experienced chemist a good deal about reactivity, even near-quantitatively, although not quantitatively enough for a kineticist.

If we measure biological activity first, and then ask what makes different compounds act alike in a definable biochemical or at best very simple biological test, we find lipophilicity a major factor. But except to prove a scientific point, who wants to prepare a drug with exactly the same activity as the one in hand? The whole purpose of molecular modification is to produce more potent, more selective, and less toxic compounds, or drugs with a wider spectrum of useful activity. Hansch focused attention on partition coefficients of a compound between 1-octanol and water as a model for distribution between lipids and blood serum.

A much earlier model for the same property had been the distribution between oil and water, studied by E. Overton and by K. H. Meyer before 1900 during attempts to explain anesthetic potency on the basis of proper transport of a drug into the nervous system, where anesthetic action takes place. By inserting Hammet substituent constants into equations in regression analysis, Hansch could use a dozen or so existing compounds in a given related structural series to predict active analogs that had not yet been prepared or tested.

Spencer M. Free and James W. Wilson of SmithKline Corp. (*17*) derived de novo substituent constants not from tables in textbooks on physical-organic chemistry, but directly from the biological activities of a set of congeners. Combinations of the two methods also have been considered (*18*), but in polyfunctional compounds which can combine with a biomacromolecule in many different ways; mathematical prediction of the optimal congeners to be tested may only furnish a nonpreferential selection of too large a number of possible candidate compounds. In such cases, experience and judgment still must supplement forecasts made by computerized regression analysis, but at least some semblance of predictable constraint on unlimited numbers of potentially active congeners can be attained.

Some prototype compounds are chosen from among biosynthetic intermediates of proteins, nucleotides, and cofactors. Gradual alteration of their structure yields analogs that may still have a biochemical activity similar to that of the prototype, but more often they inhibit enzymic reactions and compete with the natural substrate for an active site of the enzyme (*19*).

Another approach is to examine compounds for their behavior toward biochemically essential metal ions. Recently, metal inclusion complexes have become known, the best studied being the potassium derivatives of the antibiotics gramicidin-A, enniatin-B, and others. The antibiotic activity of valinomycin appears to depend on this ability to enclose and extract specific metal atoms. Many other examples have been suggested, the most interesting being compounds that help in transporting sodium, potassium, calcium, and other ions across neuronal membranes during the transmission of nervous impulses. In other types of chemistry, the "crown" ethers also can have such ion enclosures, and therefore have been contemplated as candidates for a variety of biological tests based on this common denominator.

Drug metabolism

Chemicals may pass through the body unchanged but more often are metabolized. Many kinds of reactions have been observed during drug metabolism, the most frequent ones being oxidations (including hydroxylations), reductions, O-, N-, and S-alkylations, and dehydrogenations (*20*). Most metabolic reactions change a drug to less toxic and more diffusible, soluble, ionizable derivatives or conjugates that may be excreted more easily, and thereby rid the body of the toxic foreign agent. In a few instances, the drug's metabolites are more active or more toxic than the administered substance; that is, the original compound has been activated. Such activations reveal new insights into novel prototype compounds. For example, the early bacteriostatic azo dyes of the Prontosil type are cleaved reductively to sulfanilamide, the active component of the dye molecule. The local anesthetic lidocaine and the antidepressant imipramine, which are traditional tertiary amines, are N-dealkylated to secondary amines of greater activity. The phenylbiguanide antimalarial chlorguanide owes its activity to a metabolite with a cyclized triazine structure. Molecular modification of such activated metabolites with unexpected structures has been a fruitful activity in developing series of potent and selective analogs.

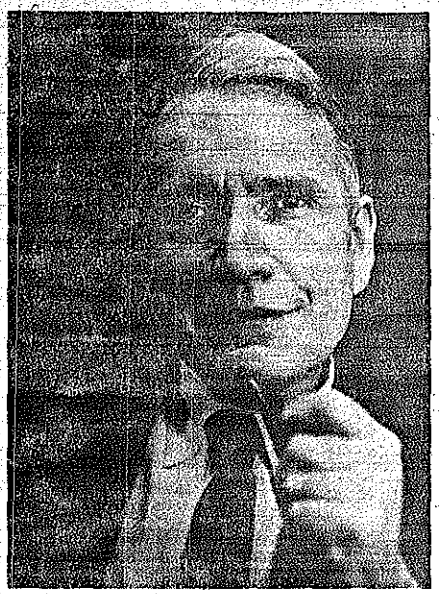
Age of medicinal biochemistry

The task of biochemistry is to describe, study, and explain the chemical syntheses and reactions in living cells or those of chemicals isolated from animate tissues. The baseline of such studies is normal cellular metabolism and emphasis has been placed on this all-important phase.

The animal body is a conglomerate of thousands of inorganic and organic chemical reactions many of which proceed simultaneously in a highly organized and compartmentalized manner. Some of these reactions occur freely in circulating body liquids and therefore affect each others' rates, course, and choice of substrates. Other biochemical reactions take place within cells or subcellular particles, occasionally across polymeric macromolecular membranes of such units or their higher aggregates, the tissues. Some of the reagents reach their transition states, and do complex and proceed to end products without special help. Others need considerable activation, and this is provided by a variety of biochemicals of which the high-energy phosphates are the best known. In turn, the high-energy phosphates are resynthesized, the bioenergy input for these syntheses being provided by the oxidative metabolism of dietary nutrients. The monomeric constituents of such nutrients (monosaccharides, amino acids, fatty acids, nucleosides, etc.) are oxidized in many coupled and sequential stages which are mediated by coenzymes and other electron acceptors, and under conditions that permit gradual dissipation of the energy created. These hundreds of steps comprise intermediary metabolism, the core of biochemistry.

The coenzymes, in many cases, are degradable to smaller units including numerous vitamin molecules from which the normal organism can reconstitute the essential biocatalysts. Some animal species can biosynthesize certain vitamins which thereby take on the role of hormones in these species.

The bewildering variety of ac-



Erwin Chargaff

tions of vitamins, hormones, coenzymes, and their synthetic congeners, as well as the frequent overlapping of their activities, has found a suggestion of a common denominator through the discovery of secondary hormones of the cyclic nucleotide type. These compounds, and enzymic reactions needed for their formation, were described by Earl W. Sutherland and his associates (*21*) and have given us an indication that the incredible diversity of biological phenomena might be reduced some day to a few fundamental concepts through chemistry. Analytical, organic, and biological chemistry has come close to this goal in genetics where the genes could be equated with deoxyribonucleic acids. Now that levels of thought, emotion, behavior, and mood are on the verge of being based on concentrations of biogenic amines in the brain, the most mysterious characteristics of human life and striving may also yield to biochemical methods and explanations.

Diseases result from the breakdown of normal biochemical pathways; such deviations are investigated best in their extreme pathological manifestations, where overlapping with pre-existing normal reactions and reagents is minimized. Medicinal chemists who must understand the causes of pathological changes have taken up at least in vitro examinations of such pathways. By the same token, pharmacologists had to branch out into biochemistry in an effort to refine gross observations of tissue pathologies. The mixture of these converging efforts has been labeled molecular biology, molecular pharmacology, and medicinal biochemistry, depending on slight differences of emphasis and the earlier training of the investigators.

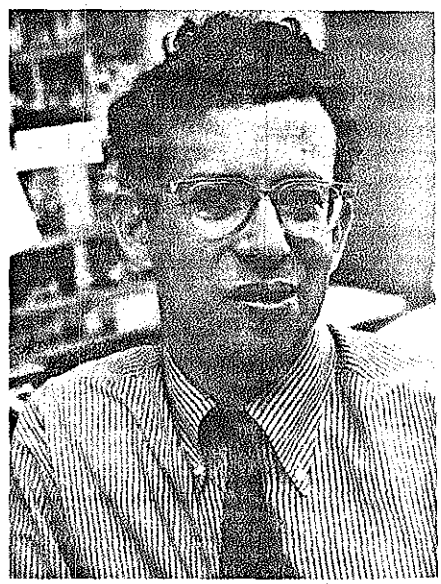
Cancer and viruses

Molecular biology took a turn toward organic chemistry when the structure and at least part of the conformation of nucleic acids (DNA and RNA) were elucidated by Erwin Chargaff, Linus Pauling, James Watson, Francis Crick, and Maurice Wilkins in the 1950's (*22*). These discoveries were followed by the recognition of the chemical details of the genetic code (H. G. Khorana) by which nucleic acids transcribe genetic information for the alignment of amino acids activated by phosphorylation in the biosynthesis of proteins, enzymes, and other polypeptides. The individual stages of the coded transmission from DNA via RNA's of various lengths (messenger RNA, short RNA, transfer RNA, etc.) and the essential features of various aggregates such as ribosomes and polysomes also are understood, although many details still need to be filled in. These findings converted genetics, previously a descriptive biological doctrine, into a science based on accurate chemical data.

This work led to much unexpected fallout of value to medicine. For example, both the nucleic acid core and the protein capsid (coat) of small viruses became amenable to detailed study, and the process of viral reproduction at the expense of normal host cells could be pictured.

James Watson

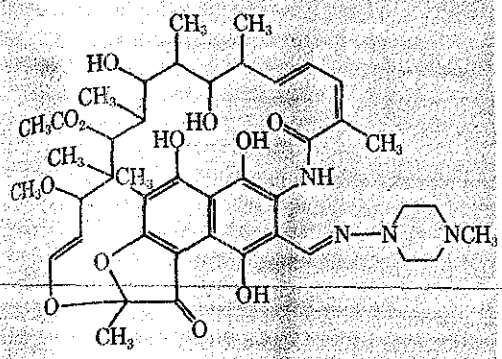
Moreover, a theoretical basis was provided for the old speculations that some malignancies of vertebrates are associated with RNA viruses—that is, viruses whose whole or predominant nucleic acid core is RNA. In all oncogenic (cancer-forming) RNA tumor viruses, the customary flow of information from DNA to RNA is reversed by the enzyme RNA-dependent DNA polymerase (reverse transcriptase), which catalyzes the synthesis of DNA from RNA by a pathway first proposed by Howard M. Temin (*23*). A similar enzyme has been extracted from white blood cells (leukocytes) of some patients with acute leukemia, and particles containing a reverse transcriptase have been found in human milk, particularly from patients with breast cancer and from inbred populations with a high incidence of this disease.



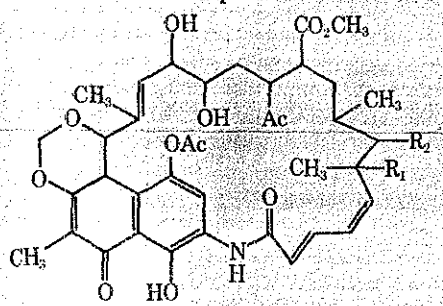
Howard M. Temin

The role of reverse transcriptase in the transformation of normal cells into malignant tumor cells is by no means clear. However, some derivatives of the antibiotics rifampicin and streptovaricin inhibit both the viral and the leukemic cell enzyme and kill leukemic cells at pharmacologically acceptable concentrations (Figure 1). Other inhibitors of the enzyme potentially useful in cancer chemotherapy also have been observed (*24*).

Cancer chemotherapy is one of the best examples of the impact of biochemical thinking on drug design, medical treatment, and cures. Its intertwining with virology, genetics, and immunology, and with the yet unsolved riddle of carcino-

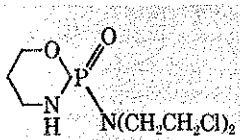


Rifampicin

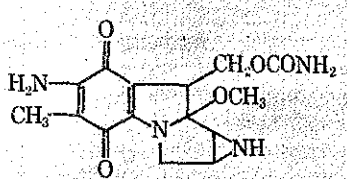


Streptovaricins
A: $R_1 = R_2 = OH$
B: $R_1 = H, R_2 = OH$

Figure 1



Cyclophosphamide



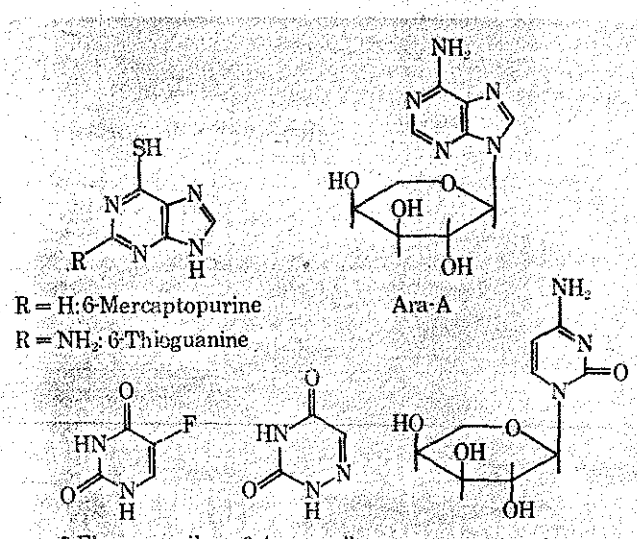
Mitamycin C

Figure 2

genesis, has made cancer chemotherapy one of the most active—and recently best funded—fields of biomedical research.

The nitrogen mustards, among them cyclophosphamide, and other alkylating agents, including the *Streptomyces caespitosus* antibiotic mitamycin C with its ethylenimine group, act primarily by way of nucleophilic reactions (Figure 2). They alkylate DNA at the 7-position of the purine base, guanine, cross-linking opposed guanine molecules on the two strands of DNA where a twist in the helix puts them in the best steric apposition for this reaction.

Other biochemically based anticancer drugs such as methotrexate are structural analogs (antagonists) of tetrahydrofolic acid. *N*-Formyltetrahydrofolic acid furnishes a one-carbon segment for the ring closure of a purine nucleotide; methotrexate inhibits this enzymic cyclization, and thereby DNA biosynthesis. Hundreds of analogs of purine and pyrimidine bases have been tested as antagonists of purine and pyrimidine biosynthesis. Only a few have a reasonable chemotherapeutic index and therefore are acceptable for cancer chemotherapy. Among these are 6-mercaptopurine and its 2-amino derivative (6-thioguanine), 5-fluorouracil, 6-azauracil, and the arabinosides of adenine and cytosine—Ara-A and Ara-C (Figure 3) (*25*). Some of these drugs also decrease the immune response and thereby are of value—albeit temporary—in suppressing rejection of organ transplants. Some others are active against herpes viruses—for example, 5-iodouridine in eye infections and Ara-A in infections of the nervous system by the virus.

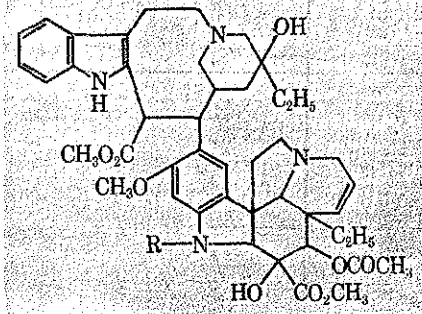


R = H: 6-Mercaptopurine
R = NH_2: 6-Thioguanine

Ara-A

5-Fluorouracil 6-Azauracil Ara-C

Figure 3

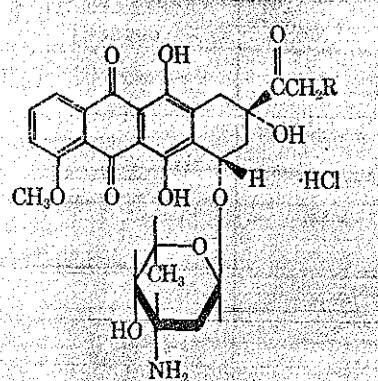


R = CH_3: Vinblastine
R = CHO: Vincristine

Figure 4

These "faulty metabolites" compete with natural substrates for active sites of enzymes that control the biosynthesis of purine and pyrimidine nucleotides. However, compounds whose action is anticipated less easily sometimes do as well as medicinal agents. For example, two periwinkle alkaloids with a long medical folklore to recommend the plant *Vinca rosea* Linn. as a drug for diabetes are used widely in the treatment of acute childhood leukemia and other neoplasms (Figure 4). These alkaloids, vinblastine and vincristine, interfere with the synthesis of soluble or transfer RNA and also may act as acylating agents in vivo (*26*).

Only an arbitrary semantic distinction separates a chemotherapeutically active alkaloid from an antibiotic. A number of Streptomyces antibiotics are useful in cancer chemotherapy, notably daunomycin (*27*) and adriamycin (*28*) (Figure 5). These compounds apparently act through intercalation with DNA (*29*).



R = H: Daunomycin
R = OH: Adriamycin

Figure 5

One of the many probable causes of hypertension is the accumulation of excessive amounts of biogenic amines (phenethylamine, tyramine, dopamine, norepinephrine, serotonin) in the central nervous system, sometimes combined with peripheral vasoconstriction by epinephrine and perhaps by other biogenic amines. Of these, dopamine, norepinephrine, and epinephrine appear as the principal culprits—at least they have been most thoroughly investigated, together with serotonin (5-hydroxytryptamine, 5-HT), which also may be involved. If the action of a biochemical is to be prevented, two routes are open to the medicinal chemist: Block its action at its receptor site, or cut down its biosynthetic supply. For the latter route, deactivation of a critical enzyme in the biosynthesis could be envisaged. One of these steps is the decarboxylation of dopa (3,4-dihydroxyphenylalanine) to dopamine under the influence of a rather unspecific enzyme, aromatic amino acid decarboxylase (dopa decarboxylase).

It appeared possible that replacement of the group, $-CH_2-CH(NH_2)CO_2H$, in the substrates by a sterically hindered group, $-CH_2C(CH_3)(NH_2)CO_2H$, would produce compounds that would inhibit the decarboxylase. This turned out to be the case; the α-methyl homolog of dopa, called methyldopa, indeed inhibits dopa decarboxylase activity. That means less dopamine is produced, and since dopamine is the biosynthetic precursor of norepinephrine and epinephrine, less of these two catecholamines also is formed (Figure 6). Methyldopa, after due testing, was introduced as an effective antihypertensive agent (*30*). Later an additional mode of action emerged from further studies. Methyldopa is not only a decarboxylase inhibitor, but also a (rather poor) substrate of this enzyme. That means some methyldopa is decarboxylated to α-methyldopamine, which, in turn, is bioconverted further to α-methylnorepinephrine. This compound antagonizes the action of norepinephrine at its receptor; this antagonism may be one of the reasons why the body's blood pressure is lowered.

Dopa for Parkinsonism

Dopamine has been identified as an important neurotransmitter. It is found in relatively high concentrations in the substantia nigra and the corpus striatum in the brain. When its concentration falls below a critical threshold, extrapyramidal motor system deficiency symptoms are observed in mammals, corresponding to the syndrome of Parkinsonism in man. Dopamine administered to such patients cannot cross the blood-brain barrier because it is too polar. Its biosynthetic precursor amino acid, L-dopa, is less polar, enough is taken up and concentrated in the corpus striatum to be decarboxylated there to dopamine. Thus dopamine concentrations are brought up to par and dramatic alleviation of the symptoms of Parkinsonism follows (*31*).

Throughout every phase of DNA synthesis in the life of each organism, and in the course of inheritance from one generation to another, there are many chances of isolated errors in assembling the nucleotide bases and probably other structural units of the DNA molecules. Some of these errors in molecular structure can be corrected, but others cannot and lead to mutations. Each faulty sequence of the nucleotides of DNA alters the genetic information, and therefore the type of proteins and enzymes biosynthesized by the organism. Every cell is programed by a copy of the individual's DNA, and every cell can mutate. Only germ cells that produce ovum and sperm can transmit a mutation to the offspring without having an effect on the individual.

The biosynthesis of catecholamines and a pathway for its inhibition

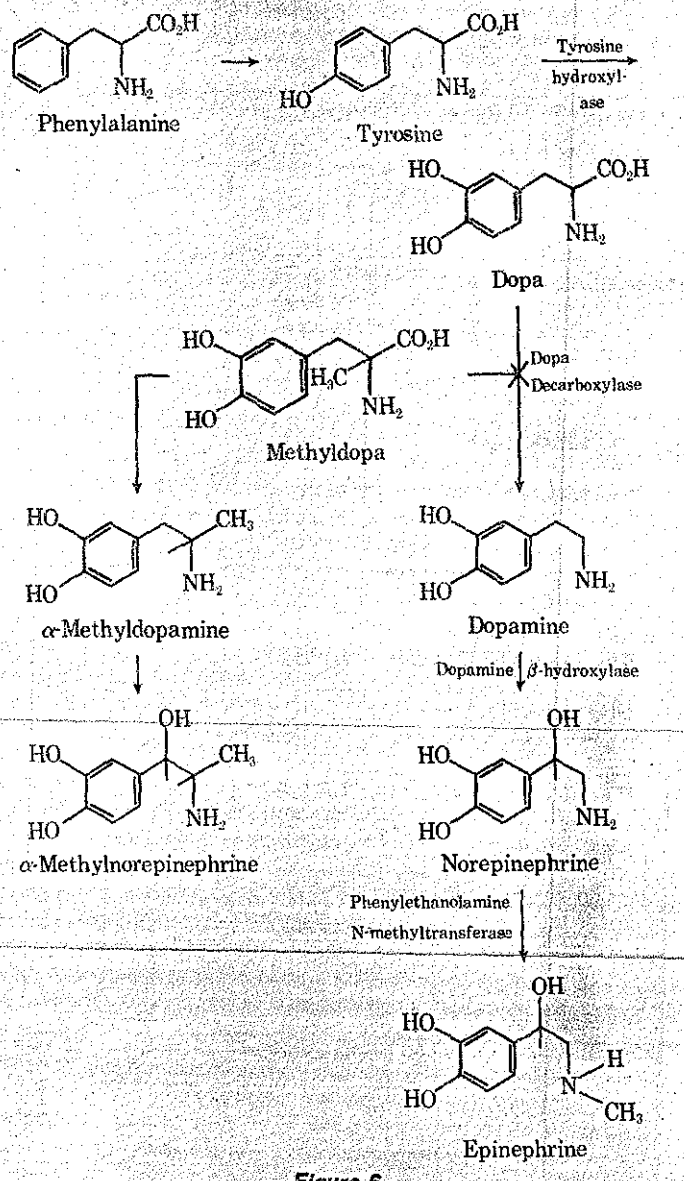


Figure 6

Agricultural research station patterned after German concept

Samuel Johnson in 1901

The first agricultural research station actually predates the founding of the American Chemical Society by something less than a year—it started its work on Oct. 1, 1875. The driving force behind its inception was an agricultural chemist named Samuel W. Johnson. He was one of a small group of farsighted individuals who felt that science and chemistry could play a valuable role in agriculture, and he felt this could best be done through agricultural research stations modeled after those already in existence in Germany.

Samuel Johnson was the son of a New York farmer and, after graduation from Lowville Academy, had later entered Yale Scientific School to study agricultural chemistry. Like many other scientists and chemists in those days, he studied for a couple of years in Germany, and it was while there that he got a first-hand look at the operations of the German station at Moeckern, which itself was the first of its kind. Literally translated, the German name for this institute was "Agricultural Experiment Station."

From Germany, Johnson returned to New Haven, Conn., and the position of chief assistant in the Yale Scientific School chemistry laboratory. A year later, in 1856, he was appointed to the chair in agricultural chemistry. It was during these days that Johnson started his campaign that would later culminate in the first agricultural station in the U.S. It was in an address, in fact, in 1856 before the New York Agricultural Society that Johnson defined what the American counterpart to the German experiment station should be and the role it could play in translating science into the field of agriculture—just one minor part of which could be the evaluation of fertilizers purchased and used by farmers.

Shortly after this, Johnson resumed his practice of analyzing and evaluating fertilizers, and this led to his being hired by the Connecticut Agricultural Society to perform the same function for them and to issue reports on his findings for the use of farmers in Connecticut. The start of the Civil War brought an end to the Agricultural Society, but the end of that conflict found the start of a State Board of Agriculture in Connecticut and Samuel Johnson back in the thick of things as its first chemist. He was to hold that position until 1898.

Johnson, of course, was still campaigning for a research station and wound up at one point as the Board of Agriculture committee chairman for the group which was evaluating just such a station. Needless to say, the unanimous decision of the committee was wholeheartedly in favor of such an installation. After meeting all over the state pushing the idea, a bill proposing it was entered into the state legislature in 1874, but it was tabled without action. With greater backing it was taken up again in 1875 and, with the help of the offer of a laboratory at Wesleyan University and a $1000 starting grant, the Connecticut legislature approved the formation of an Agricultural Experiment Station July 20, 1875, and appropriated $2800 for its first two years of operation. Shortly thereafter, a new bill moved the station to New Haven and made it a permanent part of the Connecticut agricultural scene. Not unexpectedly, Samuel W. Johnson was appointed to the position of station director.

Mutations occurring in body cells have no effect on later generations but are suspected of causing cancer-like diseases and possibly playing a role in the aging of the organism. Inheritable (germ cell) mutations may affect physical or emotional characteristics, appearance, or intellectual capacity, and cause deformities or handicaps. The mutation may be dominant (immediately expressed in the next generation) or recessive, that is, it may appear in posterity when an egg and sperm carrying the same defect are united.

Factors that cause increased mutations are radiation and carcinogenic and mutagenic chemicals. Among such chemicals are some compounds in our environment, and certain food additives and drugs. Some of them may induce inheritable mutations, whereas others (teratogens like thalidomide) may cause direct bodily deformations of a growing fetus, but are not transmitted to further generations. For drugs and food additives, tests in animal model systems for carcinogenicity and teratogenicity are mandatory before approval by the Food & Drug Administration for their use in foods and in medicine.

The medical significance of germ cell mutations is the surfacing of hereditary diseases caused by deficiencies of pivotal enzymes. Many of the known inherited diseases involve the absence of a crucial enzyme. Genetic enzyme deficiencies are transmitted from parents to children, usually as autosomal recessive traits, both parents being carriers of the gene for the disease. The carriers themselves are not affected by the deficiency since they have about one half of the normal concentration of the enzyme—enough to keep them well and unaware of their condition. The affected child, however, usually has so little of the enzyme that he or she succumbs to the disease.

In some cases, dietary nutrients and foods that contain substrates requiring the missing enzyme for chemical transformation can be avoided by the patient. For example, infants suffering from phenylketonuria (PKU), an inability to oxidize the aromatic ring of the essential amino acid phenylalanine, can be placed on a diet low in phenylalanine and thus develop normally. Milk with its content of milk sugar (lactose) can be eliminated from the diet of children suffering from a deficiency of galactosidase as in galactosemia. Such deficiencies can be diagnosed by chemical tests of the newborn, but in most genetic chromosomal aberrations the physician

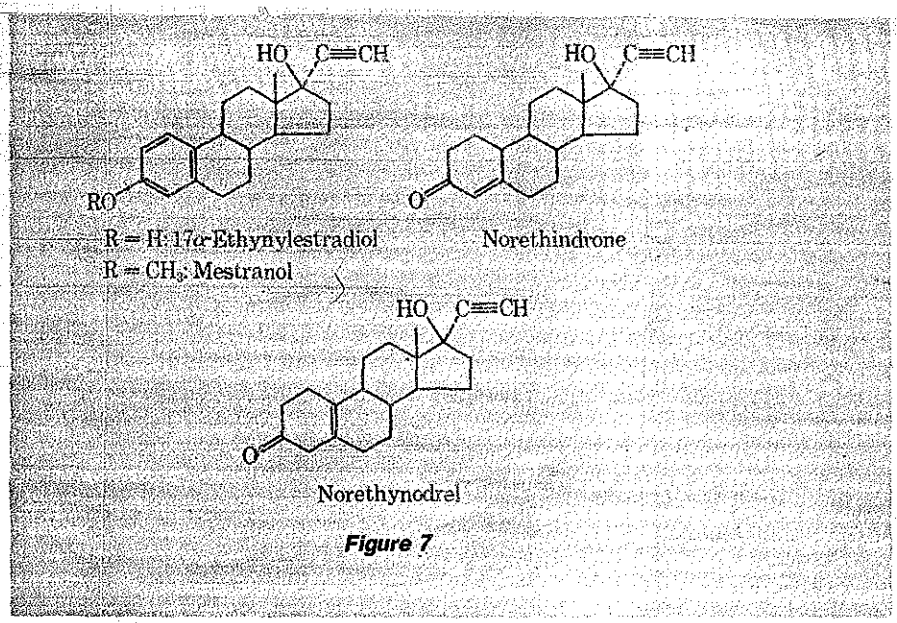


Figure 7

is helpless. To be sure, once a genetic enzyme deficiency has been diagnosed in a family, carriers of the defective gene can be detected by biochemical assays and other measures.

One of the most thoroughly investigated molecular diseases is sickle cell anemia, which results from a deformation (sickling) of red blood cells with a concomitant deficiency of oxygen transport by the abnormal hemoglobin in such cells. This inherited disease is caused by one variant amino acid group in globin. The abnormal hemoglobin S can be separated by electrophoresis. Sickle cells are of genetic advantage in regions in which *Plasmodium falciparum*, the parasite of malignant malaria, is prevalent. Individuals with a sickle cell trait which also involves zinc deficiency have an enhanced resistance to this blood cell infection. Sickle cell disease now can be treated with cyanate ion, although, as a side effect, this therapy may lead to nerve conduction abnormalities.

Hormonal therapy

The problems of replacement also plague the use of many polypeptide hormones. Securing adequate amounts of hormones at affordable prices from animal sources with a minimum of allergenicity has been achieved only in a few cases. Synthetic attempts to simplify and modify the structure of hormonal peptides indicate that more specific analogs can undoubtedly be made, but a lack of interest in the pharmaceutical industry has not let these searches come to clinical fruition, perhaps because massive uses for such hormones have not developed. The synthesis of insulin (51 amino acids), calcitonin (32 amino acids), and human growth hormone (Choh Hao Li, 1971; 190 amino acids) has demonstrated that there is no real barrier left to the small-scale and presumably the large-scale synthesis of such peptides if the need should arise. The fascinating biological properties of the hypothalamic neurohormones which release thyrotropin, corticotropin, growth hormone, prolactin, luteinizing hormone, etc. make it seem most likely that these and other polypeptide hormones will find a place in therapy soon.

The case is quite different for the modified steroid hormones which have revolutionized the control of female fertility by methods of contraception. Last year, more than 50 million women worldwide, and 11 million in the U.S., relied on the "pill" or, less frequently, on injectable contraceptive agents to prevent unwanted pregnancy.

The pill is usually a combination of a progestational agent and an estrogen, in varying ratios, and blocks ovulation in the normally cycling woman, thereby preventing conception without suppressing withdrawal bleeding (32). This medication was conceived by the endocrinologist-biologist Gregory Pincus, and the gynecologist John Rock, and their coworkers in Massachusetts. Their combined medication became possible through the development of the orally active estrogen, 17α-ethynylestradiol (Hans H. Inhoffen, 1938) and its 3-methyl ether (mestranol), followed by the orally active progestational hormones, 17α-ethynyl-19-nortestosterone (norethindrone) and its $\Delta^{5(10)}$ isomer (norethynodrel) synthesized 25 years ago by Carl Djerassi at Syntex and Frank B. Colton at G. D. Searle (Figure 7). Combinations of norethynodrel and mestranol and of norethindrone and mestranol are examples of widely used oral contraceptives.

Many modifications of these agents have been proposed and tested. Especially the progestational components have been varied with the intention of eliminating the estrogen altogether. This has been realized in injectable preparations that block ovulation up to six months. (Amenorrhea is, however, a common side effect.) Another application of progestational agents alone is the minipill, an orally active means of altering the cervical mucus and making it impassable to sperm.

The contribution of chemistry to this important field of medication has been to provide a long series of steroids that exhibit minimal or virtually no side effects on administration over several decades. Since the oral contraceptives do not fulfill a therapeutic purpose in disease but are taken voluntarily by normal, healthy women, the restrictions on their benefit-to-risk ratio imposed by regulatory agencies have been particularly severe.

Dilemma of pharmacological selectivity

When drugs are administered, nobody wants to add insult to injury and expose a suffering patient to additional discomfort, pain, poisoning, or even danger to life. Yet it is inherent in the concept of pharmacotherapy that the drug interrupts some damaging, unwanted, pain-producing, or disease-forming process, thereby bringing relief. It is unlikely, based on accumulated experience, that a drug will be found that will do this without ever spilling over into other vital or unrelated bodily reactions. The hope for absolute pharmacologic specificity appears to be an unattainable myth.

In every phase of our lives we have to make value judgments between competing courses of action. These lead to choices between options. Such often vexing and crucial questions force us into compromises and send us for help to consultants, counselors, and confidants. With drugs, the counselor is the physician. He must weigh the odds, decide on the risks, estimate the benefits, and then take a chance on exposing the patient to foreign and not always selective chemicals. Although the ultimate decision about what drug, what dosage, and what regimen to use rests with the physi-

cian, he and the patient can learn from preclinical and extensive clinical trials before the drug has been made available. Most importantly, the Food & Drug Administration has evaluated the drug's advantages and disadvantages before it—always hesitatingly—puts its stamp of approval on the use of the drug.

Life-saving drugs for acute and lethal infections, for leukemias and other malignancies, and for catastrophic diseases of vital organs will be allotted lower margins of safety and a measure of nonselectivity if no better agent is available. This concession disappears almost completely for therapeutic agents of general value—those that ameliorate a nonlethal disorder or provide relief from tolerable pain. The vast majority of prescription and over-the-counter drugs fall into this category. Demands for absolute safety are raised for medicines that are taken voluntarily as prophylactics, such as vaccines and contraceptives. The hurdles to be overcome by a new contraceptive agent consist of clinical tests for efficacy, side effects, and absence of chronic toxicity extending over a decade or more and costing an estimated $18 million, calculated before the 1973 inflation (*33, 34*).

Projections into the future

Forecasting scientific progress without proper experimental data is not rewarding. But in a profession where intuition, imagination, and beating the odds are conditions for success, it is not unusual to encounter discussions of therapeutic problems whose solution appears intangible at the moment. The impetus for such occasions usually is provided by a clinical inquiry, when the symptomatology of a given disease suggests a biochemical cause. What do we know about applicable biochemical metabolites and reactions? Is there an indication that some metabolites have gone astray and that a resupply might do some good? Or should one block the supply of some biochemicals; perhaps their metabolism could be at fault? If indeed there is a biochemical derangement, should it be corrected by medication or by other means?

There is a temptation to program computer memory with such multiple questions and extract some composite answer. But that activity cannot yet replace human intuition in drug design (*16*).

Some important practical constraints loom in the background of such discussions. Like it or not, somebody has to pay for research projects. In the pharmaceutical industry, market analysts will have a voice in the choice of such programs. That means that the number of patients with a given disease will be a persuasive argument to risk research capital. One suggestion that incorporates very large patient populations concerns the field of tropical diseases. The figures in these areas run in the hundreds of millions of patients for malaria, schistosomiasis, filariasis, amebiasis, leishmaniasis, and others (*35*). Although we have "leads" to compounds with such badly needed activity spectra, only a few developmental studies are going on in these areas, mostly because of the depressed economic conditions of the affected nations.

It is not surprising that many speculations about unorthodox approaches to new drugs center on the role of the immune system and on agents and conditions that suppress or enhance autoimmune responses. These phenomena are involved in so many poorly understood pathologies that compounds affecting the immune response should radiate into diverse therapeutic missions. Some of them have already been touched upon, in the discussion of antitumor drugs and compounds that prevent the rejection of homografts. Other diseases in which immune responses are implicated include allergies, immunizations to infection, natural resistance to infection in a given animal species (including man, who cannot be infected by numerous mammalian or avian pathogens), and bone marrow depression. Delayed hypersensitivity or cell-mediated immunity, such as the tuberculin PPD skin reaction, may be mentioned in a long list of autoimmune phenomena. The continuing keen interest in these subjects points to the probability that medicinal research in coming years will deal heavily with such topics. □

References

1. Vane, J. R., *Nature New Biol.*, **231,** 235 (1971); Ferreira, S. H., Moncada, S., Vane, J. R., *ibid.*, p. 237.
2. Burger, A., "Medicinal Chemistry," 3rd ed., Ed. Burger, A., Chapter 2, Wiley-Interscience, New York, 1970.
3. For a review, see Gourley, D. R. H., *Prog. Drug Res.*, **20** (1976).
4. Burger, A., "Paul Ehrlich," *Chem. Eng. News*, **32,** 4172 (1954).
5. Einhorn, E., Uhlfelder, E., *Ann. Chem.*, **371,** 131 (1909).
6. Barger, G., Dale, H. H., *J. Physiol.*, **41,** 19 (1910).
7. Chen, K. K., Schmidt, C. F., *J. Pharmacol. Exp. Ther.*, **24,** 339 (1933).
8. Alles, G. A., *J. Pharmacol. Exp. Ther.*, **32,** 121 (1927); **47,** 339 (1933).
9. Siegmund, O. H., Granger, H. R., Lands, A. M., *J. Pharmacol. Exp. Ther.*, **90,** 254 (1947).
10. Loewi, O., *Arch. Gesamte Physiol. Menschen Tiere*, **189,** 239 (1921).
11. Kushner, S. L., Brancone, L. M., Hewitt, R., McEwen, W. L., Subbarow, Y., Stewart, H. W., Turner, R. J., Denton, J. J., *Ann. N. Y. Acad. Sci.*, **50,** 120 (1948).
12. Fox, H. H., *J. Org. Chem.*, **17,** 542, 547, 555 (1952); Fox, H. H., Gibas, J. T., *ibid.*, p. 1653.
13. "Molecular Modification in Drug Design," Gould, R. F., Ed., *Advan. Chem. Ser.*, **45,** American Chemical Society, Washington, D.C., 1964.
14. Domagk, G., *Deut. Med. Wochenschr.*, **61,** 250 (1935); Mietzsch, F., Klarer, J., German Patent 607,537 (1935).
15. For a review, see Burger, A., Bioisosterism in Molecular Modification, in "Medicinal Chemistry," 3rd ed., Ed. Burger, A., pp. 72–80, Wiley-Interscience, New York, 1970.
16. Hansch, C., *Bioisosterism, Intra-Science Chem. Rept.*, **8,** No. 3, 17 (1973); *J. Med. Chem.*, **19,** 1 (1976).
17. Free, S. M., Jr., Wilson, J. W., *J. Med. Chem.*, **7,** 395 (1964).
18. Hansch, C., Silipo, C., Steller, E. C., *J. Pharm. Sci.*, **64,** 1186 (1975).
19. Baker, B. R., in "Medicinal Chemistry," 3rd ed., Ed. Burger, A., Chapter 12, Wiley-Interscience, New York, 1970.
20. For a review, see McMahon, R. E., in "Medicinal Chemistry," 3rd ed., Ed. Burger, A., Chapter 5, Wiley-Interscience, New York, 1970.
21. Sutherland, E. W., *Science*, **177,** 401 (1972).
22. Watson, J. D., "The Double Helix," Atheneum, New York, 1968.
23. Temin, H. M., Mizutani, S., *Nature*, **226,** 1211 (1970).
24. For a review, see Apple, M. A., *Ann. Rep. Med. Chem.*, **8,** 251 (1973).
25. For a review, see Montgomery, J. A., Johnston, T. P., Shealy, Y. F., in "Medicinal Chemistry," 3rd ed., Ed. Burger, A., Chapter 28, Wiley-Interscience, New York, 1970.
26. Creasey, W. A., Markiw, M. D., *Biochim. Biophys. Acta.*, **87,** 601 (1964); Moncrief, J. W., Heller, K. S., *Cancer Res.*, **27,** 1500 (1967).
27. Arcamone, F., Cassinelli, G., Franceschi, G., Mondelli, R., Orezzi, P., Penco, S., *Gazz. Chim. Ital.*, **100,** 949 (1970).
28. Ross, W. J., Jamieson, W. B., McCowen, M. C., *J. Med. Chem.*, **15,** 1035 (1972).
29. Karnaky, K. J., *Southwest Med.*, **53,** 10 (1972).
30. Sourkes, T. L., *Arch. Biochem. Biophys.*, **51,** 444 (1954); Oates, J. A., Gillespie, L. Jr., Udenfriend, S., Sjoerdsma, A., *Science*, **131,** 1890 (1960).
31. Yahr, M. D., Duvoisin, R. C., Hoehn, M. H., Schear, M. J., Barrett, R. E., *Trans. Amer. Neurol. Ass.*, **93,** 56 (1968).
32. For a review, see Deghenghi, R., Mason, A. J., in "Medicinal Chemistry," 3rd ed., Ed. Burger, A., Chapter 35, Wiley-Interscience, New York, 1970.
33. Djerassi, C., *Science*, **168,** 941 (1970).
34. Burger, A., *Chem. Eng. News*, **53,** No. 38, 37 (1975).
35. See the collection of pertinent papers in *Prog. Drug Res.*, **18** (1974); **19** (1975).

deals with the toxic effects of chemicals on individual organisms.

Another topic treated by the report is environmental management, including monitoring, simulation modeling, establishment of standards, and risk estimation. The panel emphasizes the need for more knowledge in all environmental areas. "It is difficult to see how best to improve the environment without first establishing fundamental facts; such facts will also serve to offset the interminable speculation frequently passing for knowledge."

However, the report notes, a comprehensive global environmental monitoring system, endorsed by the UN Conference on the Human Environment in 1972, is still not being set up. The delay may be caused by deficient understanding of how to go about monitoring in practice, SCOPE says, and it suggests ways of remedying such deficiencies.

One of the panel's key points is that when scientists gain knowledge about the environment and its possible threats, they must be willing and able to communicate their knowledge in an understandable fashion to scientists in other disciplines, policy makers, and the public, including use of the mass media. "They must not ponder this knowledge in the detached and rarified atmosphere of the intellectual ivory tower," notes Holdgate. "This kind of science is not just addressed to scientists." Indeed, SCOPE has an ongoing research project bringing together scientists and policy makers to examine the difficulties of actual use of scientific evidence in environmental decisions.

The tone of the SCOPE report is one of "cautious optimism," despite the many environmental threats. "No other attitude is sensible," says Holdgate, "unless we doubt our own powers and understanding so much that we are left with no other recourse but despair." There are already many success stories of wise management of natural resources, he points out. And the impacts of human activities "will certainly not all continue to grow at [an] exponential rate."

What about implementation of the report's recommendations? Highest priority for further research "should clearly be given to those problems whose solution is being impeded by lack of scientific knowledge" rather than by deficient social or political will, Holdgate stresses, and a multidisciplinary approach must be taken. ICSU and its unions and committees are already working in some areas discussed, and may undertake cooperative research efforts in additional ones.

"I'm optimistic," concludes Kovda. "But you have to pressure governments, you have to create social opinion" in order to get a comprehensive network of global monitoring stations, exploratory research, modeling, environmental legislation, and other efforts. "What is the point? Action is the point. Action, action, and action."

Richard J. Seltzer, C&EN Washington

Scientists called to action on world problems

A "call to action"—urging scientists and engineers to help move the world away from awesome threats to its future—was sounded at the final session of the symposium held in Washington, D.C., in conjunction with the General Assembly of the International Council of Scientific Unions. Prepared at a meeting in Bellagio, Italy, by a panel of 17 prominent and "concerned" scientists from eight countries, the appeal focuses with "guarded optimism" on the possibilities of solving over the next 25 years such major science- and technology-related world problems as food supply, environmental control, materials and energy supply, and arms control and nuclear proliferation. The panel was chaired by Dr. Lewis M. Branscomb, vice president and chief scientist of IBM and former director of the National Bureau of Standards.

The report, according to the panel, "is not a view of impending doom, but neither is it a view that justifies complacency or procrastination. Rather, it is a sobering view of a great challenge, together with an assertion that the world *can* reach the goal of a better life for all humankind, if it can chart a prudent course through troubled times." Success, the panel adds, will depend not on a single dramatic effort or institutional invention, but rather on "a long sequence of small, correct decisions," with science and technology as "necessary agents" in making these decisions and in carrying them out.

Much of the scientific knowledge and technological tools for improving living conditions worldwide are already available, the report notes, but their application is often frustrated by political, economic, and social constraints. Scientific and technical skills must be much better distributed globally to deal with world problems, for example. And many uses of science and technology contribute short-term benefits, but do so at the expense of future resilience—"leaving an ominous legacy for future generations."

Nevertheless, the panel's recommendations assume no major changes in world institutions and attitudes, "however much such changes might be welcome." But the report does strongly urge revamping of the traditional roles of scientists and scientific institutions, to do far more than just contribute new knowledge.

Successful management of human affairs will "depend strongly on the involvement of scientists and engineers with the social and political institutions that determine the use of technology," stresses Branscomb (himself a leading science adviser to Presidential candidate Jimmy Carter). And the panel emphasizes "the responsibility of the engineer to be alert to consequences of his technological contributions." Indeed, it says, "failure of the world's technical community to commit itself" and to insist on "development of needed policies . . . and cooperative activities could make the pessimistic view of doomsayers a self-fulfilling prophecy."

The panel thus urges creation of new problem-oriented institutions for scientific and policy research to provide facts and analysis enabling "anticipatory decisions" and contingency planning before hazards become critical. Such institutions, together with scientific societies, international scientific unions, and academic institutions, will have to learn to deal credibly and as rigorously as possible with incomplete information and problems "so riddled with uncertainties that hypothetical situations must be modeled as the basis for public decisions."

And it is urgent that scientists learn to communicate their conclusions relevant to policy making to the general public, because "the public's sense of priorities and values limits the decision options of its leaders," the panel points out. "The public must understand the alternatives before it is asked to forego a near-term benefit" for the sake of later gain or safety, Branscomb stresses. "In the past, the scientific community has sometimes taken an elitist view of its role."

Antimalarial research proposals sought

As part of its antimalarial drug development program, the Army is seeking research proposals for synthesis of new antimalarial agents. Proposals, the Army says, should be supported by a compelling chemical, biochemical, biological, or pharmacological rationale. Proposals that request support for basic chemical research not related to the antimalarial program, it notes, will not be supported.

Proposals should include a title page; organizational and administrative information; a budget sheet; a technical presentation, including methods of approach; résumés for key personnel; and a description of facilities. The Army says that proposals may be written to cover research for more than one year but that contracts are funded on a yearly basis. Also, all proposals are subjected to peer review by a study group.

Proposals should include an original and two copies and should be sent to: Commanding General, U.S. Army Medical Research & Development Command, Attn: SGRD-SSL, Washington, D.C. 20314. Inquiries on technical matters can be sent to: Division of Medicinal Chemistry, Walter Reed Army Institute of Research, Walter Reed Army Medical Center, Washington, D.C. 20012. □

Chemical & Engineering News
1155 16th St., N.W., Washington, D.C. 20036

Published by
AMERICAN CHEMICAL SOCIETY
(202)-872-4600
Robert W. Cairns, Executive Director
Arthur Poulos, Editorial Promotion
Marion Gurfein, Circulation Development

Subscription Service: Send all new and renewal subscriptions with payment to: Office of the Controller, ACS, 1155—16th St., N.W., Washington, D.C. 20036. All correspondence and telephone calls regarding changes of address, claims for missing issues, subscription service, status of records and accounts should be directed to: Manager, Membership and Subscription Services, ACS, P.O. Box 3337, Columbus, Ohio 43210; telephone 614-421-7230.
On changes of address, include both old and new addresses with ZIP code numbers, accompanied by mailing label from a recent issue. Allow four weeks for change to become effective.
Claims for missing numbers will not be allowed if loss was due to failure of notice of change of address to be received in the time specified; if claim is dated (a) North America: more than 90 days beyond issue date, (b) all other foreign: more than one year beyond issue date; or if the reason given is "missing from files."

Subscription Rates 1976: nonmembers U.S. 1 yr. $15, 3 yr. $32; Pan American Union $22.50, $54.50; Canada and other nations $23, $56. Air freight rates available on request. Single copies: Current $1.00. Rates for back issues and volumes are available from Special Issues Sales Dept., ACS, 1155—16th St., N.W., Washington, D.C. 20036. An annual index is available for $25. Standing orders are accepted. Back and current issues are available on microfilm. For further information, contact Special Issues Sales.
Published by ACS from 20th and Northampton Sts., Easton, Pa., weekly except for an extra issue in April and except the last week in December. Second class postage paid at Washington, D.C., and at additional mailing offices.
ACS assumes no responsibility for the statements and opinions advanced by the contributors to its publications. Views expressed in the editorials are those of the editors and do not necessarily represent the official position of ACS.

Editorial

Editorials

Taxing our research and development effort

The scientific community, among other groups, has been a largely unresisting witness to the decline in research and development in the United States over the past decade. There have been sporadic protests, of course, but most of these were weakly structured and short-lived. This long-term decline in R&D, however, represents a potentially serious problem that needs more than just casual attention by both the scientific community and industry at large.

The U.S. research and development effort is a primary factor in this nation's ability to compete successfully in the world market place. It is our advances in electronics, materials, agriculture, chemicals and pharmaceuticals, and medicine, just to name a few, that have allowed the U.S. to achieve a position of economic and technological leadership in the world today—but we are throwing that lead away. While other countries are increasing their investment in research and development, we are letting ours decrease—and our ability to create economic growth and jobs is decreasing along with it.

With the increasing cost and levels of foreign oil imports, our need to export goods and services to maintain a balance of trade has increased drastically. And the exportable products come primarily from the high-technology arena served by research and development. It is this same high-technology arena, by the way, that offers the best opportunity of generating new jobs and reducing the unemployment that is presently such a major problem in the United States. The federal government can generate a lot of jobs, but these have a disturbing tendency to be nonproductive most of the time.

There is considerable hope that the incoming Carter Administration will help reverse some of the decline in federal impact on R&D, but in the meantime, we have evidence of another government move that goes in the opposite direction. The Internal Revenue Service has issued a new regulation, to implement the new tax reform(?)laws, that could particularly affect the U.S. chemical industry and chemical employment.

These proposed changes in section 861 of the Internal Revenue Code are directed primarily at multinational corporations with substantial foreign sales. Under this regulation, a portion of domestic R&D related to foreign sales will no longer be a tax-deductible expense. This loss of a tax deduction for a part of research and development expenditures means that the overall cost of doing research will increase. And that means less R&D will be performed and a loss in present and potential employment in that same R&D sector—and in the industries that rely on that sector for new products. A couple of companies have indicated that this new regulation will add about 30% to the cost of research and development.

We can expect, naturally, that the tax lawyers will figure out some loopholes in the new regulation to reduce or eliminate its full impact on some companies, but that's not a very good solution to the overall problem. We need a regulatory tax structure that will foster technological innovation and R&D, not one that forces us to look for loopholes just to maintain it. It has been pointed out by some economists and manpower specialists, that we will have to create some 15 million to 20 million new jobs over the next decade to solve our unemployment problem and achieve satisfactory economic growth.

Technological innovation provides the products for domestic and international growth and it is that growth which will provide new jobs and economic stability in the future. If we reduce our technological competence by instituting counterproductive tax regulations, the future costs are going to be a darn sight bigger than the current tax revenues. And guess who will pay the difference!

Albert F. Plant

C&EN editorials represent only the views of the author and aim at initiating intelligent discussion.

The handicap of the legalistic approach

Philip J. Mause, Washington, D.C., counsel for the Environmental Defense Fund, had this to say at last month's meeting of the American Association for the Advancement of Science in Denver. It is excerpted verbatim from a paper in which he generally supported a proposal for an independent energy information authority within the federal government.

I think our society is unique in its domination by lawyers, and I think this domination has some relevance to the way we view the future. De Tocqueville noticed this domination more than a hundred years ago. For better or for worse, lawyers and people trained in the law permeate (unkind observers might say "infest") our political system and policy-making at every level of the government.

Indeed, we have a tendency in America to resolve any important issue that confronts our society by having a trial or quasi-trial. It is remarkable that the "science court" proposals seem to follow this pattern faithfully. It is only when one opens one's mind and questions the propriety of resolving disputes about the level and design of electric rates, the siting of nuclear reactors, the definition of peanut butter, and effluent standards for chemicals in trials and trial-like proceedings that the peculiar bias of our system toward litigation becomes clear.

I sometimes wonder how I would explain to an economist from the planet Mars why it is necessary to have a trial to determine whether electric rates should be based on marginal or average costs. Unfortunately, it would not be honest to dodge the question with humorous references to our Anglo-Saxon heritage—I have had more difficulty explaining our fixation with trials to English economists than I have in my worst nightmares about conversations with Martians.

Because facts—however developed—will be filtered through a system of decision-making which resembles our legal system, it is important to understand the special limitations on that system's ability for dealing with facts. The legal system has developed a peculiar and often useful methodology for dealing with questions of fact. It has evolved complex rules for making factual determinations about *past events,* but has never been particularly adept at dealing with *the future.*

Our society's approach to violent crime illustrates this dichotomy. While our legal system has evolved a complex set of procedures for determining the guilt or innocence of a suspect (a *past* fact), our process for determining which of a number of possible remedies are appropriate (probation, parole, confinement in a variety of institutions, execution, etc.) is laughable.

Once having determined what has happened in the past, we find ourselves incapable of dealing with its future significance. It is not hard to find analogies to this asymmetrical precision in dealing with the past and total failure to deal with the future in the areas of antitrust law, securities law, and family law.

The fact is that lawyers look at facts very differently from scientists—and our policy formation process tends to favor the approach adopted by lawyers. Although the future can only be intelligently discussed in terms of probabilities, lawyers continue to use burdens of proof—a concept which may not be very useful in dealing with an uncertain future. Thus, on top of all the inherent difficulties of dealing with the future—we have the application of analytical principles which make sense only in looking at the past. □

C&EN editorials represent only the views of the author and aim at initiating intelligent discussion.

Chemical & Engineering News
1155—16th St., N.W., Washington, D.C. 20036

Acting Editor: Michael Heylin
Assistant Managing Editors: William F. Fallwell, David M. Kiefer, James H. Krieger, Donald J. Soisson
Staff Editor: Ernest L. Carpenter
Senior Editor: Earl V. Anderson (New York)
Senior Associate Editors: Wilbert C. Lepkowski, Howard J. Sanders
Assistant Editors: Jeffrey L. Fox, David J. Hanson, Rebecca L. Rawls, Richard J. Seltzer, M. Mitchell Waldrop
Editorial Assistant: Theresa L. Rome
Editing Services: Joyce A. Richards (Head)
News Bureaus: New York: William F. Fallwell (Head), William J. Storck, Assistant Editor. Chicago: Ward Worthy (Head), Joseph Haggin (Staff Writer). Houston: Bruce F. Greek (Head). Washington: Janice R. Long (Head), P. Christopher Murray (Assistant Editor)
Foreign Bureau: London: Dermot A. O'Sullivan (Head)
Editorial Reference: Barbara A. Gallagher (Head)
Graphics and Production: Bacil Guiley (Head). Leroy Corcoran (Manager). John V. Sinnett (Art Director). Norman W. Favin (Designer). Staff Artists: Linda Mattingly, Diane J. Reich
Editorial Services: Arthur Poulos, Editorial Promotion; Marion Gurfein, Circulation Development

ADVISORY BOARD: Alfred E. Brown, Mary Carter, Theodore L. Cairns, Marcia Coleman, Arthur W. Galston, Derek P. Gregory, James D. Idol Jr., Gerald D. Laubach, Richard D. Mullineaux, Paul F. Oreffice, Rustum Roy, Edward R. Thornton, Herbert L. Toor, M. Kent Wilson

Published by
AMERICAN CHEMICAL SOCIETY
(202)-872-4600
Albert F. Plant, Publisher

EDITORIAL BOARD: Robert W. Parry (*Chairman*), Herman S. Bloch, Bryce Crawford Jr., Mary L. Good, Gordon L. Nelson, Gardner W. Stacy; *President-Elect:* Anna J. Harrison; *Representative Council Publications Committee:* Ernest L. Eliel; *Past-President*, Glenn T. Seaborg

Subscription Service: Send all new and renewal subscriptions with payment to: Office of the Controller, ACS, 1155—16th St., N.W., Washington, D.C. 20036. All correspondence and telephone calls regarding changes of address, claims for missing issues, subscription service, status of records and accounts should be directed to: Manager, Membership & Subscription Services, ACS, P.O. Box 3337, Columbus, Ohio 43210; telephone 614-421-7230.
On changes of address, include both old and new addresses with ZIP code numbers, accompanied by mailing label from a recent issue. Allow four weeks for change to become effective.
Claims for missing numbers will not be allowed if loss was due to failure of notice of change of address to be received in the time specified; if claim is dated (a) North America: more than 90 days beyond issue date, (b) all other foreign: more than one year beyond issue date; or if the reason given is "missing from files."

Subscription Rates 1977: nonmembers U.S. 1 yr. $17.50, 3 yr. $37.50; Pan American Union $25.50, $61.50; Canada and other nations $27, $66. Air freight rates available on request. Single copies: Current $1.00. Rates for back issues and volumes are available from Special Issues Sales Dept., ACS, 1155—16th St., N.W., Washington, D.C. 20036. An annual index is available for $25. Standing orders are accepted. Back and current issues are available on microfilm. For further information, contact Special Issues Sales.
Published by ACS from 20th & Northampton Sts., Easton, Pa., weekly except for the last week in December. Second class postage paid at Washington, D.C., and at additional mailing offices.
ACS assumes no responsibility for the statements and opinions advanced by the contributors to its publications. Views expressed in the editorials are those of the authors and do not necessarily represent the official position of ACS.

Advertising Management
CENTCOM, LTD.
(For list of offices see page 67)

Letters

The legalistic approach

SIR: I for one do not agree that the "legalistic approach" is a "handicap" as Mr. Mause says in the Editor's Page of the March 7 issue. Our "adversary" system of settling disputes and making policy allows decision making to be made with as much information being brought forth as any method yet devised.

Mause uses as his main argument that this system works for determination of past events but is not "particularly adept" at dealing with the future. I ask: What approach is better? I think simply that with *any* policy-making approach it would be far more difficult to deal with the future than to determine the past.

Mause says, "The fact is that lawyers look at facts very differently from scientists." I disagree. I think good lawyers and good scientists will look at facts in pretty much the same way. The differences among them are more in their rationality and bias than in their scientific or legal training.

I think the real problem here is the notion among many "advocates" and "liberals" that "An ounce of prevention is worth a pound of cure." Or "It is better to do something about our problems now than to react to them later." Anyone familiar with feedback and feedforward control knows the fallacy here. You must know far more about the black box to use feedforward control (prevention) than to use feedback control (cure). I think that in most cases it is far better to let a potential social problem develop a bit so that it can be defined (using an adversary approach) and then make policy, than to try to anticipate and define the problem before it develops and institute policies before the problem even appears. Most social problems take a relatively "long" time to develop.

Lubbock, Tex. Paul R. Harris

SIR: Mr. Mause gives an excellent description of one limitation of the legalistic approach to problems. A related limitation is that a large number of similar trials (suits) resulting from a common problem do not provide the best (or even a good) answer to the problem. This limitation is easily apparent for the legalistic approach of awarding financial payment for suffering or permanent injury. The costs of the trials and awards are diffused to everyone as higher prices on higher insurance payments without any direct effect on eliminating the problem. Large awards for medical malpractice suits do not eliminate the causes of incompetent medical services. Large awards for automobile accident suits do not inhibit drunk drivers, repair defective cars, or stop near-blind or otherwise handicapped drivers.

We need to recognize that the legalistic approach is inefficient, expensive, and nonproductive for many situations to which we currently apply it. Many decisions involving the environment and economics require choices between undesirable possibilities—there are no choices available without major disadvantages. We need all the information available, public participation, and competent government officials and legislators to set policies, but we cannot afford to subject every decision to a legal review. In summary, a legalistic solution (a court trial) is undesirable and costly to society and is only justified when a highly undesirable situation cannot be corrected by simpler procedures.

Knoxville, Tenn. Paul A. Haas

SIR: The handicap of the legalistic approach in the March 7 issue of C&EN was a very appropriate comment for the Editor's Page. It is time that we face the fact that our laws are made by lawyers for lawyers with the consent of lawyers. It has gone so far that if a medical doctor pronounces a man dead, a judge can reverse his decision.

With our lives more and more regulated by laws, we need to examine the legal system to see if a new and better system needs to be devised. The present system is incapable of dealing with the future.

Wilmington, Del. Andrejs Baidins

Opportunity knocking?

SIR: There are 114 departments of chemical engineering in the U.S., and today virtually every one of them is seeking at least one new faculty member. Most of these opportunities are for junior-level faculty, but such people just are not being produced from our graduate schools in nearly sufficient numbers to meet this need.

Young Ph.D.-level professionals with a few years of experience in industry would be ideal candidates for these opportunities that now exist in such unprecedented numbers. Unfortunately, the mode of operation in industry is such that excellent individuals may have already built outstanding reputations for themselves and may already be undergoing grooming for greater things within their companies, and yet, these extraordinarily able individuals, though already famous within the walls of their corporations, may be virtually unknown in the broader professional community. One of the greatest difficulties of academic department heads is in identifying these scientifically very able men and women in industry so that they might be made aware of academic opportunities as they arise.

Have you ever wondered why professors receive such a large share of the national awards of professional societies? Are professors really responsible for such a large share of the most important work in pure and applied chemistry? Surely this relative dominance in professional recognition is just another artifact of this same barrier on the professional fame of an individual that exists at the walls of the corporation. True, some few professionals in industry have overcome this barrier, or perhaps it was quantum tunneling, but their numbers are a mere fraction of the exceptionally competent technical people in industry.

Will all of you outstanding chemical engineers, chemists, biochemists, and microbiolo-

Continued on page 54

Max Tishler: worried over research's future

This year's recipient of the Gold Medal of the American Institute of Chemists is Dr. Max Tishler, a man of immense energy (reputedly due to his passion for jelly-beans) and impressive accomplishments. Now emeritus professor of sciences at Wesleyan University, he was for 33 years a research chemist at Merck & Co., where he produced more than 100 patents in the fields of vitamins, steroids, antibiotics, and sulfonamides. He is a member of the National Academy of Sciences, a past president of the American Chemical Society, and in 1970 was the recipient of ACS's Priestley Medal.

The AIC Gold Medal has been awarded yearly since 1926 to "stimulate and recognize service to the science of chemistry or the profession of chemist or chemical engineer." Tishler's own goals have been more specific: He wants to help relieve the sufferings of the sick.

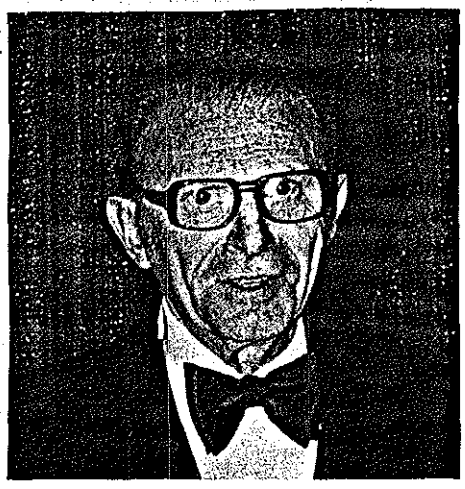
Often working late into the night—then being first to arrive at the lab in the morning—he has pursued his goal with an intensity that has been the despair of colleagues more used to a nine-to-five schedule. His dreams of easing pain and anguish are fired by the memory of 1918, when as a 12-year-old he delivered prescriptions for a Boston pharmacy during the great flu epidemic. The sufferings he saw then, he says, have had a lasting impact.

Working his way through school in another drugstore job, Tishler eventually became a registered pharmacist. Even today he proudly carries a copy of his license in his wallet.

After a brief flirtation with poetry, he graduated magna cum laude from Tufts University in 1928, with a degree in chemistry and plans for Harvard medical school. Chemistry proved too compelling, however, and in 1934 he obtained his Ph.D. under Dr. E. P. Kohler. Three years later, Tishler, by then an instructor at Harvard, was persuaded by the late George W. Merck to join Merck Laboratories.

In those days the idea of industrial work was somewhat distasteful to chemists interested in basic research, Tishler recalls. A good university was the place to be. But Tishler was impressed by the fundamental work that Merck was doing at the time on vitamin B_1. And besides, he says, "It was the depths of the depression, and most of my colleagues at Harvard thought I was lucky to get the job."

In 1937 Tishler joined a research staff of 100; by 1969, when he was elected senior vice president for research and development, he was in charge of a staff of 2300. In his 33 years with Merck before his retirement in 1970, Tishler was instrumental in the discovery of dozens of new drugs and in the development of practical production processes for many others. He helped achieve a practical large-scale synthesis of vitamin K_1, for example, as well as vitamin A, vitamin C, and riboflavin. He also developed a synthesis for sulfaquinozaline, a long-acting drug effective against the poultry disease coccidiosis.



C&EN staff photo

"Serious possibility of becoming a hostage of government"

During World War II, Tishler led a team of microbiologists, chemists, and chemical engineers in developing mass-production processes for penicillin G and streptomycin. Largely as a result of these efforts, Merck was able to fulfill its commitments to produce penicillin in quantities sufficient for wartime.

Following the first synthesis of cortisone by a Merck chemist in 1948, Tishler directed development of a large-scale production process for the compound, a process involving chemistry of a sophistication then unknown to industry. Other developments under his direction have included new drugs for the treatment of heart disease, hypertension, rheumatoid arthritis, and other inflammatory diseases, mental depression, and infectious diseases.

In 1970, Tishler left Merck to become professor of chemistry at Wesleyan University in Middletown, Conn. In 1975, he became emeritus professor there. One attraction of Wesleyan may well have been the hothouse next to the chemistry lab—Tishler is an avid horticulturist. But the college life also gives him a chance to do research and to teach. "Chemistry is useful," he tells his students. "It can do things and serve society."

After such a busy, successful career, capped with many honors, Tishler might be expected to take a sanguine view of affairs. Yet he does not. Max Tishler is a worried man.

In his Gold Medal acceptance speech at the AIC annual meeting in New Orleans last month (C&EN, March 28, page 5) Tishler expressed his distress at the new and hostile pressures bearing down on basic research. "This is anti-intellectualism hostility," he said, "the ugly sentiment that frequently surfaced in the late '60's and that is still with us in many latent forms."

Tishler is no blind apologist for science. In 1969, as Priestley Medalist, he took the unpopular position that the federal funding slowdown—then just beginning—would be good discipline for a self-indulgent and inefficient scientific community. In 1963, he echoed Clemenceau, saying, "The future control over the power of science is too important to entrust to scientists . . . . Science demands a high price in energy and time for a scientist, and, because of the limitations of the human mind, imposes a narrowness on all but a few."

Yet he is concerned that modern science is facing an ancient challenge: "For the first time in this country, pure research faces the serious possibility of becoming, at least in part, a hostage of government and a servant of political power." A clear example, he said, is seen in the controversy over recombinant DNA research. "Society no longer accepts one of the basic precepts on which research . . . is based, namely: The pursuit of knowledge is justified wherever it may take us, no matter how prepared or unprepared the world may be to cope with the truth scientists set before it."

Legislation to limit the kinds of recombinant DNA research that may be carried out already has been adopted in Cambridge and is pending in Congress, Tishler pointed out. "The cleavage of scientists themselves on these issues has bewildered and frightened the public," he said.

"We, as scientists, must act with wisdom and restraint," Tishler concluded. "As the decibels increase, the voices of reason are the first to be drowned out. . . . It is the right of society to know what the consequences of research can be, and to demand appropriate safeguards . . . (yet) we must convince society, by words and actions, that our interests and society's interest are the same."

Mitch Waldrop, C&EN Washington

Yet electroplating does not work on silicon either. So the researchers used wet-chemistry techniques to deposit nickel or titanium on the floor as a seed layer for zinc to stick to during electroplating. Growing zinc in a uniform manner so that there were not small mountains of zinc in some places and none elsewhere required laborious trial and error by fiddling with temperatures, electric current and concentrations of chemicals. "Looking back, I'm surprised it took only a year," Simon remarks.

After the scientists had a prototype working, they began to talk to potential customers. These discussions triggered a radical revamping of the battery. The initial design was a sandwich, with the cathode on top, the zinc chloride electrolyte solution in the middle, the nanograss under it and the anode on the bottom. Officials at the U.S. Army Research Laboratory in Adelphi, Md., expressed concern about how constant contact between the electrolyte and any electrode could result in unwanted chemical reactions. After the redesign, electrolyte now rests on top, the anode and cathode compounds occupy physically separated patches on the bottom, and a nanosilicon barrier is suspended in between, which, when activated, enables the electrolyte to penetrate and immerse the electrodes.

The team originally used nanopillars to separate the electrolyte from the anode because the pillar took up the least amount of space, allowing more surface area for chemical reactions between those electrodes. But the difficulty of manufacturing the nanopillar battery design prompted researchers instead to develop a nanohoneycomb membrane to isolate the electrolyte from the electrodes. Creation of the electrowetting membrane, with pores 20 microns across and thin, fragile walls 600 nanometers wide, was also a challenge. First the scientists used a plasma to etch the delicate honeycomb structure from wafers of silicon covered in silicon dioxide. Then they grew silicon dioxide on the bare silicon walls of the pores in furnaces heated to 1,000 degrees Celsius and suffused with oxygen. Finally, they coated the entire honeycomb with fluorocarbon.

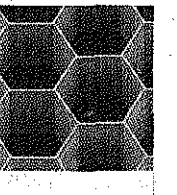
The researchers developed their first redesigned samples in October 2005. One of the great advantages of the system is that it now helps the team avoid having to laboriously find the exact conditions required to grow a uniform anode layer amid a forest of nanopillars every time it wants to try out a new anode-cathode combination. Instead the scientists can simply lie the electrode patches down on otherwise featureless surfaces. At the same time, the experience they gained in electroplating should make creating the patches far easier, Simon notes. Bell Labs and mPhase are currently collaborating with Rutgers University on incorporating the kind of lithium-based battery chemistries found in digital cameras and cellular phones.

The nanobattery might also allow for a more environmentally friendly power source that includes compounds that can entomb the electrolyte. "That would keep it from leaching into the ground or, if soldiers got shot, would keep the battery from leaking all over them," Krupenkin says. Plastic nanostructures might also be used in place of employing silicon, Simon adds, potentially paving the way for flexible nanobatteries.

The scientists are not seeking to replace disposable batteries, since mass production of those "is in the fractions of cents per AA battery," Krupenkin says. Instead they are targeting more specialized applications, such as sensors dropped from military aircraft that may have to use their radio transmitters just once or twice in their lifetimes, to signal the presence of intruders, for instance, or toxins or radiation. "If the sensor sees nothing interesting, it has nothing to transmit, but if it does, it needs a lot of power," Krupenkin explains. Alternatively, devices monitoring environmental change could use that extra juice to transmit over larger distances, thereby cutting down on the number of sensors needed. Emergency reserve batteries might also be incorporated into medical implants, cell phones or radio-transmitting pet collars.

The team has considered a rechargeable version of their device. A pulse of current could run through a depleted nanobattery, causing the surface on which the electrolyte rests to heat. That could evaporate a tiny layer of the liquid, forcing the droplet to jump up back on top of the nanostructure. "In principle, it's possible. In practice, it's really far out," Krupenkin cautions. For instance, mPhase expects to get product samples to potential first adopters in two to three years. A nanobattery would demonstrate how power sources are finally beginning to keep pace with the revolution in miniaturization that has driven the rest of the electronics industry for decades.

A nanomembrane separated the electrolyte from the electrodes in a later battery design.



Charles Q. Choi is a frequent contributor to Scientific American.

MORE TO EXPLORE

From Rolling Ball to Complete Wetting: The Dynamic Tuning of Liquids on Nanostructured Surfaces. T. N. Krupenkin, J. A. Taylor, T. M. Schneider and S. Yang in *Langmuir*, Vol. 20, pages 3824–3827; May 11, 2004.

A film about one phase of development of the nanobattery is available at **www.mphasetech.com/video/mphase.mov**

A Novel Battery Architecture Based on Superhydrophobic Nanostructured Materials. V. A. Lifton and S. Simon. **www.mphasetech.com/nanobattery_architecture.pdf**

(nanomembrane)

Patents on DNA have not caused the severe disruption of biomedical research

OWNING

By Gary Stix

There is a gene in your body's cells that plays a key role in early spinal cord development. It belongs to Harvard University. Another gene makes the protein that the hepatitis A virus uses to attach to cells; the U.S. Department of Health and Human Services holds the patent on that. Incyte Corporation, based in Wilmington, Del., has patented the gene of a receptor for histamine, the compound released by cells during the hay fever season. About half of all the genes known to be involved in cancer are patented.

Human cells carry nearly 24,000 genes that constitute the blueprint for the 100 trillion cells of our body. As of the middle of last year, the U.S. Patent and Trademark Office had issued patents to corporations, universities, government agencies and nonprofit groups for nearly 20 percent of the human genome. To be more precise, 4,382 of the 23,688 genes stored in the National Center for Biotechnology Information's database are tagged with at least one patent, according to a study published in the October 14, 2005, *Science* by Fiona Murray and Kyle L. Jensen of the Massachusetts Institute of Technology. Incyte alone owns nearly 10 percent of all human genes.

The survey of the gene database confirmed that the patenting of life is today well established. Yet it still strikes a lot of people as bizarre, unnatural and worrisome. "How can you patent my genes?" is often the first question that comes up. How can someone own property rights on a type of mouse or fish when nature, not humans, "invented" its genes? What happens to the openness of scientific research if half of all known cancer genes are patented? Does that mean that researchers must spend more time fighting in the courts than looking for a cure?

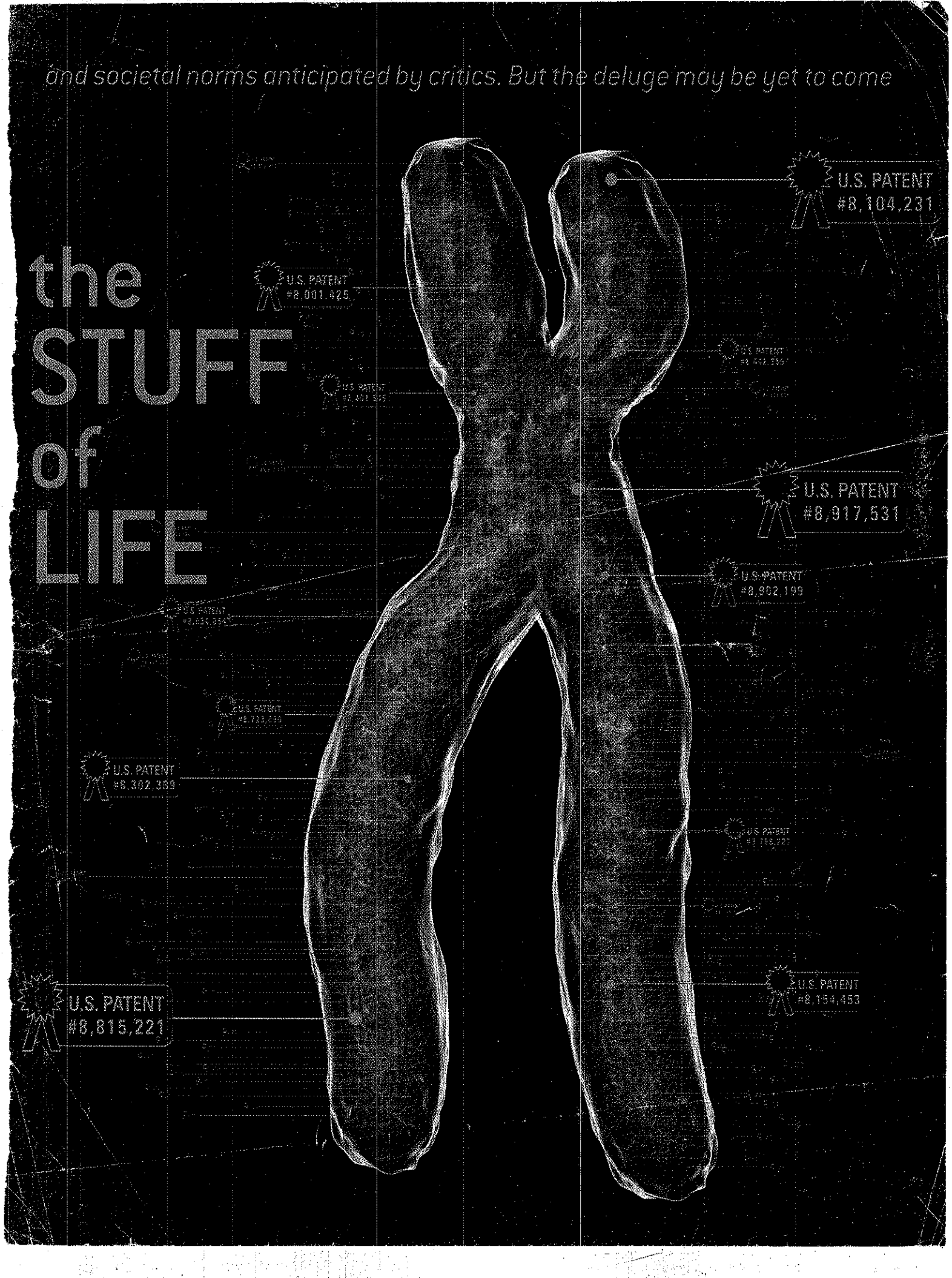
Ethicists, judges, scientists and patent examiners continue to immerse themselves in these debates, which will only grow more acute in a new era of personalized medicine and of genomics and proteomics research that examines the activities of many different genes or proteins at the same time. Doctors will rely increasingly on patented tests that let clinicians match genetically profiled patients with the best drugs. Investigators are already assessing the functioning of whole genomes. Potentially, many of the biological molecules deployed in these complex studies could come burdened with licensing stipulations that would prevent research leading to new therapies or that would fuel the nation's already robust health care inflation.

Anything under the Sun

THE QUESTION of "who owns life" has been asked before. But the M.I.T. researchers' taking stock of the intersection of intellectual property and molecular biology came fittingly at the 25th anniversary of a landmark decision by the U.S. Supreme Court that

and societal norms anticipated by critics. But the deluge may be yet to come

the STUFF of LIFE



held that living things are patentable—as long as they incorporate human intervention—in essence, that they are "made" by humans.

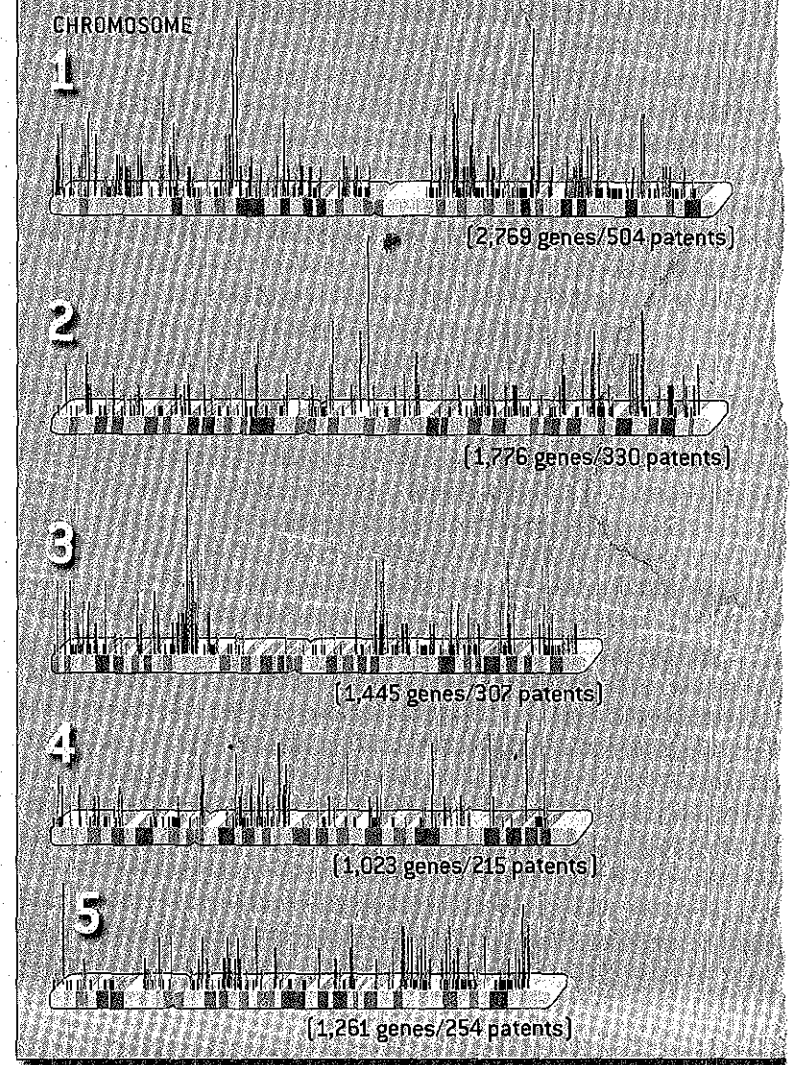
Ananda M. Chakrabarty, a General Electric engineer, filed for a patent in 1972 on a single strain of a *Pseudomonas* bacterium that could break down oil slicks more efficiently than if a bioremediation specialist deployed multiple strains for the task. Chakrabarty did not create his strain by what is usually meant by genetic engineering—in fact, recombinant DNA splicing methods were not invented until the year of his filing. Instead he tinkered with the bacterium in a more classical way and coaxed it to accept plasmids (rings of DNA) from other strains with the desired properties. The patent office rejected Chakrabarty's application, saying that "products of nature" that are "live organisms" cannot be patented.

By the time the Supreme Court decided to hear the appeal of the case in 1980, the landscape of molecular biology was changing radically. The splicing of DNA from one organism to another had become commonplace. A new firm called Amgen had formed that year to take advantage of the nascent technology of cutting and pasting DNA. A paper had just appeared detailing how recombinant methods had been used to synthesize interferon. Stanley Cohen and Herbert Boyer received a patent on a key technology for manipulating DNA. Technological boosterism was in the air. Congress passed the Bayh-Dole Act, which allows universities to engage in exclusive licensing agreements for technology they have patented. The Stevenson-Wydler Act let the National Institutes of Health and other federal agencies do the same.

The Supreme Court justices received friend-of-the-court briefs arguing both for and against granting the claims in the Chakrabarty patent. Groups ranging from Genentech to the Regents of the University of California urged that the patent application be granted, citing benefits for pharmaceutical development, environmental remediation and new sources of energy, to name a few. The Peoples Business Commission, co-directed by activist Jeremy Rifkin, decried the commodification of life and described environmental disasters in the offing.

THE HUMAN PATENTOME

This map of the chromosomes offers an indication of how often genes have been patented in the U.S. Each colored bar represents the number of patents in a given segment of a chromosome, which can contain several genes. Patents can claim multiple genes, and one gene may receive multiple patents. As a result, the number of patents indicated for each chromosome does not necessarily match the sum of the values represented by the colored bars.



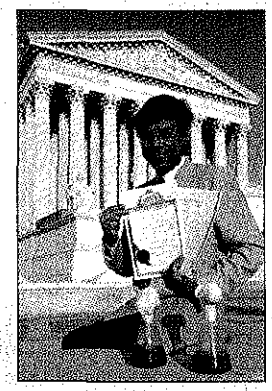
Overview/*Genetic Patenting*

- Last year marked the 25th anniversary of the landmark court decision that opened a floodgate of patenting on both DNA and even whole organisms.
- Nearly one fifth of the nearly 24,000 genes in the human genome have one or more patents on them. Almost 50 percent of known cancer genes have been patented.
- Overall the feared blocking of basic research by ownership of both gene-based tools and critical knowledge has not yet occurred, but it still could materialize as genomic and proteomic discoveries are commercialized.
- In the U.S., ethical issues about patenting life have been largely ignored in enacting legal decisions and policy, but they are still a consideration in Europe and Canada.

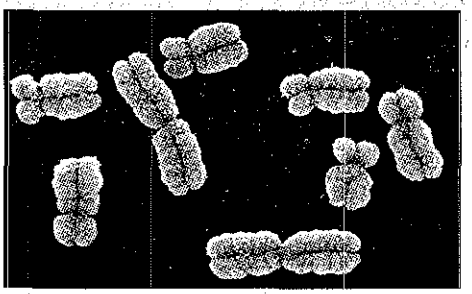
In the majority opinion, Chief Justice Warren Burger waved away the objections to patenting life as irrelevant, saying that "anything under the sun that is made by man" could be patented. The only question for the court was whether the bacterium was a "product of nature" or a human invention. "Einstein could not patent his celebrated law that $E = mc^2$; nor could Newton have patented the law of gravity," the opinion acknowledged. But as a "product of human ingenuity," Chakrabarty's engineered bacterium was different. Dismissing Rifkin's "gruesome parade of horribles," the court suggested that it was incapable of standing in the way of progress. "The large amount of research that has already occurred when no researcher had sure knowledge that patent protection would be available sug-

LAURIE GRACE; SOURCE: KYLE JENSEN AND FIONA MURRAY *Massachusetts Institute of Technology*

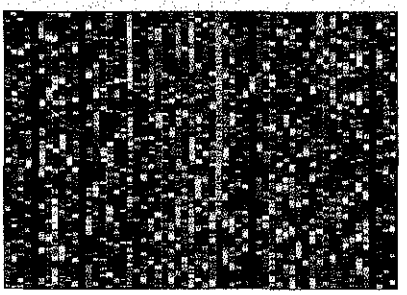
1980
The Supreme Court rules that Ananda Chakrabarty's bacterium is not a "product of nature" and so can be patented; other living things "made by man" are declared patentable as well



Ananda Chakrabarty



Human chromosomes



DNA sequencing

1980
Congress passes the Bayh-Dole Act (the Patent and Trademark Laws Amendment), which allows universities to enter into exclusive licensing for their intellectual property

1988
Harvard University gets a patent for the OncoMouse, a rodent with a gene inserted that predisposes it to cancer

1990
The Human Genome Project is launched

1996
Both public- and private-sector scientists from all over the world involved in DNA sequencing pass a resolution—the Bermuda Rules—that states that "all human genomic sequence information, generated by centers funded for large-scale human sequencing, should be freely available and in the public domain"

tual property. Noncommercial research, in their view, receives an exemption. Yet a 2002 case decided by the CAFC—*Madey v. Duke*—disabused universities and other nonprofit institutions of any notion of special status. The court decided that noncommercial research furthers the "legitimate business objectives" of a university, and so both research tools and materials, which would include DNA, do not merit an exemption. (An exemption does exist for research that is specific to preparing an application to file for a new drug.)

Patent holders generally have little interest in beating down lab doors to track down infringers. In the wake of the *Madey* decision, the level of notification from patent owners has picked up a bit, according to the NAS survey, but this increase has not caused major disruption. A growing awareness of the absence of an exemption, however, could lead to a more restrictive research environment, which is why the NAS panel recommended that Congress put in place a statutory research exemption.

Major intellectual-property hurdles may begin to appear as genomics and proteomics—fields in which many genes or proteins are studied together—reach maturation. "The burden on the investigator to obtain rights to the intellectual property covering these genes or proteins could become insupportable, depending on how broad the scope of claims is and how patent holders respond to potential infringers," the NAS panel remarked.

Genomics and proteomics are only starting to bear fruit in the form of medical diagnostics and drugs. "You really get ownership issues coming up when things get closer to market," says Barbara A. Caulfield, general counsel for Affymetrix, the gene-chip company that has opposed DNA patenting because it could impede research with its products.

Already, Caulfield says, examples of patents with a very broad scope burden both industry and academia. Genetic Technologies Ltd., an Australian company, holds patents that it is using to seek licensing arrangements from both companies and universities that conduct research on the noncoding portion of the genome. The breadth of its patents—covering methods of obtaining information from the approximately 95 percent of the genome that is sometimes erroneously called junk DNA—would make most scientists rub their eyes. Genetic Technologies, however, has already entered into licensing arrangements with the likes of U.S. biotechnology giant Genzyme and Applera, the parent of Celera and Applied Biosystems.

Keeping the *Ordre Public*

U.S. POLICYMAKERS and courts have, in general, taken a no-holds-barred approach to the commercialization of new biotechnologies. Though often debated by government advisory panels, ethical, philosophical and social questions have seldom entered into actual decision making about whether to extend patent protection to living things. In *Chakrabarty*, the Supreme Court justified its decision, in part, by quoting the statement of the first patent commissioner, Thomas Jefferson, that "ingenuity should receive a liberal encouragement."

One of the obvious questions raised by the *Chakrabarty* decision was, Where does patenting life stop? Does it extend to creatures above the lowly *Pseudomonas* on the phylogenetic tree? In 1988, eight years after *Chakrabarty*, the patent office issued No. 4,736,866, the patent for the Harvard OncoMouse, which contained a gene that predisposed the animal to contract cancer, a valuable aid in researching the disease. The justification for granting the patent could be traced directly to the reasoning of the justices in *Chakrabarty:* the addition of the oncogene meant that this was a mouse "invented" by a human.

Not every country has handled the issue of patenting higher organisms with the same utilitarian bent demonstrated by U.S. courts and bureaucrats. Much more recently, Canada reached an entirely different decision about the small mammal with the extra gene. On appeal, the Supreme Court of Canada rejected the Harvard OncoMouse patent. In 2002 it decided that the designation "composition of matter"—in essence, an invented product that is eligible for patenting—should not apply to the mouse. "The fact that animal life forms have numer-

TED SPIEGEL *Corbis [Chakrabarty];* BIOPHOTO ASSOCIATES/PHOTO RESEARCHERS, INC. *[chromosomes];* DAVID PARKER *Photo Researchers, Inc. [DNA sequencing]*

PATENTING LIFE: A CHRONOLOGY

The patent system—both courts and patent examiners—has always wrestled with the question of what is truly an invention (and therefore deserving of a patent) and what constitutes a mere attempt to expropriate in unaltered form a physical law or material from the natural world, a reason for rejecting an application.

1889
The commissioner of patents determines that plants, even artificially bred ones, are "products of nature," and therefore ineligible for patenting. The applicant in this case—*Ex parte Latimer*—had tried to patent fibers separated from the plant and was turned down


Iris

1930
The U.S. Congress passes the Plant Patent Act, which allows the patenting of new plant varieties that reproduce asexually

1948
A Supreme Court ruling held that simply combining bacteria does not count as an invention (*Funk Brothers Seed Company v. Kalo Inoculant Company*)

1971
Cetus, the first biotechnology company, opens its doors

Continued on next page

mere act of using that information in the course of conducting scientific research run the risk of infringement?

In response to some of these pressures, in 2001 the U.S. patent office made final new guidelines that directed examiners to look for "a specific and substantial utility" in granting biotechnology patents. In most other technological pursuits, the requirement that a patent be useful is secondary to criteria such as whether an invention is truly new, because most inventors do not seek protection for worthless inventions. In the arena of life patents, the assessment of an invention's usefulness has become a crucial filter to maintain a check on patent quality. Designating a sequence of DNA simply as a gene probe or chromosome marker is not enough to meet the new rules.

These changes have had an effect. So far only a small number of EST patents have been issued, according to the NAS. An important affirmation of the patent office's approach to weeding out useless and overly broad patents came in a decision on September 7, 2005, by the U.S. Court of Appeals for the Federal Circuit (CAFC), which hears appeals of patent cases. The court upheld the patent office's denial of Monsanto's application for a patent for five plant ESTs that were not tied to a given disease. The patents would have amounted to "a hunting license because the claimed ESTs can be used only to gain further information about the underlying genes," wrote federal circuit chief judge Paul Michel.

Data on the extent of a feared anticommons have just begun to emerge in recent months. A survey performed as part of an NAS report—"Reaping the Benefits of Genomic and Proteomic Research," released in mid-November 2005—received responses from 655 randomly selected investigators from universities, government laboratories and industry about the effect of life patents on genomics, proteomics and drug development research. The study found that only 8 percent of academics indicated that their research in the two years prior had anything to do with patents held by others; 19 percent did not know if their research overlapped; and 73 percent said that they did not need to use others' patents. "Thus, for the time being, it appears that access to patents or information inputs into biomedical research rarely imposes a significant burden for academic biomedical researchers," the report concluded.

The number of patents actively being sought has also declined substantially. Patents referring to nucleic acids or closely related terms peaked at about 4,500 in 2001, according to a recent report in *Nature Biotechnology*, and declined in four subsequent years—a trend that may result, in part, from the patent office's tightening of its utility requirement [*see box on opposite page*].

Some of the downturn may relate to the success of a de facto open-source movement in the biomedical sciences, akin to the one for information technologies. In 1996 scientists from around the world in both the public and private sectors devised what are referred to as the Bermuda Rules, which specify that all DNA sequence information involved in the Human Genome Project should be placed immediately into the public domain. Data sharing was later encouraged in other large-scale projects, such as the Single Nucleotide Polymorphism Consortium, which mapped genetic variation in the human genome. In some cases, researchers have taken out patents defensively to ensure that no one else hoards the knowledge. Both companies and public health groups involved with discovering and sequencing the SARS virus are trying to form a "patent pool" to allow nonexclusive licensing of the SARS genome.

This embrace of the public domain torpedoed the idea of building a business on public information. Both Celera Genomics and Incyte—two leaders in the genomics field—restructured in the early years of the new century to become drug discovery companies. J. Craig Venter, who spearheaded the private effort to sequence the human genome, left Celera and turned into an open critic. "History has proven those gene patents aren't worth the paper they were written on, and the only ones who made money off them were the patent attorneys," Venter commented at a 2003 conference.

A patent thicket that blocks basic research has also failed to materialize because academics tend not to respect intellec-

An expressed sequence tag (EST) is a sequenced segment of DNA only a few hundred nucleotides long located at one end of a gene. It can be used as a probe to rapidly fish out the full-length gene from a chromosome. Researchers started filing patents on ESTs—sometimes by the hundreds. They did so without really knowing what the ESTs in question did: the applicants often guessed at the biological function of the gene fragments by poking through protein and DNA databases. "This involves very little effort and almost no originality," once remarked Bruce Alberts, former president of the National Academy of Sciences.

The justification for patenting DNA sequences of unclear function was that these ESTs could serve as research tools. Yet this reason was precisely what concerned much of the scientific community. Owners of patents on EST probes might demand that researchers license these tools, adding expense and red tape to medical research and possibly impeding the development of new diagnostics and therapeutics.

In a 1998 article in *Science,* Rebecca S. Eisenberg of the University of Michigan Law School and Michael A. Heller, now at Columbia Law School, worried about the emergence of an "anticommons," the antithesis of the traditional pool of common knowledge that all scientists share freely. Those concerns were heightened by the audacious scope of some of these applications, which staked out not only the ESTs but any DNA that resides adjacent to them. Such a claim could translate, in theory, into granting property rights for an entire chromosome.

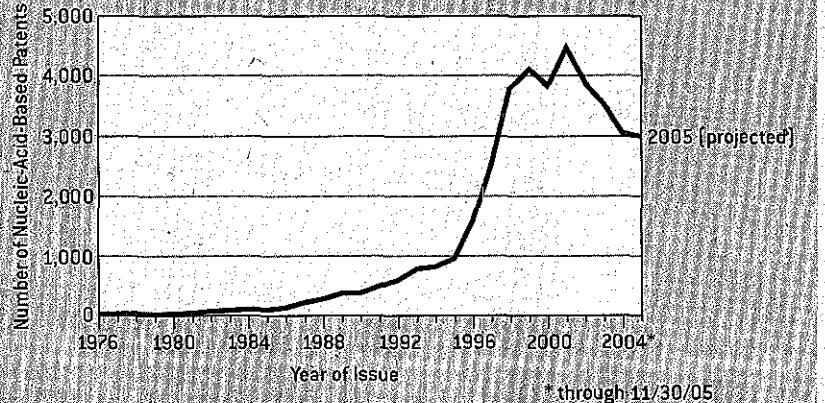
But a further, more intellectual objection to the concept of these patents was that the use of ESTs to pin down the location of genes actually occurs in a database, not in a laboratory. The value of ESTs exists more as information than as one of the tangible "processes, machines, manufactures and compositions of matter" that are eligible for patenting. Abstract ideas have traditionally been considered outside the realm of patentable subject matter, although a number of federal court cases have blurred this distinction during the past 10 years.

Allowing information to be patented would tend to undermine the balancing act that is a cornerstone of the whole system. In exchange for a 20-year monopoly, the patent applicant must disclose how to make an invention so that others can use that knowledge to improve on existing technology. But how does the traditional quid pro quo work if the information disclosed to others is the patented information itself? Does the

WHO OWNS THE PATENTS?

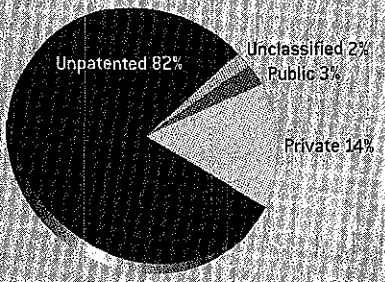
YEARLY U.S. PATENTS RELATED TO DNA OR RNA

The granting of patents involving nucleic acids, including from nonhumans, peaked in 2001 and then declined (*graph*), probably because of tightening requirements. The holders of many of the patents are listed in the table (*right*).



PATENTS ON HUMAN GENES

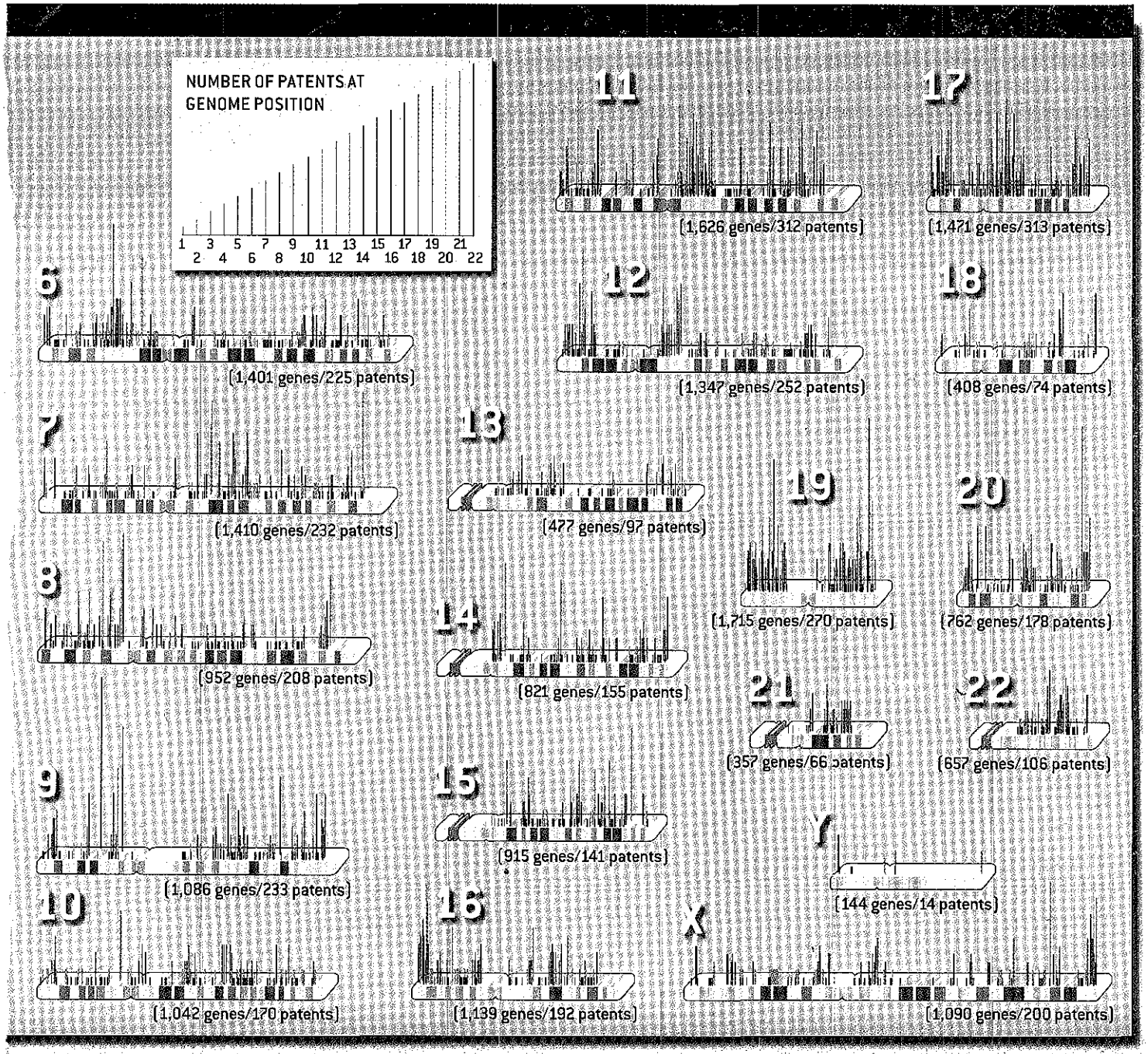
As the pie chart shows, private interests in the U.S. were the largest holders of patents on the 23,688 human genes in the National Center for Biotechnology Information database in April 2005.



LARGEST PATENT HOLDERS	NUMBER OF PATENTS†
University of California	1,018
U.S. government	926
Sanofi Aventis	587
GlaxoSmithKline	580
Incyte	517
Bayer	426
Chiron	420
Genentech	401
Amgen	396
Human Genome Sciences	388
Wyeth	371
Merck	365
Applera	360
University of Texas	358
Novartis	347
Johns Hopkins University	331
Pfizer	289
Massachusetts General Hospital	287
Novo Nordisk	257
Harvard University	255
Stanford University	231
Lilly	217
Affymetrix	207
Cornell University	202
Salk Institute	192
Columbia University	186
University of Wisconsin	185
Massachusetts Institute of Technology	184

† as of 9-14-05

LAURIE GRACE; SOURCES: KYLE JENSEN AND FIONA MURRAY *Massachusetts Institute of Technology [pie chart and graph]*; LORI PRESSMAN, ROBERT M. COOK-DEEGAN AND LEROY WALTERS ET AL. IN *NATURE BIOTECHNOLOGY* (IN PRESS) AND MELISSA SOUCY *Kennedy Institute of Ethics, Georgetown University [table]*



gests that legislative or judicial fiat as to patentability will not deter the scientific mind from probing into the unknown any more than Canute could command the tides," Burger noted.

After the close 5–4 ruling, industry and academia have looked to the broad interpretation of patentability in the Chakrabarty case as justification for patenting not only genes but other stuff of life, whole organisms and cells—including stem cells—to give but an incomplete list. The early patents on genes followed closely in the tradition of patents on chemicals. Incyte does not actually own the rights to the gene for the histamine receptor in your body but only to an "isolated and purified" form of it. (At times, patent examiners or courts have invoked the U.S. Constitution's prohibition of slavery to explain why a patent cannot be issued on an actual human or on his or her body parts.) A patent on an isolated and cloned gene and the protein it produces grants the owner exclusive rights to market the protein—say, insulin or human growth hormone—in the same way that a chemical manufacturer might purify a B vitamin and file for a patent on it.

Little Effort, Less Originality

BY THE 1990S the inexorable pace of technological development had overturned the status quo again. The high-speed sequencing technologies that emerged during that decade—which powered the Human Genome Project—muddied the simple analogy with chemical patenting.

INFORMATION RESOURCES ∞

BOOKS & REPORTS

Competitive Advantage;
Michael E. Porter;
The Free Press, New York, NY,
557 pp., $23.95.

The author, a professor at the Harvard Business School and a member of the President's Commission on Industrial Competitiveness, picks up where his earlier *Competitive Strategy* left off. That book presented techniques for analyzing industries and competitors, while his new one shows how a firm can actually create and sustain a competitive advantage in its industry. Porter explains how managers can evaluate their competitive position and implement the specific actions necessary to improve it. He introduces the value chain and shows how managers of technical as well as other companies can use value-chain analysis to separate the underlying activities a firm performs which ultimately lead to competitive advantage—designing, producing, marketing, and servicing its product. Using value analysis Porter shows, for example, how to create competitive advantage through corporate strategy by harnessing interrelationships among related industries. (Japan's NEC Corporation, for example, has exploited interrelationships among its telecommunications, computer, electronic component, and consumer electronics businesses to become a world-class competitor against the likes of IBM, AT&T and Philips.)

Intrapreneuring;
Gifford Pinchot III;
Harper & Row, New York,
224 pp., $19.95.

This book is aimed at those who wish to innovate within an organization (or despite it) as well as those managers who would like to create an environment supportive of innovation and "intrapreneuring." Consultant Pinchot tells the would-be intrapreneur how to choose an idea, how to get it approved, where to find the money for it, and how to make the project succeed. Through such case histories as 3M's Post-it Notes, Intel's magnetic bubbles, and IBM's personal computer, he provides guidelines for building an intrapreneurial corporation—"the true Renaissance Corporation of the 1980s."

Managing Creative People;
Albert Shapero;
The Free Press, New York, NY,
252 pp., $20.75.

Drawing upon extensive research, case studies and his own consulting experience, Prof. Shapero makes specific suggestions for: Hiring professionals (when using reference networks note that good performers tend to be members of social circles that have values and norms that elicit high performance); motivating professionals (very productive people need and seek diversity; deliberate steps should be taken to encourage and assign diverse tasks, including a number of projects, a mix of administrative and professional work, and a mix of functions); performance evaluation (treat the formal evaluation system as only one part of a comprehensive feedback system in which frequent, informal feedback sessions bear the brunt of the coaching and criticism effort); enhancing creativity (managers should assign tough deadlines but stay out of the operating details of a project; creative people resist closure because they may see new possibilities as the project unfolds).

Managers will also learn how to cope with—and prevent—the problems of technical obsolescence, "burnout," and "midcareer crisis" that can cut the productive life of the professional worker. (Shapero's chapter on creativity was digested in the March-April issue of *Research Management*, pp. 23–28.)

Who Owns Innovation?
The Rights and Obligations of Employers and Employees;
Robert A. Spanner;
Dow Jones-Irwin, Homewood, IL,
149 pp., $27.50.

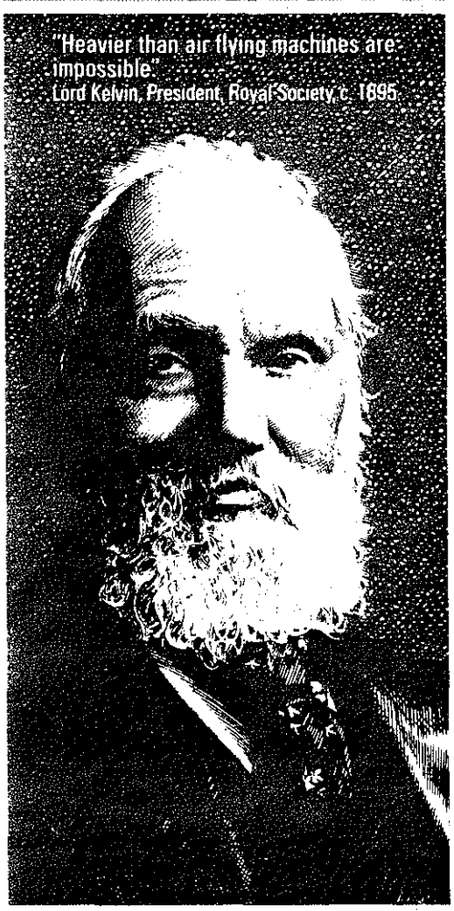
Silicon Valley attorney Spanner warns that because courts have failed to provide consistent guidelines for proper conduct in the fast-growing area of trade secret law, technology companies and their employees increasingly risk the possibility of disastrously expensive lawsuits. He examines the conflicts that stem from the joint possession of valuable information, and gives corporate managers and employees step-by-step advice on how to preserve corporate information secrets and negotiate the legal minefields of trade secret law. The book starts with an overview of trade secrets, followed by an analysis of their social and economic policy implications. An extensive section then details the types of information considered proprietary and lists the measures companies have employed to successfully keep them secret. The book also covers confidentiality and invention assignment agreements, as well as the severance of the employment relationship. There is a detailed index of topics and legal cases.

How To Keep Product Costs in Line;
Nathan Gutman;
Marcel Dekker Inc., New York, NY,
208 pp., $35.

This seventh volume in a series on cost engineering describes practical ways to reduce operating costs in manufacturing organizations. It offers an approach to cost analysis and introduces several techniques intended to help engineers and manufacturing managers identify high cost elements of a product. Several chapters deal exclusively with human relations.

The Making of a Profession:
A Century of Electrical Engineering in America;
A. Michal McMahon;
IEEE Press, New York, NY,
303 pp., $39.95.

Historian McMahon recounts the growth of the electrical engineering profession by following the careers of representative engineering figures like Charles Steinmetz, David Sarnoff and the educator Frederick Terman, and by examining pivotal events in the history of the American engineering societies and the collective profession. The history of the American Institute



The future isn't what it used to be.

There's no future in believing something can't be done. The future is in making it happen.

A company called TRW has built a business by asking people to tackle the impossible. TRW people created the first spacecraft to leave the solar system, Pioneer 10. We fit up to 100,000 electronic parts on a single computer chip. We built a financial and data service that handles 350,000 inquiries a day.

Along the way, there were those who knew all the reasons these things couldn't be done. Fortunately, there were those who knew enough not to listen.

Tomorrow is taking shape at a company called TRW.

TRW

A Company Called TRW

Adm. Inman In Command At Consortium

MCC Research Team Ready for Business

By Michael Schrage
Washington Post Staff Writer

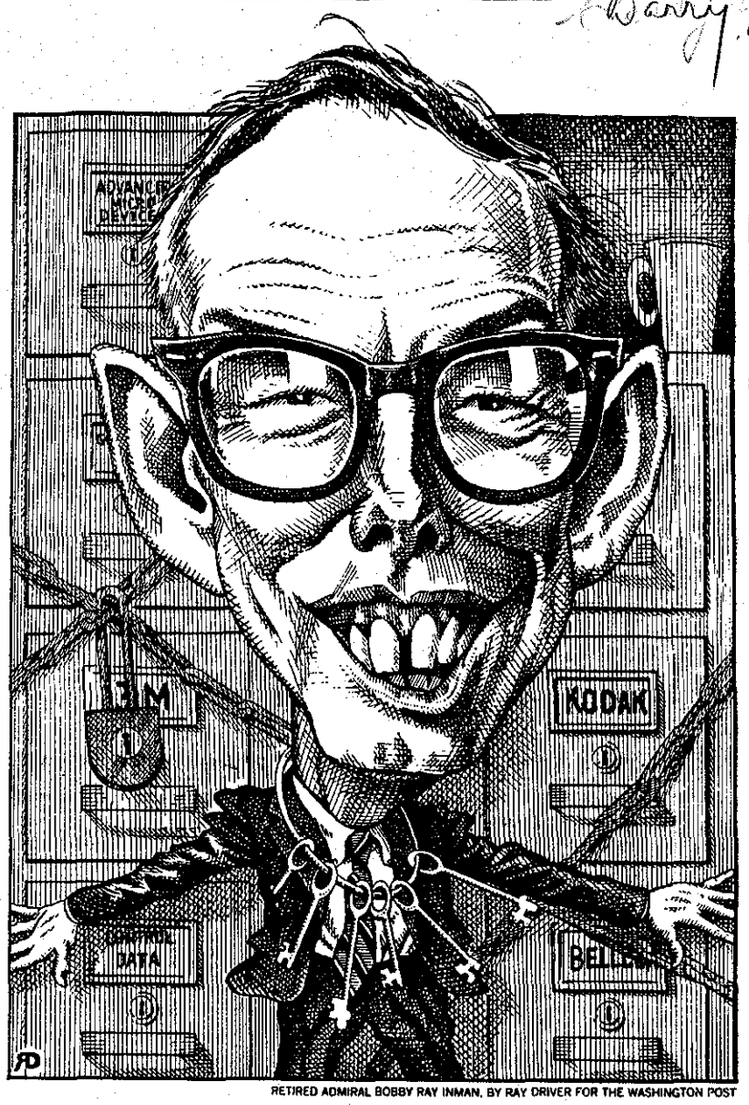
AUSTIN, Tex.—With the skill and savvy that once made him Washington's consumate high technocrat, retired admiral Bobby Ray Inman has turned his talents from the classified to the proprietary.

The man who managed this country's most sophisticated national security technologies—he ran the National Security Agency from 1977 to 1981 and served as deputy director of the CIA—has glided smoothly to the private sector, where he now bids to become the unofficial U.S. ambassador of innovation.

"Much to my surprise, I haven't needed to adapt my management style at all," said Inman, with a disarming deployment of his gap-toothed grin. "The management skills I've acquired through trial and painful error are serving me well here."

Inman is chairman and chief executive officer of MCC—the Microelectronics and Computer Technology Corp. research consortium—which presents itself as the American computer industry's response to Japan's highly publicized "Fifth Generation" computer challenge for global supremacy in the information-processing industry.

The creation of Control Data Corp. Chairman William C. Norris in 1982, MCC was seen as new cooperative venture by American companies to achieve breakthroughs in areas of basic research crucial to the evolution of information technology. The idea was that member companies would finance establishment of the venture, underwrite its research programs, and lend it some of their top scientists and engineers. Norris argued that a combined approach would prove more cost-effective than any one company's individual efforts in this risky and capital intensive industry.



RETIRED ADMIRAL BOBBY RAY INMAN, BY RAY DRIVER FOR THE WASHINGTON POST

In many respects, MCC is the forerunner and model of what may prove to be the next generation of industry research and development—a cooperative of companies that share first-level research and development efforts that later will become proprietary products. MCC has about 300 employes and an annual budget approaching $100 million but has not disclosed what is being spent on specific programs.

"Mid- and small-sized companies simply don't sustain long and broad-scaled research in an industry where the prospect for technological surprise is high," Inman said.

Inman, who had retired from public service in July 1982, was assiduously wooed by Norris and other MCC members. He formally came on board in January 1983.

A superb politician with an ability to implement an agenda, he surprised and annoyed many of the members of his board by consistently rejecting many of the researchers initially offered up by the member companies as simply not good enough.

Moreover, although MCC's seven research programs—which range from semiconductor packaging to new computer architectures to parallel processing—originally were supposed to be run by scientists from MCC member companies, it turns out that six of the seven are independent and highly re-

See MCC, D8, Col. 1

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.

THE NEW LIBERTARIANS MAKE WAVES

Baby-boom business leaders are taking a fresh look at politics. Neither consistent liberals nor conservatives, they oppose government intervention in both the economy and personal lives. The major parties are listening to them. ■ *by Thomas Moore*

LIKE MANY young executives and professionals who came of age during the political tumult of the 1960s and 1970s, Fred Gibbons, 35, has strong ideas about politics and government. He doesn't like either. The chief executive of Software Publishing Corp., a firm that has built annual sales to $34 million in five years, he recalls attending a dinner at which former California governor Jerry Brown urged a group of Silicon Valley entrepreneurs to get involved in politics. "Jerry, around here we try to minimize politics," Gibbons told Brown after the dinner. "Our philosophy of government is less, not more. We don't want anybody telling us what to wear, who to be, or what to do."

Gibbons's politics, or antipolitics, are typical of baby-boom executives, entrepreneurs, and professionals whom FORTUNE interviewed around the U.S. and who confirm what pollsters and political strategists are finding. Most young executives have been so preoccupied with making it in business that they have largely withdrawn from political activity, except to cast an occasional vote. Such behavior is fairly common at their busy stage of life, but a few, having achieved some measure of success, are beginning to take a fresh, if skeptical, look at politics. Whether these executives are newly intrigued by politics or still standing on the sidelines, how they see the world is colored by their vantage point in business.

Their views are increasingly important to politicians and policymakers. Young managers, especially the entrepreneurs, are emerging as role models and opinion leaders for their generation. Says Robert Lichter, one of two political scientists who conduct the Rothman & Lichter survey on attitudes of business and media leaders, "While the status of FORTUNE 500 leaders is low in public opinion polls, young antiestablishment entrepreneurs are being exalted today and can be very influential, particularly among their own age group." Baby-boomers will make up about half the electorate by 1988—a statistic strategists for both major parties know by heart.

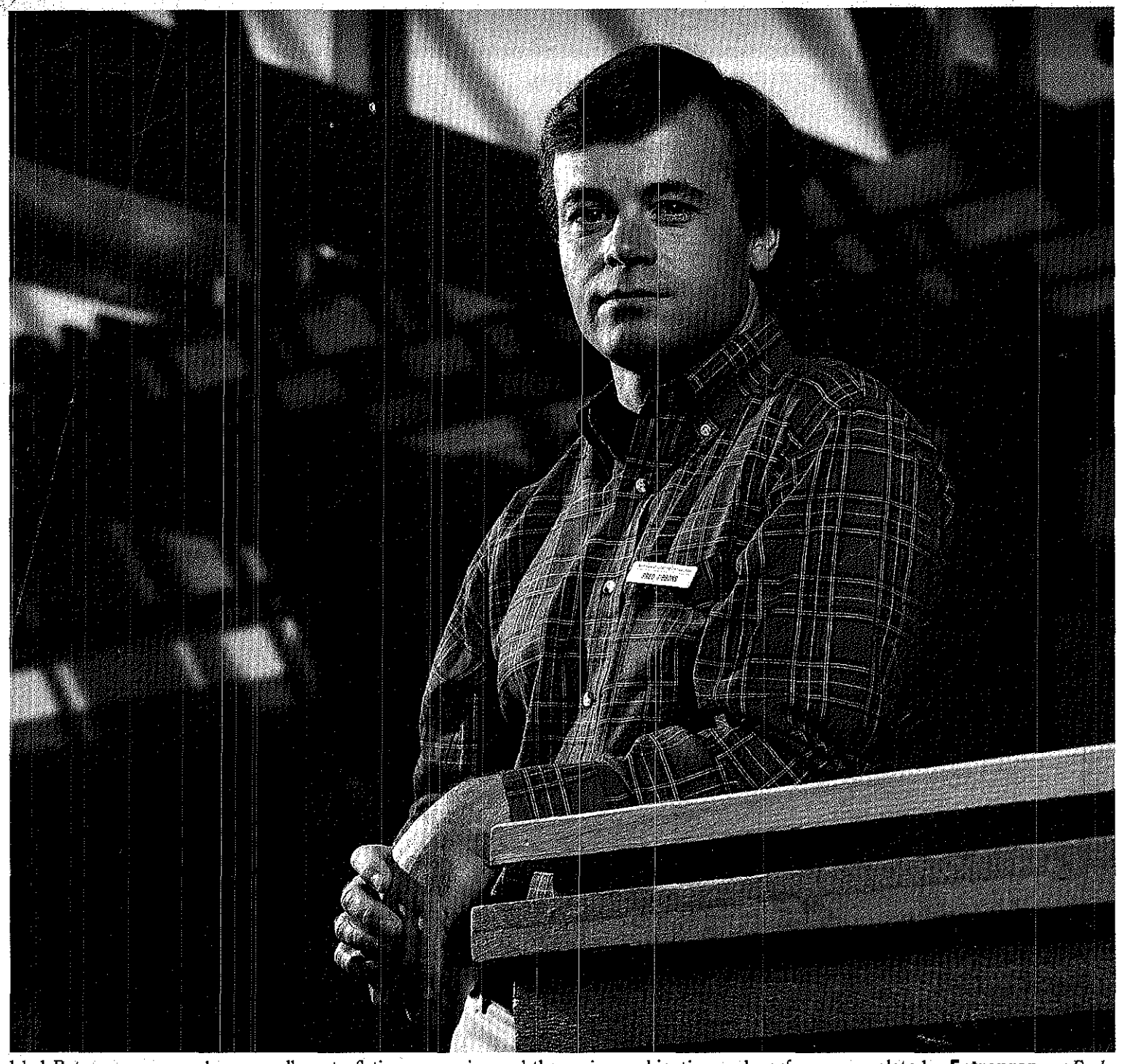
The Administration has already started to pitch key policies to the young managerial class. President Reagan, in a speech rallying support for his tax reform plan, claimed it would help entrepreneurs—63% of whom are under the age of 45, according to a recent Gallup/*Wall Street Journal* poll. He appealed to young Americans to "follow in the footsteps of those two college students who launched one of America's great computer firms from the garage behind their house"—Steven Jobs and Stephen Wozniak of Apple Computer.

The problem for politicians is that young managers defy conventional pigeonholes. As a group, they are neither liberal nor conservative, Democratic nor Republican. What they tend to be, in attitude if not ideology, is libertarians: people who believe in maximizing personal liberties and minimizing government controls. They believe individuals should be allowed to do, think, and live however they please, so long as their actions do not hurt or interfere with others.

Few, however, belong to the utopian Libertarian party. It peaked in popularity in 1980, when it captured 1% of the U.S. presidential vote, and has since been taken over by ideologues who champion a romantic individualism that opposes nearly all tax-supported government activity, including many police and defense functions. The new libertarians are realists who have little interest in leading or following lost causes. D. Quinn Mills, a Harvard Business School professor and the author of a new book about baby-boom executives called *The New Competitors*, estimates that 60% of the young managerial group could be considered libertarian, 35% conservative, and 5% liberal.

Libertarianism has yet to establish itself as a widely recognized creed. The label itself confuses many Americans, conjuring up images of extremists cavorting naked in public. Some young managers we spoke to prefer to bill themselves as neo-liberal or neo-conservative, with an emphasis on neo. Most feel uncomfortable with any

RESEARCH ASSOCIATE *Brett Duval Fromson*



label. But many agree, as do some pollsters, business consultants, and political analysts, that most young managers are indeed libertarian in attitudes toward government and its role in the economy and people's lives.

Their mind-set borrows heavily from Jeffersonian ideas about a limited role for government and the importance of individual rights. It has been conditioned by what young executives see as the failures of big activist government in the past two decades: Vietnam, the Great Society, Watergate, stagflation economics, and the gaping budget deficit. It has found expression and validation in a resurging entrepreneurial spirit in the U.S.

As baby-boom executives begin to reconsider politics, they are applying lessons and values they have picked up on the job. Many were contemptuous of business and materialism in the 1960s and 1970s and have belatedly discovered the marketplace and made competition an article of faith. "Overwhelmingly this generation of managers wants to be measured on the most objective and performance-related standards," says Mills. "They are very worried that the older generation, if it measures them on more subjective and social criteria, will object to aspects of their lifestyle, their self-expression, their attitudes."

On economic issues, younger managers have come to adopt many beliefs held by their superiors and older colleagues. According to the Rothman & Lichter poll, most executives under 40, like those over 40, feel that less government regulation of business is

Entrepreneur *Fred Gibbons (above) told former California governor Jerry Brown he didn't want to have anything to do with politics. Brown retorted: "If you don't get involved, other people will, and they are not going to represent your interests."*

PHOTOGRAPH BY BOB SEIDEMANN

my, many are skeptical. "I find the cooperation of industry with government dangerous," says Scott Wurcer, 35, a senior design engineer at Analog Devices, a Massachusetts electronics components manufacturer. "You end up forming a dependent relationship."

Where young managers differ most with their elders is on social rather than economic issues. Younger executives tend to be more tolerant of nonconformist behavior and believe more strongly in equal opportunity without regard to sex or sexual preference. For instance, two-thirds of the executives under 40 surveyed in a Rothman & Lichter poll believe lesbians and homosexuals should be allowed to teach in public schools, compared with less than half of the executives over 40. Only one out of ten of the under-40s thinks married women should be laid off before men, vs. one out of four of the over-40s. Younger executives also tend to be less receptive to top-down hierarchical command—the military model many senior executives learned during World War II.

POLITICALLY, the new libertarian managers oppose government attempts to engineer social affairs or intervene in matters involving personal liberties—a position that brings them into conflict with elements of both major parties. Contrary to Democratic doctrine, they tend to be against gun control laws. They believe that equal opportunity is fundamental to society and free markets, but government-enforced affirmative action plans go into too much detail and often don't work. "Affirmative action became a liberal-chic thing to do at a given time and was done really badly," says David Liddle, 40, chief executive of Metaphor Computer Systems in Mountain View, California.

Libertarians also bridle at proposals favored by many Republicans, the Moral Majority, and Ronald Reagan to promulgate traditional values through government action, arguing that such actions infringe on individual rights. For example, they object to laws against so-called victimless crimes, such as pornography, prostitution, and marijuana smoking. They oppose prayers in public schools and laws discriminating against homosexuals. According to the Rothman & Lichter poll, over 80% of executives under 40 believe women should have the right to decide whether to have abortions.

Like many Americans, libertarians have trouble making up their minds about foreign policy. On one hand, Vietnam was the formative experience of their generation, and they distrust American urges to intervene militarily abroad. According to poll data, three-quarters of the baby-boom generation would oppose an American invasion of Nicaragua—about the same level of opposition as is found among most other age groups. Many libertarians oppose the draft, and quite a few have been uncomfortable with Reagan's big increases in defense spending.

On the other hand, libertarians find it hard to ignore the Soviet threat to the liberty they believe in. While the Libertarian party advocates unilateral and drastic defense cuts, many new libertarian executives are realists about Soviet aggression, in addition to being philosophically opposed to just about everything the authoritarian Communist state represents. "The greatest tyranny on the planet is the Soviet Union and it is projecting its tyranny worldwide," says Gary Hudson, 35, president of Pacific American, a California space vehicle design firm with no government contracts. "We are the bulwark against that threat, and so we have to spend on defense."

Both parties have started to cultivate this young managerial group, looking for ideas, endorsements, organizational support, and money. More libertarians are Republicans (34%) than Democrats (17%), according to an analysis of 1980 election data by William Maddox and Stuart Lilie in their recent book, *Beyond Liberal and Conservative*. The Republicans hope to expand the array of young business and professional groups formed for Reagan in 1984—such as Young Bankers for Reagan, Young Realtors for Reagan, and Young Lawyers for Reagan—into a political base for future candidates. Says a Republican strategist who helped organize the 1984 effort, "We will be forming a new national organization targeting these people."

Several Democratic groups of baby-boom executives and professionals have sprung up to help raise funds and develop a new agenda. The Lexington Group, an organization of business-oriented baby-boom Democrats in California, was formed in 1981 and has spawned similar organizations elsewhere, such as the Hudson Group in New York and the Potomac Group in Washington, D.C. They have been pushing a flat-tax proposal since the spring of 1982—which Democratic leaders chose to ignore during last year's election. The groups have over 750 members, who each pay on average $250 in annual dues. State and local Democratic committees are organizing similar groups, says John Emerson, 31, a Los Angeles lawyer who helped found the Lexington Group and is on the Democratic National Committee. "The younger generation of Democratic leaders recognizes that young managerial talent is moving into positions of power in the private sector and is politically up for grabs," he says.

To appeal to the largest number of baby-boom managers, both parties would have to make libertarian adjustments. At a panel on the politics of the baby boom, sponsored by the Cato Institute, a libertarian think tank in Washington, party strategists concluded that the Republicans need to loosen ties with the Moral Majority and come across as more socially tolerant, while the Democrats must unhitch themselves from big labor and discard their notions about economic intervention. "There's no question that the appeal of libertarian views is the fastest-growing political phenomenon," says Lee Atwater, 34, a political strategist in the Reagan campaign. "There's a consensus out there that's going to bite people in the ass."

WALTER MONDALE and the Democratic party have already been bitten. In the 1984 election nearly 60% of voters under 40 voted for Ronald Reagan. They did so, say many pollsters and analysts, largely because of Reagan's libertarian appeal on economic matters. Reagan had cut taxes, started to deregulate the economy, and exhorted Congress to cut the size of the federal government. And it seemed to be working: inflation was down and the economy was growing. In contrast, Mondale wanted to raise taxes rather than reduce government programs; he had the backing of old party hacks, big labor, and special interests; and, worst sin of all, he didn't come across as open to new ideas. Laments Democratic pollster Patrick Caddell, "The Democratic party has a death wish to drive this generation away."

continued

A political strategist in the Reagan campaign says: "There's no question that the appeal of libertarian views is the fastest-growing political phenomenon."

NIH Role in Biotechnology Debated

Science adviser thinks NIH should go beyond its health mission when it comes to nonmedical biotechnology research

For some time now, James B. Wyngaarden, director of the National Institutes of Health (NIH), and presidential science adviser George A. Keyworth, II, have been discussing NIH's role in the development of the biotechnology industry in the Untied States. Wyngaarden, believing that the NIH should focus most of its energy on basic biomedical research, has resisted suggestions that the institutes support biotechnology in nonmedical areas such as agriculture or computer architecture. Keyworth takes the contrary view. As an advocate of government measures to increase the United States' competitive position in biotechnology, Keyworth thinks that NIH should show its support for the national effort by broadening its sense of mission. Debate on this issue is said to have strained relations between the two.

The debate moved to a public forum recently when Wyngaarden called the members of his NIH director's advisory committee together for a 2 day meeting on the proper role of the institutes in the arena of biotechnology policy. The unspoken hope was that Keyworth would be convinced by the evidence that NIH does best when left to its traditional mission. Keyworth was in China.

A look at the NIH budget reveals the extent of the institutes' biotechnology effort both in dollars and in areas of research. For instance, in fiscal year 1983, NIH support for basic research and training "directly related" to biotechnology came to $442 million or 11 percent of the total NIH budget, according to figures in a report NIH prepared for Congress. In FY 1983, support for the "underlying basic research," came to $994 million or 25 percent of the total budget. For FY 1985, projected estimates are $600 million for research and training directly related to biotechnology and $1.3 billion for the broader effort. Giving examples of areas in which these funds are spent, NIH's report includes the following: understanding cancer, genetics and transplantation biology, clinical immunology and allergic response, and disease prevention through vaccine production. NIH's identity as a medical research agency is evident and the kind of diversification Keyworth is asking for truly constitutes a change of course.

Bernadine Healy, deputy director of the White House Office of Science and Technology Policy (OSTP), presented Keyworth's position. Describing NIH's "disease mission" as "too narrow a focus," Healy said that the Administration's commitment to basic research "is as strong as ever," but that Keyworth is looking for a "broadening of NIH's awareness" of the needs of other fields that will benefit from the new biology. Among specific suggestions was one that NIH support training in biotechnology in all disciplines, including the agricultural and physical sciences. NIH's recent collaboration with the National Science Foundation (NSF) in support of a new bioengineering center at the Massachusetts Institute of Technology was something Healy cited as an example of what

> To maintain leadership in biotechnology, we should "let the NIH be the NIH," Theodore Cooper says.

NIH ought to be doing. The NIH's unwillingness to expand the role of its recombinant DNA advisory committee into a government-wide body rather than one tied exclusively to the institutes was noted as an example of NIH's recalcitrance. There is, said Healy, a "broad cultural gap" between the way NIH sees itself and the way Keyworth thinks it should be. NIH, she said, could do with a little consciousness raising.

Other participants in the advisory meeting took different positions that fall into two categories. On the one hand were those who, like Wyngaarden, think that NIH should retain its focus on basic research. On the other were representatives of biotechnology companies who argued for NIH funding of work they would like have supported in "generic applied research," which includes bioprocessing technologies.

According to Nanette Newell of Calgene, Inc., in Davis, California, the U.S. position in the world market demands a substantial commitment to research that falls in between truly basic research and clearly applied work. Japan, she said, has been ranked second to the United States largely because the Japanese are good at fermentation technology. However, recent indications that one cannot get sufficiently pure proteins from fermentation have lead to a new interest in finding ways to use mammalian cell cultures as a growth medium. Identifying this as an example of generic applied research, she observed that learning how to grow mammalian cells in industrial quantities could be important competitively. According to Newell, the U.S. spends about 1 percent of its research budget in generic applied research; Japan spends closer to 50 percent.

Newell called for NIH funding of this kind of intermediate research, as did Robert A. Swanson of Genentech in South San Francisco. "Our lead is fragile," said Swanson, who pointed out that both the Japanese and Europeans are targeting funds in the area of biotechnology development, particularly since they can take advantage of the U.S. commitment to basic research through licensing agreements. In Japan, he said, which has signed some 32,000 licensing agreements with American companies, the largest share of the research dollar goes to work that includes bioprocessing and development. The question of who should fund this kind of intermediate research promises to loom large in the overall biotechnology debate. NIH does not now see a major role for itself in this. But Newell observed that it is a kind of research that is both expensive and risky, something which the big companies can afford but which may be out of reach for smaller biotechnology outfits unless there is federal support.

Company representatives called for NIH participation in the development of the biotech industry in other ways as well. Richard Nesbit of Beckman Instruments suggested that NIH should promote "intellectual support" for biotechnology companies. "It is not usual," he said, "for academics to espouse the philosophy that business should succeed." Mark Pearson of Dupont suggested that since industry allows its staff to consult with NIH, it would be useful if NIH scientists were permitted to consult with industry. (Pearson's comments prompted Wyngaarden to report that NIH is, in fact, about to change its policy on this score. New guidelines defining the circumstances under which NIH researchers can consult will be issued soon.)

Whereas these industry represen

Biotech Policy Draws Flood of Comments

Hardly anybody seems to be comfortable with the way the Environmental Protection Agency (EPA) plans to regulate genetically engineered products, but there is little agreement on how it should be done differently. This is apparent from dozens of letters submitted by university researchers, professional societies, industry, and environmental groups in response to a draft proposal to regulate biotechnology that was circulated by the federal government in January.

The proposal articulated the plans of several agencies that will be involved in regulating various aspects of biotechnology—namely the Environmental Protection Agency, the Food and Drug Administration, and the U.S. Department of Agriculture—and was coordinated by the White House Office of Science and Technology Policy. It was EPA's approach that elicited the most comment.

A persistent complaint is that EPA intends to subject genetic engineering methods and products to more elaborate review than similar products produced by conventional techniques. EPA, in fact, is already asking Monsanto and University of California researchers for more information before they can conduct field tests of genetically engineered microbial pesticides.

Many objected to EPA's premise that products produced by genetic manipulation may pose special risks. Commenters pointed out that the Department of Agriculture and the Food and Drug Administration have said that they plan to evaluate biotechnology products no differently from any others. The American Society for Microbiology remarked that EPA's plans to single out biotechnology products "is unfair, unnecessary and not in the public interest." EPA should evaluate the product on its own merits, regardless of its method of manufacture, it said.

The Natural Resources Defense Council took a different view, however. "The technology is new, and the risks therefore, though unknown and not easily characterized or quantifiable, may indeed be fundamentally different from the risks posed by chemical substances and other industrial products," it argued.

(The National Academy of Sciences proposed last year to address some of these issues in a $600,000 study. No government agency has signed up to fund the project, however. The study would evaluate the scientific basis for predicting possible adverse effects of genetically engineered organisms released into the environment. The American Society for Microbiology will hold a 4-day meeting on this topic beginning 10 June in Philadelphia.)

The scope of EPA's authority was also challenged. Under federal law, EPA can require a variety of information about a new chemical before it is manufactured. But what constitutes a "new" chemical and what is naturally occurring in the context of biotechnology have not yet been precisely defined by the agency. Whatever definition the agency chooses will influence the speed with which products are approved for manufacture. In its draft proposal, EPA suggested that a chemical is new if it is manufactured by recombinant DNA methods and also by other genetic techniques that do not rely on recombinant DNA, such as cell fusion, plasmid transfer, and transfection.

Several biotechnology companies and many researchers said that EPA should not define "new" so broadly because nonrecombinant DNA techniques mimic what already occurs in nature. The National Institutes of Health (NIH) advisory group on recombinant DNA—commonly known by its acronym RAC—also pointed out that cell fusion is already subject to federal standards governing basic laboratory research.

The biotechnology company Genex, of Rockville, Maryland, was virtually alone in supporting the idea of putting all these techniques under the heading of new chemicals. "Speculations about what could exist in nature seem likely to be wasteful of time and resources," company president J. Leslie Glick wrote. " . . . [T]echniques used to produce a microorganism are not necessarily related to the degree of risk that the microorganism may pose to either health or the environment." Rather, the risk is related to the microbe's genetic characteristics, its ability to survive and to transfer genetic information to other species, and the concentration in which it will be used. To distinguish between the different genetic techniques "would seem to suggest—and will probably so imply to the lay public that recombinant DNA techniques are more likely . . . to produce dangerous microorganisms" than other methods that are less precise in producing genetic changes.

In the January document, the White House science office floated the idea of creating a biotechnology science board, and this idea drew many questions. It proposed setting up committees similar to NIH's RAC at EPA, Agriculture, the Food and Drug Administration, and the National Science Foundation. The committees, which would be composed of scientists, would report to the science board. The science office recommended that the board be placed directly under the assistant secretary of health at the Department of Health and Human Services, but intentionally left the function of this new review mechanism vague and solicited comment.

Industrial Biotechnology Association, a trade group representing major companies involved in genetic engineering, echoed the comments of many by remarking that "it had reservations about how this [review mechanism] would work in reality." The association said it was worried that the board would introduce another layer of bureaucracy in the review process.

A working group of RAC had a host of questions about the board and the new committees, their authority and role, but did not offer any clear-cut plan of its own. "Whatever approach is adopted, it must retain public confidence and trust." Representatives of the public, it said, should be included in the membership of the committees and boards, and meetings should be open. The other point, the working group stressed, is that the NIH committee should continue to have oversight over all laboratory research in recombinant DNA, both academic and industrial.

All these comments are now being mulled over by the various agencies. According to EPA staff members, there were no big surprises among the responses. Nevertheless, the issues raised and their resolution will shape the course of U.S. research and development in biotechnology. The Administration plans to circulate the final policy document this fall.—**MARJORIE SUN**

Government R&D expenditure by fields (1980). [Source: Gary Saxonhouse and Daniel Okimoto]

	United States	Japan	France
Defense and aerospace	47.3 percent	16.3 percent	49.3 percent
Industry	0.3 percent	12.2 percent	7.9 percent
Agriculture	2.7 percent	25.4 percent	4.3 percent
Energy and infrastructure	14.2 percent	34.4 percent	16.0 percent
Health and welfare	15.2 percent	11.2 percent	7.5 percent

ported that there are 1600 subsidiaries of Japanese firms in Los Angeles County, increasing so far this year at the rate of about one a day.

Imports and investments are pouring into the United States because the U.S. dollar has a high relative value in currency trading. This gives U.S. buyers strong purchasing power and attracts transient capital to the United States. Several speakers bemoaned the federal budget deficit in this connection, saying that debt raises federal borrowing, which raises interest rates, which draws foreign investments. This web of relationships supports the economy, but in a precarious way, making it dependent on debt financing from overseas.

However, those who were adamant about the need to cut the federal deficit neglected to say how or where it should be cut. This may have been a tactful omission, in that many of the companies at the meeting have fed on the recent growth in the military budget.

No one suggested that Japan's success can be explained solely in tariff or financial terms. Japanese businesses have learned to develop novel process technologies, enabling them to make better use of materials. They have become good salesmen in widely different markets. And in the 1980's, they have become innovators in their own right, competing with America on what once seemed exclusively Western turf. Several speakers, including Brooks, said that Europe will probably end up a distant third in the high-tech competition of the next decade.

One of the organizers of the meeting, Stanford economist Nathan Rosenberg, spoke about different patterns of innovation and the ways they are perceived. Japan has excelled at the applied sciences. Rosenberg's coauthor in this paper, Stanford mechanical engineering professor Stephen Kline, called this "rejuggling what already exists." Corporations like IBM, AT&T, and Kodak have learned to compartmentalize this kind of inventiveness.

Another kind of innovation creates "technological discontinuity" and arises with the discovery of new facts about [illegible]. These inventions bring about sharp breaks with the past and involve the type of innovation at which America excels—the "revolutionary" kind, Rosenberg and Kline call it. Recent examples are the development of silicon chip electronics, lasers, and recombinant DNA pharmacology. Discoveries of this type are hard to monopolize.

But Rosenberg and Kline say that the popular view, which sees innovation as something that begins in the realm of science and moves through engineering and marketing, is naive. "Contrary to much common wisdom, the initiating step in most innovations is not research, but is rather a design." The creative process does not flow in one direction but involves both engineering and theory in a repetitive testing of ideas, always centered on a model. There must be a steady flow of information from the basic researchers to the designers and back.

U.S. policy since World War II has rested on what Rosenberg and Kline see as an oversimplified belief that research leads to development, development to products, and products to a fat GNP. The Carter and Reagan administrations invested billions of dollars in basic research, not for the sake of knowledge but in the hope it would improve national productivity. This may do wonders for science, but not so much for the economy.

There is "little doubt about the continuing excellence of the U.S. performance in basic science," said Harvey Brooks, but "our performance in applied science and in the commercialization of new knowledge is much more in question." He mentioned that the share of U.S. R&D-intensive manufactured goods in world trade dropped from 31 to 21 percent from 1962 to 1977, while Japan's share rose from 5 to 14 percent.

Brooks pointed to another sign of the weakening technological infrastructure in America. The U.S. machine tool industry has lost "half of its traditional market" in the last 5 years, he said, and during the same period, "over 50 percent of all machine tools purchased in the United States were manufactured abroad, mainly in Japan and to a lesser extent in West Germany." The message in this and other talks on America's applied sciences was that they deserve more respect and more money.

Ironically, while these experts would like to have more and better engineering, the Japanese are trying to break out of the engineering mold and do more basic science. Daniel Okimoto, a political science professor at Stanford, described the steps the Japanese government has taken since 1980 to boost research and encourage technological creativity.

Until now, Japan has had a very small venture-capital market. The government has begun to deregulate the financial system to promote high-risk private investments. It is "doing all it can to push Japan beyond the frontiers of technology by organizing a variety of ambitious national research projects in such seminal areas as new materials and optoelectronics," Okimoto said. It has increased government support for R&D and may reach a spending level of 3 percent of GNP by the 1990's. Most important, Japan has begun a general curriculum reform to reduce the emphasis on rote learning and encourage "creative synthesis" throughout the educational system.

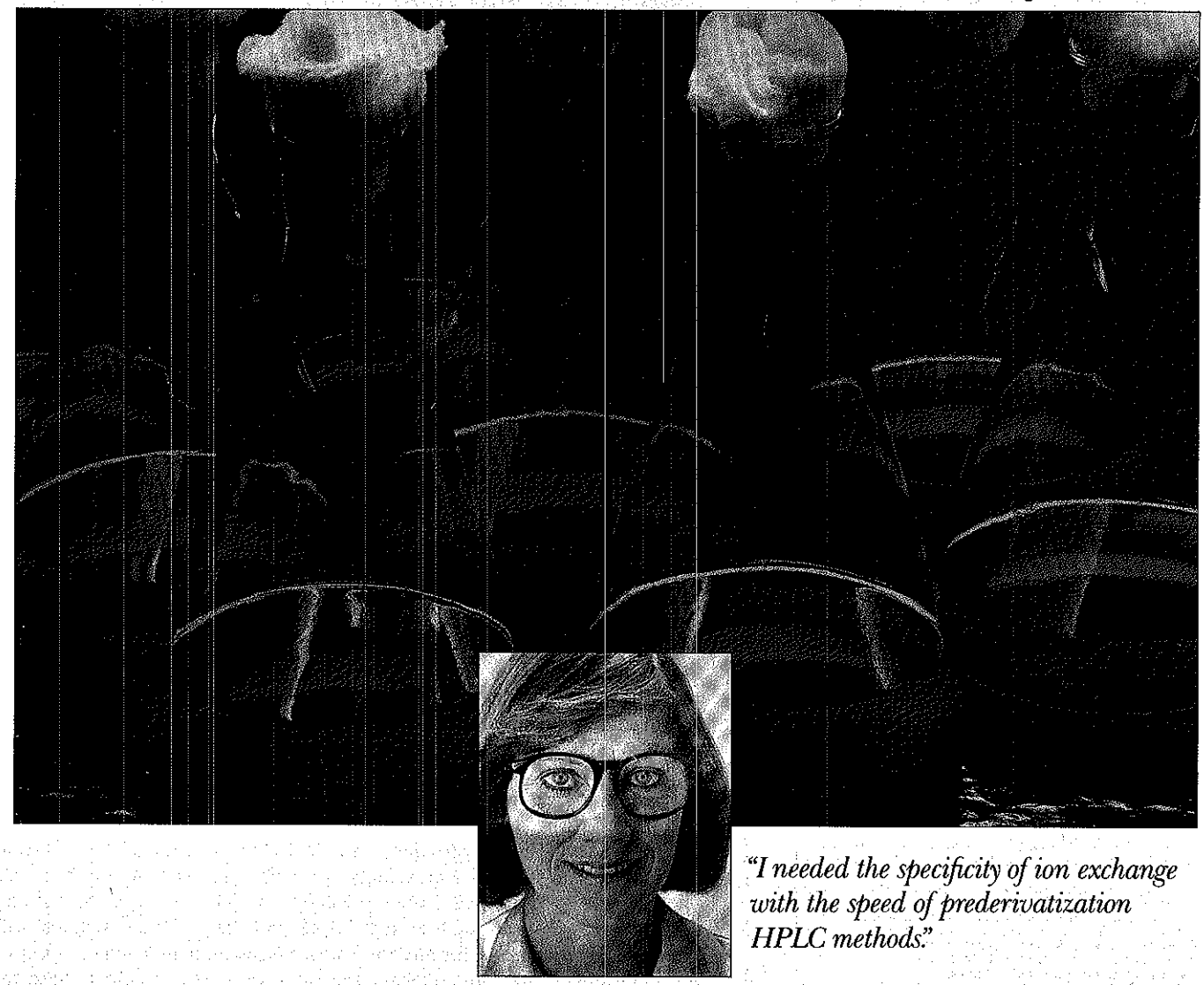
Okimoto thinks that Japan's system of "targeting" special industries for fast development should not be seen as supercompetitive, but as compensation for the lack of venture capital and absence of a military procurement budget. Okimoto predicted that Japan will have to become more innovative, if only to stay ahead of the "new Japans"—Singapore, Taiwan, and South Korea.

Conferences such as this abound in gloomy forecasts. However, despite the air of foreboding, a few speakers conceded that the news for the United States was not all bad. They seemed to agree that the key to American inventiveness—particularly in California's silicon valley—is inventors' access to money. The relaxation of capital gains taxes under Carter in 1978 and again under Reagan in 1981 opened up a trickle that has now become a flood of speculative investment. William Perry, the former chief of R&D in Carter's Defense Department, now an officer of the investment firm of Hambrecht and Quist, said that high-risk capital invested in 1984 amounted to $4 billion.

Foreign manufacturers of high technology are clearly catching up with the Americans, perhaps at an alarming rate for the companies that will feel the heat. But there is every reason to think that new companies are being born in the United States at an equally impressive rate, and that they will bring with them unanticipated technological revolutions.—**ELIOT MARSHALL**

Tales of Chemists:

The Amino Acid Story

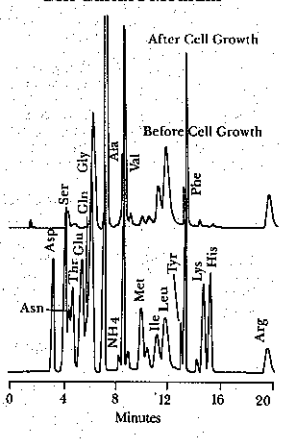


"I needed the specificity of ion exchange with the speed of prederivatization HPLC methods."

"Ion exchange is really specific for analyzing amino acids in complex samples like cell culture media. The problem is that it's just too slow. So I investigated prederivatization HPLC. It was faster, but now I had interferences to contend with. Not to mention all the time I ended up spending on sample preparation.

"The other day I finally discovered the best of both worlds. It's called Dionex. Now I get fast analysis, excellent specificity *and* reproducibility, with precious little sample prep. Most of the time I just dilute, filter, and inject.

"Also, with column switching I can use my Dionex to analyze organic acids, carbohydrates, organic amines, and inorganic ions."



DIONEX
THE ION EXPERTS

P.O. Box 3603, Sunnyvale, CA 94088-3603 (408) 737-0700

Circle No. 170 on Readers' Service Card

Joseph Kraft

Weinberger's One-Liner

"It is a system of destroying weapons rather than people," Cap Weinberger said of the Strategic Defense Initiative, or Star Wars proposal, at a lunch with this columnist and two other journalists on Sept. 4. Thirteen days later, at his press conference of Sept. 17, President Reagan said of SDI: "We're talking about a weapon that won't kill people, it'll kill weapons."

The near repetition testifies to the influence the secretary of defense enjoys with the president. The Pentagon boss has dominated public debate about the upcoming Big Two summit, and cast a dark shadow over its prospects. But analysis of his clout shows how little the Russians have to do if they really want to achieve progress on arms control at the November meeting in Geneva.

A strong personal rapport with Reagan is the starting point for Weinberger. Like the president, the secretary of defense is a man of grace and fluency. Like Reagan, Weinberger has a nice sense of humor, even about himself. At lunch the other day he joked about his "intransigence" and "stubbornness."

Strong powers of articulation enable the defense secretary to make even dubious arguments sound plausible. SDI, for example, is a dangerous enterprise given the context of nuclear stability. If the United States acts to perfect a strong defense, the Russians will counter with steps to improve their offense. To ensure penetration of some offensive missiles, Moscow would have to start things in an all-out attack. Thus, SDI presents the peril of a renewed arms race, and the threat of apocalypse if anything goes wrong.

The claim that the weapons do not kill people is truly irrelevant—a piece of utter sophistry. But it sounds good in a one-liner. And Reagan, perhaps even more than Weinberger, goes for what sounds good in one-liners.

Apart from personal rapport, the secretary of defense carries institutional power. Every previous secretary of defense supported efforts to reach accord with the Russians on limiting nuclear weapons. Some—notably Robert McNamara under Johnson, Mel Laird and James Schlesinger under Nixon and Ford, and Harold Brown under Carter—even forced the pace. Weinberger is the first secretary of defense opposed to arms control in principle.

The Pentagon weight in the country and the world is far greater than often recognized. Even if scheduled cuts in spending take effect, defense outlays will be around $300 billion annually. Well over half the amount spent on research and development in the country comes from the military budget. Virtually every state has a stake in a major weapons system, and big foreign firms are particularly keen to work on SDI, with its potential technological spinoffs. As a former Air Force secretary put it: "The Pentagon can buy off every constituency in the world."

Even that influence has not been decisive, however. For Reagan has repeatedly emphasized the need for achieving a "mix" of the offensive and defensive weapons systems in the arsenals of the Big Two. So have National Security Adviser Robert McFarlane and Secretary of State George Shultz. But the mix concept implies a trade whereby the United States and Russia both advance down the path of missile defense while cutting offensive forces.

Mikhail Gorbachev, the new Soviet leader, has repeatedly hinted at such a deal. Foreign Minister Eduard Shevardnadze took the theme a step further in speaking of "Star Peace" at the United Nations Tuesday.

But the Russians have not done much more than wiggle their eyebrows and nudge people in the ribs. They have not formally asserted how defense might be limited or offensive weapons reduced, or to what levels. That is why the president and Shultz and McFarlane all keep telling the Russians to make the hints official, to fill in the boxes with numbers.

As the summit draws closer, Moscow will almost surely move toward concrete proposals. That is what the private meetings of Shevardnadze with Shultz and Reagan this week are all about.

But probably the Russians will not move far enough to satisfy Reagan that they are dealing in good faith. After all, Moscow must find useful the propaganda gains scored in Western Europe and Japan by the Gorbachev peace offensive. There is even a risk that the Russians will be so mesmerized by the propaganda opportunities as to let genuine arms control progress drop through the cracks.

But the best bet is that the November summit will prevent such a sad outcome. There is every chance Reagan and Gorbachev will dance around the idea of an agreed mix of offensive and defensive missiles. They would then agree to discuss the matter further at a later summit. In the interim, they might also agree to abide by the provisions of the unratified SALT II treaty for another year, even though the treaty expires at the beginning of 1986.

Such an accord would not only assure a whittling down of the Weinberger clout. It would provide a start on arms control and ensure the one thing both leaders clearly want—a successful summit.

Patrick J. Leah

A Count

After years of complacen
and Congress are trying to t
espionage under tighter con
and Congress are both now
U.S. counterintelligence and

Many counterintelligence
directed more at ensuring th
icans with access to secrets
difficult for Soviet KGB offic
Yet the spy problem leads b
tile intelligence agents oper
bassies, consulates, U.N. mi
zations and "press" offices.
policy with teeth must inclu
intelligence agents here, as
ments in U.S. personnel and
practices.

To begin restricting the I
ence, we drafted a bill aime
standing advantage the Sov
their diplomatic and consula
States as compared to the r
cials in Moscow. The Leahy
quires numeric equality, wa
law by President Reagan.

With some 320 diplomat
the United States (not cour
ence at the United Nations
ets overwhelm the FBI by
30 and 40 percent of Sovie
States are thought to be pr
officers. Evading surveillan
freely, meet whomever the
their work of trying to blac
to become traitors.

By contrast, the United
officials in the Soviet Unio
under the constant eye of t
with "spy dust" and irradia
are subject to innumerable
limit their effectiveness as

It was the president's e
Cohen approach in a radio
overcame the resistance o
reaucracy to effectively co
professional establishment
wanted to do as interferen
age U.S. diplomatic relatio

In offering the bill, we p
two approaches to attainin
resentation. One way wou
ber of Americans serving i
miserable conditions, how
limits on how many could

Miller Aides Follow Him To OMB

Former Federal Trade Commission Chairman **James C. Miller III** was sworn in yesterday as the new director of the **Office of Management and Budget,** where he'll be working with three former FTC bureau directors and its general counsel.

The day before, President Reagan named FTC Commissioner **Terry Calvani** as acting FTC chairman until a successor to Miller is nominated and confirmed. Calvani, 38, a former law professor at Vanderbilt University and a member of the commission for almost two years, moved quickly to fill some of the vacant slots:

- **Timothy J. Muris,** who had directed the FTC's **Bureau of Competition,** becomes executive associate director of OMB, while **Walter T. Winslow,** the bureau's deputy director, becomes acting director. Muris worked at OMB as an assistant to Miller when Miller was head of OMB's **Office of Information and Regulatory Affairs.**
- **Carol T. Crawford,** who headed the FTC's **Bureau of Consumer Protection,** becomes associate director of OMB for economics and government. **Amanda Pedersen,** the bureau's deputy director, becomes acting director.
- **Wendy Lee Gramm,** who directed the Bureau of Economics, takes over Miller's old job as administrator of the regulatory affairs office. **David T. Scheffman,** deputy director of the bureau, will serve as acting director.
- Former FTC general counsel **John H. Carley** becomes counselor to the OMB director. **Mary Tiffany,** executive assistant to the chairman, becomes acting general counsel.
- **Jeffrey A. Eisenach,** formerly special adviser to the FTC chairman for economic policy and operations, becomes executive assistant to the OMB director.

Karen Johnston, the FTC's director of congressional relations, is also leaving the FTC, but not joining the exodus to OMB. Johnston plans to leave Washington at the end of the month to work on the campaign of Rep. **James T. Broyhill** (R-N.C.) for the North Carolina Senate seat of Republican **John P. East.** She will be working alongside her husband, former Rep. **Eugene Johnston** (R-N.C.), who will serve as Broyhill's finance chairman.

Johnston previously had said she would stay on until Congress passed a bill reauthorizing the FTC, but she said yesterday that the bill is not expected to pass before her departure Nov. 1. But a House-Senate conference is expected before the end of the month, she said, and a final bill is expected to pass by the end of the congressional session.

Calvani has named one of his attorney advisers, **Randolf W. Tritell,** to serve as his executive assistant. Calvani also named three special assistants: **Neil W. Averitt,** former attorney adviser to former Commissioner **George W. Douglas** and former special assistant to Miller; **Donald S. Clark,** a former attorney adviser to Douglas; and **Cynthia E. Smith,** an attorney from the agency's Atlanta regional office.

JAMES A. PARCELL—THE WASHINGTON POST

As wife Demaris holds Bible, Miller is sworn in as OMB chief by Vice President Bush; President Reagan looks on.

Calvani's appointment may be a sign that the White House will not move quickly to nominate replacements for Miller and Douglas, a conservative Democrat who left the commission last month to return to Texas.

The president is expected to nominate **Agriculture Department** general counsel **Daniel Oliver** and Kenneth Elzinga, a University of Virginia economics professor, to fill the seats of Miller and Douglas, respectively.

Oliver, a Republican, also served as general counsel of the **Education Department** and is a former executive editor of National Review, as well as a former director of the American Conservative Union Inc. Elzinga, an independent, is an antitrust expert who writes mystery novels on the side. From 1970-71, he served as special economic adviser to the assistant attorney general for antitrust and from 1971-79 as a member of the **Nuclear Regulatory Commission's Atomic Safety and Licensing Board Panel.**

Although agency and congressional sources say the administration is close to a decision, Crawford, Muris and Gramm have also been mentioned as possible nominees.

=

WAITING GAME . . . Rep. **James J. Florio** (D-N.J.), chairman of the House Energy and Commerce subcommittee on commerce, transportation and tourism, is still waiting for answers from the FTC to his questions about Gulf Corp.'s divestiture of certain assets in the Southeast.

In a Sept. 4 letter, Florio asked the agency to respond to complaints from gasoline retailers about the FTC's review of its consent agreement approving Chevron Corp's $13.2 billion takeover of Gulf. The agreement required the divestiture of 4,000 gas stations, including "the Gulf brand name and trademark." The retailers have complained that despite that, the FTC later approved the sale of Gulf stations that had only a temporary license to the Gulf trademarks. Florio requested a reply by Oct. 4, but his staff said yesterday that he has not yet received one.

—Nell Henderson

Spatially Regulated Expression of Homeotic Genes in *Drosophila*

Katherine Harding, Cathy Wedeen
William McGinnis, Michael Levine

Abstract. *The sites of transcript accumulation for six different homeotic loci of the Antennapedia and bithorax gene complexes (ANT-C and BX-C) were identified within embryo tissue sections by in situ hybridization. These six loci belong to the Antennapedia class of the homeo box gene family. Transcripts encoded by each locus are detected primarily in discrete, nonoverlapping regions of the embryonic central nervous system (CNS). The regions of the CNS that contain transcripts encoded by each of these loci correspond to the embryonic segments that are disrupted in mutants for these genes. The maintenance of spatially restricted expression of each ANT-C and BX-C locus could involve hierarchical, cross-regulatory interactions that are mediated by the homeo box protein domains encoded by these genes.*

A fundamental problem of development is how embryonic cells acquire their particular developmental fates as a result of their location within a developing embryo. A model system for analyzing the elaboration of this positional information during *Drosophila* development involves the morphogenesis of body segments. The adult fruit fly is composed of eight abdominal, three thoracic, and four to six head segments (*1*). Several of the constituent tissues of a given segment have morphological properties specific for that segment. For example, the epidermis elaborates cuticular structures, such as legs and antennae, that are distinct for a particular segment. In addition, the morphology of some of the mesodermal (*2*) and neural tissues (*3, 4*) may be specific for a given segment.

Homeotic genes are those that establish the diverse pathways by which each embryonic segment primordium develops a distinct adult phenotype (*5, 6*). Mutations of homeotic loci result in partial or complete transformations of the epidermal tissues of one segment into those of another. Homeotic transformations may include the neural and mesodermal tissues of the affected segment as well (*2, 3, 7*). For example, embryos that lack the *Antennapedia* (*Antp*) gene function display a transformation of the meso- and metathorax (T2 + T3) into homologous tissues of the prothorax (T1) (*8*).

Many homeotic genes appear within one of two clusters in the *Drosophila* genome, the bithorax complex (BX-C) (*5, 9*) or the Antennapedia complex (ANT-C) (*10, 11*). Genes of the BX-C are required for the specification of segments in the posterior regions of the fly (*5, 12, 13*). Lewis has identified a number of homeotic loci within the BX-C on the basis of embryonic and adult mutant phenotypes (*5*). Recently, a minimum of three essential domains of homeotic function within the BX-C have been identified by means of lethal complementation analyses: *Ultrabithorax (Ubx), Abdominal-A (abd-A), and Abdominal-B(Abd-B)* (*9*). The ANT-C is required for the specification of anterior body segments (*8, 14*). Several homeotic lethal complementation groups have been identified for the ANT-C (*8, 11, 14, 15*). These include the *Antp, Sex combs reduced (Scr), and Deformed* (*Dfd*) loci. Each ANT-C and BX-C homeotic lethal complementation group controls the development of a different subset of the embryonic segment primordia (Fig. 1a).

K. Harding, C. Wedeen, and M. Levine are in the Department of Biological Sciences, Fairchild Center, Columbia University, New York 10027. W. McGinnis is in the Department of Molecular Biophysics and Biochemistry, Yale University, New Haven, Connecticut 06520.

A central problem in elucidating the genetic control of segment morphogenesis is how the different ANT-C and BX-C loci come to function in primarily nonoverlapping domains along the body axis of the fly. The molecular cloning of ANT-C and BX-C loci has permitted a direct assessment of the spatial and temporal limits of homeotic gene expression. The previous demonstration that *Ubx* and *Antp* share direct nucleotide sequence homology (*16-19*) facilitated the isolation of ANT-C and BX-C loci. This homology occurs within a conserved protein coding region designated the homeo box. A total of seven genomic DNA fragments cross-hybridizes strongly with the *Antp* and *Ubx* homeo boxes (*20*). These seven regions correspond to the Antennapedia class of the homeo box gene family, all of which are located within either the ANT-C or the BX-C (*20*). It appears that each of the six lethal complementation groups of the ANT-C and BX-C (Fig. 1) contains an Antennapedia class homeo box. However, there are additional homeotic loci within the BX-C that do not contain the homeo box (Fig. 1a) (*21*).

We show that each of the ANT-C and BX-C homeotic loci that contains a homeo box specifies transcripts that accumulate in discrete regions of the embryonic central nervous system (CNS). To a close approximation, the regions of the CNS that contain transcripts encoded by each of these loci correspond to the embryonic segments that are disrupted in mutants for these genes. We propose that spatially restricted expression of each ANT-C and BX-C locus involves hierarchical, cross-regulatory interactions that are mediated by the homeo box protein domains encoded by these genes. Support for this model is based on analysis of the distribution patterns of *Antp* transcripts in mutant embryos that lack BX-C loci.

Isolation of a new ANT-C homeo box locus. Molecular clones for the *Dfd, Antp, Ubx, iab-2*, and *iab-7* loci have been previously isolated (*16, 20, 22–25*). In order to determine the spatial limits of expression for each homeotic lethal complementation group within the ANT-C and BX-C by in situ hybridization, it was necessary to obtain a molecular probe for the *Scr* locus. A genomic DNA fragment that appears to derive from *Scr* was isolated on the basis of homeo box sequence homology as described below.

A total of 6×10^4 recombinants from a *Drosophila*–Charon 4 DNA library (approximately six genome equivalents) were screened with the homeo box se-

differ is in the type and amount of government support for the development of biotechnology. In Japan there is a clear effort by government to enhance the future commercial success of the pharmaceutical industry by assisting in the development of biotechnology. Although this support is administered by a few different agencies and is small in size (by U.S. standards), it is viewed both externally (*2, 25*) and internally (*16*) as a single cohesive effort with a high potential for success. The companies involved must create their own basic research and development programs; government assistance is at the next level, helping to foster commercialization of products, manufacturing, and generic support, such as gene banks (*18*). In the United States, federal support for biotechnology is ten times greater in magnitude and is aimed at basic research. Although support of basic research programs in biotechnology should be continued and expanded to ensure maintained leadership in basic research, support for more applied areas is also needed (*2, 16*).

Another contrast between the two countries is in the availability of basic researchers in biotechnology and bioprocess engineering. There was a reported shortage in the United States of basic researchers trained in genetic engineering, but this problem appears to have abated (*2, 30*). Due to strong academic programs in this and related areas, the availability of basic researchers should continue to be sufficient (*2*). However, a paucity of academic programs in bioprocess engineering continues (*2*). As more companies generate products of biotechnology for scale-up, it is expected that there will be a severe shortage of personnel trained in production technologies, which may hamper commercial success (*2*). Japan has the opposite problem—an adequate supply of fermentation engineers but too few basic researchers with training in molecular genetics (*16*). This is another reason why Japanese companies have been borrowing U.S. basic research, but are predicted to outpace the United States in commercialization (*2, 3*).

Outlook

In January 1984 the U.S. Congress Office of Technology Assessment (OTA) published a 612-page analysis on commercial biotechnology (*2*). The report noted the importance of biotechnology both for its basic scientific benefit and for its potential commercial development. In assessing the competitive position for the United States, the OTA report stated the following (*2*, p. 7):

> Japan is likely to be the leading competitor of the United States for two reasons. First, Japanese companies in a broad range of industrial sectors have extensive experience in bioprocess technology. Japan does not have superior bioprocess technology, but it does have relatively more industrial experience using old biotechnology, more established bioprocessing plants, and more bioprocess engineers than the United States. Second, the Japanese Government has targeted biotechnology as a key technology of the future, is funding its commercial development, and is coordinating interactions among representatives from industry, universities, and government.

When the focus of analysis is narrowed to the pharmaceutical industry, it can also be concluded that the Japanese have the potential to be a leading competitor. An important factor in their success has been the borrowing of basic biotechnological research by Japanese companies from U.S. biotechnology firms. Although biotechnology licensed by U.S. firms to Japanese companies generally involves marketing rights in Japan or Asia (*2*), the Japanese market for pharmaceuticals is the second largest in the world. When added to other Asian markets, it becomes two-thirds the size of the North American or European markets (*9*). U.S. pharmaceutical companies have gained 40 percent of their revenues from foreign sales, and the loss of a foreign market may represent lost income (*9*).

In addition to basic biotechnology borrowed from the United States, Japan has been simultaneously building its own strength in this field. There are more and more frequent reports of new developments in basic biotechnology and discoveries of new drugs from Japanese industrial laboratories (Table 3) (*12*). It is thus possible that Japan's predicted future strength in pharmaceutical biotechnology will come both from internal developments and strategic government programs (*16*).

This is not to imply that with Japanese strength in biotechnology will come U.S. weakness in this area. As stated earlier, pharmaceutical and other companies in the United States are expanding their efforts in biotechnology and are nearing their goals of bringing new therapeutics and diagnostics to market. However, an analysis of Japanese strategies may help to understand how U.S. industry can optimize this process. In addition, U.S. industry will be strengthened if the U.S. government makes the commercialization of biotechnology a high priority and funds specific academic and other programs leading to that goal (*2*). As stated in the OTA report (*2*): "The United States may compete very favorably with Japan if it can direct more attention to research problems associated with the scaling-up of bioprocesses for production."

In addition, government activities that enhance cooperation between companies, decrease regulation, or provide centers to assist in biotechnology would help meet this goal (*2, 6, 31*). However, in the period since the OTA report was made public, no broad program of support to strengthen the U.S. position in biotechnology has been announced by the federal government.

Steps in the Right Direction

A few recent developments should prove useful to the future development of biotechnology in the United States. The first is the opening of biotechnology centers to assist in the transfer of biotechnology expertise from academia to industry. Two of these centers are at Pennsylvania State University and in Research Triangle Park, North Carolina. The Penn State Biotechnology Institute has planned research and educational facilities and will allow member companies access to "application-oriented research" and to a pilot production facility for assistance in scale-up (*32*).

The North Carolina Biotechnology Center currently receives $2.5 million in annual funding from state, federal, and industrial sources. The center funds specific programs, such as its Monoclonal Lymphocyte Technology Center, which involves academic research at the University of North Carolina and Duke University, the participation of industry, and funding by the National Science Foundation. The five industrial members agree on priorities for directed research to be funded by specific grants to participating laboratories. Although still in its infancy, the Monoclonal Lymphocyte Technology Center is fostering cooperation between companies in a university environment that probably would not have otherwise occurred (*33*).

The Center for Advanced Research in Biotechnology (CARB), to be built in Gaithersburg, Maryland, will combine federal, state, county, and university efforts (*34*). With CARB, the National Bureau of Standards will add its analytical expertise to molecular biology expertise from the University of Maryland. A CARB research facility to be completed

Table 2. Equity purchased in firms with a major focus on biotechnology. Equity purchases selected from database (*12*).

Large company (purchaser)	Biotechnology firm	Year
Purchased by U.S. pharmaceutical companies		
Abbott	Amgen	1980
Baxter Travenol	Genetics Institute	1982
Becton Dickenson	Applied Biosystems	1984
Johnson & Johnson	Enzo Biochem	1982
Lederle	Molecular Genetics	1981
Lederle	Cytogen	1983
Lilly	Synergen	1984
Schering-Plough	Biogen	1982
Schering-Plough	DNAX Ltd.*	1982
SmithKline	Beckman*	1982
Syntex	Genetic Systems	1982
Purchased by other U.S. companies		
Dow	Collaborative Research	1981
Du Pont	New England Nuclear*	1981
Fluor	Genentech	1981
W. R. Grace	Amicon*	1983
Martin Marietta	Molecular Genetics	1982
Monsanto	Biogen	1980
Monsanto	Collagen Corporation	1980
Purchased by Japanese companies		
Green Cross	Collaborative Research	1981
Mitsubishi	BioVec	1984

*Acquisition. Each nonacquisition purchase involved an average of $8 million.

Table 3. Comparison of U.S. and Japanese pharmaceutical industries and involvement in biotechnology. All 1983 data, except as noted. [Sources: (*1*, *2*, *9*, *15*)]

Data category	United States	Japan
Population (millions)	234.5	119.2
Gross national product	$3.3 trillion	$1.2 trillion
Domestic pharmaceutical market (world rank)	$21.3 billion (1)	$13.4 billion (2)
Number of pharmaceutical companies with sales over $1 billion*	11	1
Total pharmaceutical sales of ten largest pharmaceutical companies†	$16.7 billion	$6 billion
Pharmaceutical sales as percent of total sales‡	50.1	74.1
Number of new pharmaceutical products introduced:		
1961–1980	353	155
1981–1983	24	41
R&D expenditures as percent of sales‡	6.8	9.2
Scientists and engineers in industrial R&D§:		
Total number	573,900	272,000
Percent of work force	0.58	0.50
Government-funded research in biotechnology:		
Total	$520 million	$60 million
Percent of basic research	>98	<50
Targets of funding in biotechnology	Basic research	Basic research, scale-up, industrial projects, government laboratory facilities, manufacturing technology

*Pharmaceutical sales only. †Total world pharmaceutical sales in 1983 were approximately $60 billion. ‡Average of top ten companies. §All industries, 1977 data.

the Ministry of Agriculture, Forestry and Fisheries (MAFF) (*2*, *18*). The total government support for biotechnology, $50 million to $60 million in 1984, is only about one-tenth of that spent by the U.S. government (Table 3) (*2*, *18*), but Japanese funding is much more focused on specific projects. For example, MITI, in a 10-year strategic program beginning in 1981, has targeted next-generation technologies to foster scale-up techniques, aimed at assisting in the commercialization of biotechnology (*2*). The STA is also funding applied research, such as the development of bioreactors (*2*). The latest announced budgets of STA, MAFF, and MITI are emphasizing national centers related to biotechnology research, including the development of cell line and gene banks (*18*). Very little of the Japanese government's support for biotechnology is for basic research (*2*). In contrast, the U.S. government's support of biotechnology is almost ten times more, but support of applied research makes up only 1 to 2 percent of this total, with far less specificity than in Japan (Table 3) (*2*).

Another emphasis in Japan is to foster cooperation between companies and between industry and academia. There are more than a dozen joint ventures on record involving two or more Japanese companies that are aimed at developing therapeutics through research in biotechnology (*2*, *19*). Similar cooperation between large U.S. companies does not (or cannot) exist (*2*).

In order to further foster cooperation between Japanese companies, a trade association, tentatively called the Society for Advanced Pharmaceutical Research, was formed in 1985 with 31 member companies and the support of Japan's Ministry of Health and Welfare (*19*). A trade group, the Industrial Biotechnology Association, exists in the United States with 46 member companies, but is not supported by the federal government (*20*).

Because government funding in Japan is focused on applied research, Japanese companies are also in the process of expanding in-house expertise in basic research and development in biotechnology. Many companies have announced the expansion of research facilities, such as Sankyo's new $53-million biotechnology laboratory to be completed by 1986 (*21*). The availability of personnel to staff basic research laboratories in Japan has been a problem, primarily owing to a paucity of university programs in molecular genetics (*2*, *16*). To fill the need for researchers, some Japanese companies

25. A. C. Olson and R. A. Korus, in *Enzymes in Food and Beverage Processing*, R. L. Ory and A. J. St. Angelo, Eds. (American Chemical Society, Washington, D.C., 1977), pp. 100–131; A. Kilara and K. M. Shahan, *CRC Crit. Rev. Food Sci. Nutr.* **10**, 161 (1979); H. O. Hultin, *Food Technol.* **37** (No. 10), 66 (1983).
26. M. L. Shuler, O. P. Sahai, G. A. Hallsby, in *Biochemical Engineering III*, K. Venkatsubramanian, A. Constantinides, W. R. Vieth, Eds. (New York Academy of Sciences, New York, 1983), pp. 373–382; S. M. Miazga and D. Knorr, paper presented at the 1984 International Congress of Pacific Basin Societies, Honolulu, December 1984.
27. J. E. Prenosil and H. Pedersen, *Enzyme Microbiol. Technol.* **5**, 323 (1983); P. Brodelius and K. Nilsson, *Eur. J. Appl. Microbiol. Biotechnol.* **17**, 275 (1983).
28. B. Wasserman, *Food Technol.* **38** (No. 2), 78 (1984).
29. A. M. Klibanov, *Science* **219**, 722 (1983); W. Carasik and J. O. Carroll, *Food Technol.* **37** (10), 85 (1983).
30. D. N. Bull, R. W. Thoma, and T. E. Stinnet, *Adv. Biotechnol. Process* **1**, 1 (1985); E. Bjurstrom, *Chem. Eng.* **92**, 126 (1984); B. C. Buckland, *Bio/Technology* **2**, 875 (1984).
31. C. L. Cooney, *Science* **219**, 728 (1983).
32. M. L. Shuler, J. W. Pyne, G. A. Hallsby, *J. Am. Oil Chem. Soc.*, **61**, 1724 (1984); M. W. Glacken, R. J. Fleischaker, A. J. Sinskey, in *Biochemical Engineering III*, K. Venkatsubramanian, A. Constantinides, W. R. Vieth, Eds. (New York Academy of Sciences, New York, 1983), pp. 355–372; W. E. Goldstein, *ibid.*, pp. 394–408.
33. D. N. Bull, *Bio/Technology* **1**, 847 (1983); H. R. Lerner, D. Ben-Bassat, L. Reinhold, A. Poljokoff-Mayber, *Plant Physiol.* **61**, 213 (1978); J. Feder and W. R. Tolbert, *Am. Biotechnol. Lab.* **3**(1), 24 (1985); P. Brodelius and K. Nilsson, *Eur. J. Appl. Microbiol. Biotechnol.* **17**, 275 (1983).
34. M. W. Fowler, in *Plant Biotechnology*, S. M. Mantell and H. S. Smith, Eds. (Cambridge Univ. Press, Cambridge, 1983), pp. 3–37; P. Hedman, *Am. Biotech. Lab.* **2** (No. 3), 29 (1984); O. Sahai and M. Knuth, *Biotechnol. Prog.* **1**, 1 (1985).
35. B. H. Kirsop, *Chem. Ind.* **7**, 218 (1981); J. W. Lee and A. Lopez, *CRC Crit. Rev. Food Sci. Nutr.* **21**, 289 (1984); K. M. Ulmer, *Science* **219**, 666 (1983).
36. B. Wolnak, in *Enzymes*, J. P. Danehy and B. Wolnak, Eds. (Dekker, New York, 1980), pp. 3–10; S. Hasegawa, U.S. Patent 4,447,456 (8 May 1984).
37. R. Aneja, *J. Am. Oil Chem. Soc.* **61**, 661 (1984); A. H. Rose, *Sci. Am.* **245**, 127 (September 1981); J. B. M. Rattray, *J. Am. Oil Chem. Soc.* **61**, 1701 (1984); D. L. Gierhart, U.S. Patents 4,485,172 and 4,485,173 (27 November 1984).
38. B. Jarvis and K. Paulus, *J. Chem. Techn. Biotechnol.* **32**, 233 (1982); L. R. Beuchat, *Food Technol.* **34** (No. 6), 65 (1984); D. Tuse, *CRC Crit. Rev. Food Sci. Nutr.* **19**, 273 (1983); S. Matz, *Sci. Am.* **251**, 123 (November 1984).
39. F. L. Davies and M. J. Casson, *J. Dairy Res.* **48**, 363 (1981); L. McKay, *Antonie van Leeuwenhoek*, **49**, 259 (1983); C. A. Batt and A. J. Sinskey, paper presented at the Symposium on the Importance of Lactic Acid Fermentation, Mexico City, December 1984; A. R. Huggins, *Food Technol.* **38** (No. 6), 41 (1984).
40. A. Kramer and B. A. Twigg, *Quality Control for the Food Industry* (AVI, Westport, Conn., 1970); R. D. Middlekauff, *Food Technol.* **38** (No. 10), 97 (1984); Y. Pomeranz and C. E. Meloan, *Food Analysis: Theory and Practice* (AVI, Westport, Conn., 1978).
41. R. L. Gatz, B. A. Young, T. J. Facklam, and D. A. Scantland, *Bio/Technology* **1**, 337 (1983).
42. H. J. Neujahr, in *Biotechnology and Genetic Engineering Reviews*, G. E. Russell, Ed., (Intercept, Newcastle-upon-Tyne, 1984), vol. 1, pp. 167–186; N. Smit and G. A. Rechnitz, *Biotechnol. Lett.* **6**, 209 (1984).
43. R. Dagani, *Chem. Eng. News* **62** (No. 46), 25 (1984).
44. E. L. Korwek, *Food Drug Cosmetic Law J.* **37**, 289 (1982); D. D. Jones, *Food Technol.* **39** (No. 6), 59 (1985).
45. H. Hemfort and W. Kohlstette, *Starch* **36**, 109 (1984); V. Wiesboden and H. Binder, in *Advances in Biochemical Engineering*, A. Fiechter, Ed. (Springer Verlag, Berlin, 1982), pp. 120–171.
46. W. A. Bough, *Process Biochem.* **11** (No. 1), 13 (1976); P. R. Austin, C. J. Brine, J. E. Castle, J. P. Zikakis, *Science* **212**, 749 (1981); S. Latlief and D. Knorr, *J. Food Sci.* **48**, 1587 (1983).
47. M. R. Kula, K. H. Kroner, H. Hustedt, in *Advances in Biochemical Engineering*, A. Fiechter, Ed. (Springer Verlag, Berlin, 1982), pp. 73–118.
48. E. Stahl and K. W. Quirin, *Naturwissenschaften* **71**, 181 (1984); L. G. Randall, *Separation Sci. Technol.* **17**, 1 (1982).
49. E. Stahl, E. Schütz, H. K. Mangold, *J. Agric. Food Chem.* **28**, 1153 (1980); J. P. Friedrich and E. H. Pryde, *J. Am. Oil Chem. Soc.* **61**, 223 (1984); H. J. Gährs, *ZFL Int. J. Food Technol. Food Process. Eng.* **35**, 302 (1984).
50. J. L. Dwyer, *Bio/Technology* **2**, 957 (1984).
51. P. D. Fullbrook, *J. Am. Oil Chem. Soc.* **60**, 476 (1983).
52. H. Ruttloff, J. Huber, F. Zicker, K. Mangold, *Industrielle Enzyme* (VEB, Leipzig, 1983).
53. W. Hartmeier, *Process. Biochem.* Feb. 40 (1984); B. Dixon, *Biotechnology* **2**, 594 (1984); D. Knorr, S. M. Miazga, R. A. Teutonico, *Food Technol.*, in press.
54. C. V. Morr, *Food Technol.* **38** (No. 6), 39 (1984).
55. R. R. Zall, in *Food Processing Waste Management*, J. H. Green and A. Kramer, Eds. (AVI, Westport, Conn., 1979), pp. 175–201.
56. D. Knorr, *J. Food Technol.* **12**, 563 (1977); F. Holm and S. Eriksen, *ibid.* **15**, 71 (1980); D. Knorr, *Food Technol.* **37** (No. 2), 71 (1983); J. R. Rosenau, L. F. Whitney, J. R. Haight, *ibid.* **32** (No. 6), 37 (1978).
57. R. S. Tutunjian, in *Biochemical Engineering III*, K. Venkatsubramanian, A. Constantinides, W. R. Vieth, Eds. (New York Academy of Sciences, New York, 1983), pp. 238–253; P. Jelen, *Agric. Food Chem.* **27**, 658 (1979).
58. G. G. Birch, K. J. Parker, J. T. Worgan, *Food From Waste* (Applied Sciences, London, 1976); J. H. Green and A. Kramer, *Food Processing Waste Management* (AVI, Westport, Conn., 1980); M. W. M. Bewick, *Handbook of Organic Waste Conversion* (Van Nostrand Reinhold, New York, 1980); D. Knorr, in *Sustainable Food Systems*, D. Knorr, Ed. (AVI, Westport, Conn., 1983), pp. 249–78.
59. D. Knorr, *Food Technol.* **38** (No. 1), 85 (1984); D. Rodriquez-Sanchez and C. Rha, *J. Food Technol.* **16**, 469 (1981); K. D. Vorlop and J. Klein, *Biotechnol. Letters.* **3** (No. 1), 9 (1981).
60. S. Revah-Moiseev and A. Carroad, *Biotechnol. Bioeng.* **23**, 1067 (1981); I. G. Casio, R. A. Fisher, P. A. Carroad, *J. Food Sci.* **47**, 901 (1982); J. Zikakis, Ed., *Chitin, Chitosan and Related Enzymes* (Academic Press, Orlando, Fla., 1984); papers presented at the Third International Conference on Chitin/Chitosan, Senigellia, Italy, 1 to 4 April 1985; R. L. Rawin, *Chem. Eng. News* **62** (No. 20), 42 (1984).
61. H. Skogman, in *Food From Waste*, G. G. Birch, K. J. Parker, J. T. Worgan, Eds. (Applied Science, London, 1976), pp. 167–179; Z. G. Moulin and P. Galzi, in *Biotechnology and Genetic Engineering Reviews*, G. E. Russell, Ed. (Intercept, Newcastle-upon-Tyne, 1984), pp. 347–374.
62. D. L. Wise, Ed., *Fuel Gas Development* (CRC Press, Boca Raton, Fla., 1984); D. A. Stafford *et al.*, *Methane Production from Waste Organic Matter* (CRC Press, Boca Raton, Fla., 1984).
63. Institute of Food Technologists (IFT) Workshop on Research Needs, Arlington Heights, Ill., 11 to 14 November 1984; B. J. Liska and W. W. Marion, *Food Technol.* **39** (No. 6), 81 (1985).

64. We thank the participants of the biotechnology topic at the IFT workshop on research needs, especially A. J. Stevens. Valuable comments on drafts of this article were provided by S. P. Shoemaker, M. J. Haas, K. Venkat, P. M. Walsh, and D. Kukich.

Spatially Regulated Expression of Homeotic Genes in *Drosophila*

Katherine Harding, Cathy Wedeen
William McGinnis, Michael Levine

Abstract. *The sites of transcript accumulation for six different homeotic loci of the Antennapedia and bithorax gene complexes (ANT-C and BX-C) were identified within embryo tissue sections by in situ hybridization. These six loci belong to the Antennapedia class of the homeo box gene family. Transcripts encoded by each locus are detected primarily in discrete, nonoverlapping regions of the embryonic central nervous system (CNS). The regions of the CNS that contain transcripts encoded by each of these loci correspond to the embryonic segments that are disrupted in mutants for these genes. The maintenance of spatially restricted expression of each ANT-C and BX-C locus could involve hierarchical, cross-regulatory interactions that are mediated by the homeo box protein domains encoded by these genes.*

A fundamental problem of development is how embryonic cells acquire their particular developmental fates as a result of their location within a developing embryo. A model system for analyzing the elaboration of this positional information during *Drosophila* development involves the morphogenesis of body segments. The adult fruit fly is composed of eight abdominal, three thoracic, and four to six head segments (*1*). Several of the constituent tissues of a given segment have morphological properties specific for that segment. For example, the epidermis elaborates cuticular structures, such as legs and antennae, that are distinct for a particular segment. In addition, the morphology of some of the mesodermal (*2*) and neural tissues (*3, 4*) may be specific for a given segment.

Homeotic genes are those that establish the diverse pathways by which each embryonic segment primordium develops a distinct adult phenotype (*5, 6*). Mutations of homeotic loci result in partial or complete transformations of the epidermal tissues of one segment into those of another. Homeotic transformations may include the neural and mesodermal tissues of the affected segment as well (*2, 3, 7*). For example, embryos that lack the *Antennapedia* (*Antp*) gene function display a transformation of the meso- and metathorax (T2 + T3) into homologous tissues of the prothorax (T1) (*8*).

Many homeotic genes appear within one of two clusters in the *Drosophila* genome, the bithorax complex (BX-C) (*5, 9*) or the Antennapedia complex (ANT-C) (*10, 11*). Genes of the BX-C are required for the specification of segments in the posterior regions of the fly (*5, 12, 13*). Lewis has identified a number of homeotic loci within the BX-C on the basis of embryonic and adult mutant phenotypes (*5*). Recently, a minimum of three essential domains of homeotic function within the BX-C have been identified by means of lethal complementation analyses: *Ultrabithorax (Ubx), Abdominal-A (abd-A), and Abdominal-B(Abd-B)* (*9*). The ANT-C is required for the specification of anterior body segments (*8, 14*). Several homeotic lethal complementation groups have been identified for the ANT-C (*8, 11, 14, 15*). These include the *Antp, Sex combs reduced (Scr), and Deformed* (*Dfd*) loci. Each ANT-C and BX-C homeotic lethal complementation group controls the development of a different subset of the embryonic segment primordia (Fig. 1a).

A central problem in elucidating the genetic control of segment morphogenesis is how the different ANT-C and BX-C loci come to function in primarily nonoverlapping domains along the body axis of the fly. The molecular cloning of ANT-C and BX-C loci has permitted a direct assessment of the spatial and temporal limits of homeotic gene expression. The previous demonstration that *Ubx* and *Antp* share direct nucleotide sequence homology (*16-19*) facilitated the isolation of ANT-C and BX-C loci. This homology occurs within a conserved protein coding region designated the homeo box. A total of seven genomic DNA fragments cross-hybridizes strongly with the *Antp* and *Ubx* homeo boxes (*20*). These seven regions correspond to the Antennapedia class of the homeo box gene family, all of which are located within either the ANT-C or the BX-C (*20*). It appears that each of the six lethal complementation groups of the ANT-C and BX-C (Fig. 1) contains an Antennapedia class homeo box. However, there are additional homeotic loci within the BX-C that do not contain the homeo box (Fig. 1a) (*21*).

We show that each of the ANT-C and BX-C homeotic loci that contains a homeo box specifies transcripts that accumulate in discrete regions of the embryonic central nervous system (CNS). To a close approximation, the regions of the CNS that contain transcripts encoded by each of these loci correspond to the embryonic segments that are disrupted in mutants for these genes. We propose that spatially restricted expression of each ANT-C and BX-C locus involves hierarchical, cross-regulatory interactions that are mediated by the homeo box protein domains encoded by these genes. Support for this model is based on analysis of the distribution patterns of *Antp* transcripts in mutant embryos that lack BX-C loci.

Isolation of a new ANT-C homeo box locus. Molecular clones for the *Dfd, Antp, Ubx, iab-2,* and *iab-7* loci have been previously isolated (*16, 20, 22–25*). In order to determine the spatial limits of expression for each homeotic lethal complementation group within the ANT-C and BX-C by in situ hybridization, it was necessary to obtain a molecular probe for the *Scr* locus. A genomic DNA fragment that appears to derive from *Scr* was isolated on the basis of homeo box sequence homology as described below.

A total of 6×10^4 recombinants from a *Drosophila*–Charon 4 DNA library (approximately six genome equivalents) were screened with the homeo box se-

K. Harding, C. Wedeen, and M. Levine are in the Department of Biological Sciences, Fairchild Center, Columbia University, New York 10027. W. McGinnis is in the Department of Molecular Biophysics and Biochemistry, Yale University, New Haven, Connecticut 06520.

differ is in the type and amount of government support for the development of biotechnology. In Japan there is a clear effort by government to enhance the future commercial success of the pharmaceutical industry by assisting in the development of biotechnology. Although this support is administered by a few different agencies and is small in size (by U.S. standards), it is viewed both externally (*2*, *25*) and internally (*16*) as a single cohesive effort with a high potential for success. The companies involved must create their own basic research and development programs; government assistance is at the next level, helping to foster commercialization of products, manufacturing, and generic support, such as gene banks (*18*). In the United States, federal support for biotechnology is ten times greater in magnitude and is aimed at basic research. Although support of basic research programs in biotechnology should be continued and expanded to ensure maintained leadership in basic research, support for more applied areas is also needed (*2*, *16*).

Another contrast between the two countries is in the availability of basic researchers in biotechnology and bioprocess engineering. There was a reported shortage in the United States of basic researchers trained in genetic engineering, but this problem appears to have abated (*2*, *30*). Due to strong academic programs in this and related areas, the availability of basic researchers should continue to be sufficient (*2*). However, a paucity of academic programs in bioprocess engineering continues (*2*). As more companies generate products of biotechnology for scale-up, it is expected that there will be a severe shortage of personnel trained in production technologies, which may hamper commercial success (*2*). Japan has the opposite problem—an adequate supply of fermentation engineers but too few basic researchers with training in molecular genetics (*16*). This is another reason why Japanese companies have been borrowing U.S. basic research, but are predicted to outpace the United States in commercialization (*2*, *3*).

Outlook

In January 1984 the U.S. Congress Office of Technology Assessment (OTA) published a 612-page analysis on commercial biotechnology (*2*). The report noted the importance of biotechnology both for its basic scientific benefit and for its potential commercial development. In assessing the competitive position for the United States, the OTA report stated the following (*2*, p. 7):

> Japan is likely to be the leading competitor of the United States for two reasons. First, Japanese companies in a broad range of industrial sectors have extensive experience in bioprocess technology. Japan does not have superior bioprocess technology, but it does have relatively more industrial experience using old biotechnology, more established bioprocessing plants, and more bioprocess engineers than the United States. Second, the Japanese Government has targeted biotechnology as a key technology of the future, is funding its commercial development, and is coordinating interactions among representatives from industry, universities, and government.

When the focus of analysis is narrowed to the pharmaceutical industry, it can also be concluded that the Japanese have the potential to be a leading competitor. An important factor in their success has been the borrowing of basic biotechnological research by Japanese companies from U.S. biotechnology firms. Although biotechnology licensed by U.S. firms to Japanese companies generally involves marketing rights in Japan or Asia (*2*), the Japanese market for pharmaceuticals is the second largest in the world. When added to other Asian markets, it becomes two-thirds the size of the North American or European markets (*9*). U.S. pharmaceutical companies have gained 40 percent of their revenues from foreign sales, and the loss of a foreign market may represent lost income (*9*).

In addition to basic biotechnology borrowed from the United States, Japan has been simultaneously building its own strength in this field. There are more and more frequent reports of new developments in basic biotechnology and discoveries of new drugs from Japanese industrial laboratories (Table 3) (*12*). It is thus possible that Japan's predicted future strength in pharmaceutical biotechnology will come both from internal developments and strategic government programs (*16*).

This is not to imply that with Japanese strength in biotechnology will come U.S. weakness in this area. As stated earlier, pharmaceutical and other companies in the United States are expanding their efforts in biotechnology and are nearing their goals of bringing new therapeutics and diagnostics to market. However, an analysis of Japanese strategies may help to understand how U.S. industry can optimize this process. In addition, U.S. industry will be strengthened if the U.S. government makes the commercialization of biotechnology a high priority and funds specific academic and other programs leading to that goal (*2*). As stated in the OTA report (*2*): "The United States may compete very favorably with Japan if it can direct more attention to research problems associated with the scaling-up of bioprocesses for production."

In addition, government activities that enhance cooperation between companies, decrease regulation, or provide centers to assist in biotechnology would help meet this goal (*2*, *6*, *31*). However, in the period since the OTA report was made public, no broad program of support to strengthen the U.S. position in biotechnology has been announced by the federal government.

Steps in the Right Direction

A few recent developments should prove useful to the future development of biotechnology in the United States. The first is the opening of biotechnology centers to assist in the transfer of biotechnology expertise from academia to industry. Two of these centers are at Pennsylvania State University and in Research Triangle Park, North Carolina. The Penn State Biotechnology Institute has planned research and educational facilities and will allow member companies access to "application-oriented research" and to a pilot production facility for assistance in scale-up (*32*).

The North Carolina Biotechnology Center currently receives $2.5 million in annual funding from state, federal, and industrial sources. The center funds specific programs, such as its Monoclonal Lymphocyte Technology Center, which involves academic research at the University of North Carolina and Duke University, the participation of industry, and funding by the National Science Foundation. The five industrial members agree on priorities for directed research to be funded by specific grants to participating laboratories. Although still in its infancy, the Monoclonal Lymphocyte Technology Center is fostering cooperation between companies in a university environment that probably would not have otherwise occurred (*33*).

The Center for Advanced Research in Biotechnology (CARB), to be built in Gaithersburg, Maryland, will combine federal, state, county, and university efforts (*34*). With CARB, the National Bureau of Standards will add its analytical expertise to molecular biology expertise from the University of Maryland. A CARB research facility to be completed

Table 2. Equity purchased in firms with a major focus on biotechnology. Equity purchases selected from database (*12*).

Large company (purchaser)	Biotechnology firm	Year
Purchased by U.S. pharmaceutical companies		
Abbott	Amgen	1980
Baxter Travenol	Genetics Institute	1982
Becton Dickenson	Applied Biosystems	1984
Johnson & Johnson	Enzo Biochem	1982
Lederle	Molecular Genetics	1981
Lederle	Cytogen	1983
Lilly	Synergen	1984
Schering-Plough	Biogen	1982
Schering-Plough	DNAX Ltd.*	1982
SmithKline	Beckman*	1982
Syntex	Genetic Systems	1982
Purchased by other U.S. companies		
Dow	Collaborative Research	1981
Du Pont	New England Nuclear*	1981
Fluor	Genentech	1981
W. R. Grace	Amicon*	1983
Martin Marietta	Molecular Genetics	1982
Monsanto	Biogen	1980
Monsanto	Collagen Corporation	1980
Purchased by Japanese companies		
Green Cross	Collaborative Research	1981
Mitsubishi	BioVec	1984

*Acquisition. Each nonacquisition purchase involved an average of $8 million.

Table 3. Comparison of U.S. and Japanese pharmaceutical industries and involvement in biotechnology. All 1983 data, except as noted. [Sources: (*1*, *2*, *9*, *15*)]

Data category	United States	Japan
Population (millions)	234.5	119.2
Gross national product	$3.3 trillion	$1.2 trillion
Domestic pharmaceutical market (world rank)	$21.3 billion (1)	$13.4 billion (2)
Number of pharmaceutical companies with sales over $1 billion*	11	1
Total pharmaceutical sales of ten largest pharmaceutical companies†	$16.7 billion	$6 billion
Pharmaceutical sales as percent of total sales‡	50.1	74.1
Number of new pharmaceutical products introduced:		
1961–1980	353	155
1981–1983	24	41
R&D expenditures as percent of sales‡	6.8	9.2
Scientists and engineers in industrial R&D§:		
Total number	573,900	272,000
Percent of work force	0.58	0.50
Government-funded research in biotechnology:		
Total	$520 million	$60 million
Percent of basic research	>98	<50
Targets of funding in biotechnology	Basic research	Basic research, scale-up, industrial projects, government laboratory facilities, manufacturing technology

*Pharmaceutical sales only. †Total world pharmaceutical sales in 1983 were approximately $60 billion. ‡Average of top ten companies. §All industries, 1977 data.

the Ministry of Agriculture, Forestry and Fisheries (MAFF) (*2*, *18*). The total government support for biotechnology, $50 million to $60 million in 1984, is only about one-tenth of that spent by the U.S. government (Table 3) (*2*, *18*), but Japanese funding is much more focused on specific projects. For example, MITI, in a 10-year strategic program beginning in 1981, has targeted next-generation technologies to foster scale-up techniques, aimed at assisting in the commercialization of biotechnology (*2*). The STA is also funding applied research, such as the development of bioreactors (*2*). The latest announced budgets of STA, MAFF, and MITI are emphasizing national centers related to biotechnology research, including the development of cell line and gene banks (*18*). Very little of the Japanese government's support for biotechnology is for basic research (*2*). In contrast, the U.S. government's support of biotechnology is almost ten times more, but support of applied research makes up only 1 to 2 percent of this total, with far less specificity than in Japan (Table 3) (*2*).

Another emphasis in Japan is to foster cooperation between companies and between industry and academia. There are more than a dozen joint ventures on record involving two or more Japanese companies that are aimed at developing therapeutics through research in biotechnology (*2*, *19*). Similar cooperation between large U.S. companies does not (or cannot) exist (*2*).

In order to further foster cooperation between Japanese companies, a trade association, tentatively called the Society for Advanced Pharmaceutical Research, was formed in 1985 with 31 member companies and the support of Japan's Ministry of Health and Welfare (*19*). A trade group, the Industrial Biotechnology Association, exists in the United States with 46 member companies, but is not supported by the federal government (*20*).

Because government funding in Japan is focused on applied research, Japanese companies are also in the process of expanding in-house expertise in basic research and development in biotechnology. Many companies have announced the expansion of research facilities, such as Sankyo's new $53-million biotechnology laboratory to be completed by 1986 (*21*). The availability of personnel to staff basic research laboratories in Japan has been a problem, primarily owing to a paucity of university programs in molecular genetics (*2*, *16*). To fill the need for researchers, some Japanese companies

25. A. C. Olson and R. A. Korus, in *Enzymes in Food and Beverage Processing*, R. L. Ory and A. J. St. Angelo, Eds. (American Chemical Society, Washington, D.C., 1977), pp. 100–131; A. Kilara and K. M. Shahani, *CRC Crit. Rev. Food Sci. Nutr.* **10**, 161 (1979); H. O. Hultin, *Food Technol.* **37** (No. 10), 66 (1983).
26. M. L. Shuler, O. P. Sahai, G. A. Hallsby, in *Biochemical Engineering III*, K. Venkatsubramanian, A. Constantinides, W. R. Vieth, Eds. (New York Academy of Sciences, New York, 1983), pp. 373–382; S. M. Miazga and D. Knorr, paper presented at the 1984 International Congress of Pacific Basin Societies, Honolulu, December 1984.
27. J. E. Prenosil and H. Pedersen, *Enzyme Microbiol. Technol.* **5**, 323 (1983); P. Brodelius and K. Nilsson, *Eur. J. Appl. Microbiol. Biotechnol.* **17**, 275 (1983).
28. B. Wasserman, *Food Technol.* **38** (No. 2), 78 (1984).
29. A. M. Klibanov, *Science* **219**, 722 (1983); W. Carasik and J. O. Carroll, *Food Technol.* **37** (10), 85 (1983).
30. D. N. Bull, R. W. Thoma, and T. E. Stinnet, *Adv. Biotechnol. Process* **1**, 1 (1985); E. Bjurstrom, *Chem. Eng.* **92**, 126 (1984); B. C. Buckland, *Bio/Technology* **2**, 875 (1984).
31. C. L. Cooney, *Science* **219**, 728 (1983).
32. M. L. Shuler, J. W. Pyne, G. A. Hallsby, *J. Am. Oil Chem. Soc.*, **61**, 1724 (1984); M. W. Glacken, R. J. Fleischaker, A. J. Sinskey, in *Biochemical Engineering III*, K. Venkatsubramanian, A. Constantinides, W. R. Vieth, Eds. (New York Academy of Sciences, New York, 1983), pp. 355–372; W. E. Goldstein, *ibid.*, pp. 394–408.
33. D. N. Bull, *Bio/Technology* **1**, 847 (1983); H. R. Lerner, D. Ben-Bassat, L. Reinhold, A. Poljokoff-Mayber, *Plant Physiol.* **61**, 213 (1978); J. Feder and W. R. Tolbert, *Am. Biotechnol. Lab.* **3**(1), 24 (1985); P. Brodelius and K. Nilsson, *Eur. J. Appl. Microbiol. Biotechnol.* **17**, 275 (1983).
34. M. W. Fowler, in *Plant Biotechnology*, S. M. Mantell and H. S. Smith, Eds. (Cambridge Univ. Press, Cambridge, 1983), pp. 3–37; P. Hedman, *Am. Biotech. Lab.* **2** (No. 3), 29 (1984); O. Sahai and M. Knuth, *Biotechnol. Prog.* **1**, 1 (1985).
35. B. H. Kirsop, *Chem. Ind.* **7**, 218 (1981); J. W. Lee and A. Lopez, *CRC Crit. Rev. Food Sci. Nutr.* **21**, 289 (1984); K. M. Ulmer, *Science* **219**, 666 (1983).
36. B. Wolnak, in *Enzymes*, J. P. Danehy and B. Wolnak, Eds. (Dekker, New York, 1980), pp. 3–10; S. Hasegawa, U.S. Patent 4,447,456 (8 May 1984).
37. R. Aneja, *J. Am. Oil Chem. Soc.* **61**, 661 (1984); A. H. Rose, *Sci. Am.* **245**, 127 (September 1981); J. B. M. Rattray, *J. Am. Oil Chem. Soc.* **61**, 1701 (1984); D. L. Gierhart, U.S. Patents 4,485,172 and 4,485,173 (27 November 1984).
38. B. Jarvis and K. Paulus, *J. Chem. Techn. Biotechnol.* **32**, 233 (1982); L. R. Beuchat, *Food Technol.* **34** (No. 6), 65 (1984); D. Tuse, *CRC Crit. Rev. Food Sci. Nutr.* **19**, 273 (1983); S. Matz, *Sci. Am.* **251**, 123 (November 1984).
39. F. L. Davies and M. J. Casson, *J. Dairy Res.* **48**, 363 (1981); L. McKay, *Antonie van Leeuvenhoek*, **49**, 259 (1983); C. A. Batt and A. J. Sinskey, paper presented at the Symposium on the Importance of Lactic Acid Fermentation, Mexico City, December 1984; A. R. Huggins, *Food Technol.* **38** (No. 6), 41 (1984).
40. A. Kramer and B. A. Twigg, *Quality Control for the Food Industry* (AVI, Westport, Conn., 1970); R. D. Middlekauff, *Food Technol.* **38** (No. 10), 97 (1984); Y. Pomeranz and C. E. Meloan, *Food Analysis: Theory and Practice* (AVI, Westport, Conn., 1978).
41. R. L. Gatz, B. A. Young, T. J. Facklam, and D. A. Scantland, *Bio/Technology* **1**, 337 (1983).
42. H. J. Neujahr, in *Biotechnology and Genetic Engineering Reviews*, G. E. Russell, Ed., (Intercept, Newcastle-upon-Tyne, 1984), vol. 1, pp. 167–186; N. Smit and G. A. Rechnitz, *Biotechnol. Lett.* **6**, 209 (1984).
43. R. Dagani, *Chem. Eng. News* **62** (No. 46), 25 (1984).
44. E. L. Korwek, *Food Drug Cosmetic Law J.* **37**, 289 (1982); D. D. Jones, *Food Technol.* **39** (No. 6), 59 (1985).
45. H. Hemfort and W. Kohlstette, *Starch* **36**, 109 (1984); V. Wiesboden and H. Binder, in *Advances in Biochemical Engineering*, A. Fiechter, Ed. (Springer Verlag, Berlin, 1982), pp. 120–171.
46. W. A. Bough, *Process Biochem.* **11** (No. 1), 13 (1976); P. R. Austin, C. J. Brine, J. E. Castle, J. P. Zikakis, *Science* **212**, 749 (1981); S. Latlief and D. Knorr, *J. Food Sci.* **48**, 1587 (1983).
47. M. R. Kula, K. H. Kroner, H. Hustedt, in *Advances in Biochemical Engineering*, A. Fiechter, Ed., (Springer Verlag, Berlin, 1982), pp. 73–118.
48. E. Stahl and K. W. Quirin, *Naturwissenschaften* **71**, 181 (1984); L. G. Randall, *Separation Sci. Technol.* **17**, 1 (1982).
49. E. Stahl, E. Schütz, H. K. Mangold, *J. Agric. Food Chem.* **28**, 1153 (1980); J. P. Friedrich and E. H. Pryde, *J. Am. Oil Chem. Soc.* **61**, 223 (1984); H. J. Gährs, *ZFL Int. J. Food Technol. Food Process. Eng.* **35**, 302 (1984).
50. J. L. Dwyer, *Bio/Technology* **2**, 957 (1984).
51. P. D. Fullbrook, *J. Am. Oil Chem. Soc.* **60**, 476 (1983).
52. H. Ruttloff, J. Huber, F. Zicker, K. Mangold, *Industrielle Enzyme* (VEB, Leipzig, 1983).
53. W. Hartmeier, *Process. Biochem.* Feb. 40 (1984); B. Dixon, *Biotechnology* **2**, 594 (1984); D. Knorr, S. M. Miazga, R. A. Teutonico, *Food Technol.*, in press.
54. C. V. Morr, *Food Technol.* **38** (No. 6), 39 (1984).
55. R. R. Zall, in *Food Processing Waste Management*, J. H. Green and A. Kramer, Eds. (AVI, Westport, Conn., 1979), pp. 175–201.
56. D. Knorr, *J. Food Technol.* **12**, 563 (1977); F. Holm and S. Eriksen, *ibid.* **15**, 71 (1980); D. Knorr, *Food Technol.* **37** (No. 2), 71 (1983); J. R. Rosenau, L. F. Whitney, J. R. Haight, *ibid.* **32** (No. 6), 37 (1978).
57. R. S. Tutunjian, in *Biochemical Engineering III*, K. Venkatsubramanian, A. Constantinides, W. R. Vieth, Eds. (New York Academy of Sciences, New York, 1983), pp. 238–253; P. Jelen, *Agric. Food Chem.* **27**, 658 (1979).
58. G. G. Birch, K. J. Parker, J. T. Worgan, *Food From Waste* (Applied Sciences, London, 1976); J. H. Green and A. Kramer, *Food Processing Waste Management* (AVI, Westport, Conn., 1980); M. W. M. Bewick, *Handbook of Organic Waste Conversion* (Van Nostrand Reinhold, New York, 1980); D. Knorr, in *Sustainable Food Systems*, D. Knorr, Ed. (AVI, Westport, Conn., 1983), pp. 249–78.
59. D. Knorr, *Food Technol.* **38** (No. 1), 85 (1984); D. Rodriquez-Sanchez and C. Rha, *J. Food Technol.* **16**, 469 (1981); K. D. Vorlop and J. Klein, *Biotechnol. Letters.* **3** (No. 1), 9 (1981).
60. S. Revah-Moiseev and A. Carroad, *Biotechnol. Bioeng.* **23**, 1067 (1981); I. G. Casio, R. A. Fisher, P. A. Carroad, *J. Food Sci.* **47**, 901 (1982); J. Zikakis, Ed., *Chitin, Chitosan and Related Enzymes* (Academic Press, Orlando, Fla., 1984); papers presented at the Third International Conference on Chitin/Chitosan, Senigellia, Italy, 1 to 4 April 1985; R. L. Rawin, *Chem. Eng. News* **62** (No. 20), 42 (1984).
61. H. Skogman, in *Food From Waste*, G. G. Birch, K. J. Parker, J. T. Worgan, Eds. (Applied Science, London, 1976), pp. 167–179; Z. G. Moulin and P. Galzi, in *Biotechnology and Genetic Engineering Reviews*, G. E. Russell, Ed. (Intercept, Newcastle-upon-Tyne, 1984), pp. 347–374.
62. D. L. Wise, Ed., *Fuel Gas Development* (CRC Press, Boca Raton, Fla., 1984); D. A. Stafford *et al.*, *Methane Production from Waste Organic Matter* (CRC Press, Boca Raton, Fla., 1984).
63. Institute of Food Technologists (IFT) Workshop on Research Needs, Arlington Heights, Ill., 11 to 14 November 1984; B. J. Liska and W. W. Marion, *Food Technol.* **39** (No. 6), 81 (1985).

64. We thank the participants of the biotechnology topic at the IFT workshop on research needs, especially A. J. Stevens. Valuable comments on drafts of this article were provided by S. P. Shoemaker, M. J. Haas, K. Venkat, P. M. Walsh, and D. Kukich.

Spatially Regulated Expression of Homeotic Genes in *Drosophila*

Katherine Harding, Cathy Wedeen
William McGinnis, Michael Levine

Abstract. *The sites of transcript accumulation for six different homeotic loci of the Antennapedia and bithorax gene complexes (ANT-C and BX-C) were identified within embryo tissue sections by in situ hybridization. These six loci belong to the Antennapedia class of the homeo box gene family. Transcripts encoded by each locus are detected primarily in discrete, nonoverlapping regions of the embryonic central nervous system (CNS). The regions of the CNS that contain transcripts encoded by each of these loci correspond to the embryonic segments that are disrupted in mutants for these genes. The maintenance of spatially restricted expression of each ANT-C and BX-C locus could involve hierarchical, cross-regulatory interactions that are mediated by the homeo box protein domains encoded by these genes.*

A fundamental problem of development is how embryonic cells acquire their particular developmental fates as a result of their location within a developing embryo. A model system for analyzing the elaboration of this positional information during *Drosophila* development involves the morphogenesis of body segments. The adult fruit fly is composed of eight abdominal, three thoracic, and four to six head segments (*1*). Several of the constituent tissues of a given segment have morphological properties specific for that segment. For example, the epidermis elaborates cuticular structures, such as legs and antennae, that are distinct for a particular segment. In addition, the morphology of some of the mesodermal (*2*) and neural tissues (*3, 4*) may be specific for a given segment.

Homeotic genes are those that establish the diverse pathways by which each embryonic segment primordium develops a distinct adult phenotype (*5, 6*). Mutations of homeotic loci result in partial or complete transformations of the epidermal tissues of one segment into those of another. Homeotic transformations may include the neural and mesodermal tissues of the affected segment as well (*2, 3, 7*). For example, embryos that lack the *Antennapedia* (*Antp*) gene function display a transformation of the meso- and metathorax (T2 + T3) into homologous tissues of the prothorax (T1) (*8*).

Many homeotic genes appear within one of two clusters in the *Drosophila* genome, the bithorax complex (BX-C) (*5, 9*) or the Antennapedia complex (ANT-C) (*10, 11*). Genes of the BX-C are required for the specification of segments in the posterior regions of the fly (*5, 12, 13*). Lewis has identified a number of homeotic loci within the BX-C on the basis of embryonic and adult mutant phenotypes (*5*). Recently, a minimum of three essential domains of homeotic function within the BX-C have been identified by means of lethal complementation analyses: *Ultrabithorax (Ubx), Abdominal-A (abd-A), and Abdominal-B(Abd-B)* (*9*). The ANT-C is required for the specification of anterior body segments (*8, 14*). Several homeotic lethal complementation groups have been identified for the ANT-C (*8, 11, 14, 15*). These include the *Antp, Sex combs reduced (Scr), and Deformed* (*Dfd*) loci. Each ANT-C and BX-C homeotic lethal complementation group controls the development of a different subset of the embryonic segment primordia (Fig. 1a).

A central problem in elucidating the genetic control of segment morphogenesis is how the different ANT-C and BX-C loci come to function in primarily nonoverlapping domains along the body axis of the fly. The molecular cloning of ANT-C and BX-C loci has permitted a direct assessment of the spatial and temporal limits of homeotic gene expression. The previous demonstration that *Ubx* and *Antp* share direct nucleotide sequence homology (*16-19*) facilitated the isolation of ANT-C and BX-C loci. This homology occurs within a conserved protein coding region designated the homeo box. A total of seven genomic DNA fragments cross-hybridizes strongly with the *Antp* and *Ubx* homeo boxes (*20*). These seven regions correspond to the Antennapedia class of the homeo box gene family, all of which are located within either the ANT-C or the BX-C (*20*). It appears that each of the six lethal complementation groups of the ANT-C and BX-C (Fig. 1) contains an Antennapedia class homeo box. However, there are additional homeotic loci within the BX-C that do not contain the homeo box (Fig. 1a) (*21*).

We show that each of the ANT-C and BX-C homeotic loci that contains a homeo box specifies transcripts that accumulate in discrete regions of the embryonic central nervous system (CNS). To a close approximation, the regions of the CNS that contain transcripts encoded by each of these loci correspond to the embryonic segments that are disrupted in mutants for these genes. We propose that spatially restricted expression of each ANT-C and BX-C locus involves hierarchical, cross-regulatory interactions that are mediated by the homeo box protein domains encoded by these genes. Support for this model is based on analysis of the distribution patterns of *Antp* transcripts in mutant embryos that lack BX-C loci.

Isolation of a new ANT-C homeo box locus. Molecular clones for the *Dfd, Antp, Ubx, iab-2,* and *iab-7* loci have been previously isolated (*16, 20, 22–25*). In order to determine the spatial limits of expression for each homeotic lethal complementation group within the ANT-C and BX-C by in situ hybridization, it was necessary to obtain a molecular probe for the *Scr* locus. A genomic DNA fragment that appears to derive from *Scr* was isolated on the basis of homeo box sequence homology as described below.

A total of 6×10^4 recombinants from a *Drosophila*–Charon 4 DNA library (approximately six genome equivalents) were screened with the homeo box se-

K. Harding, C. Wedeen, and M. Levine are in the Department of Biological Sciences, Fairchild Center, Columbia University, New York 10027. W. McGinnis is in the Department of Molecular Biophysics and Biochemistry, Yale University, New Haven, Connecticut 06520.

differ is in the type and amount of government support for the development of biotechnology. In Japan there is a clear effort by government to enhance the future commercial success of the pharmaceutical industry by assisting in the development of biotechnology. Although this support is administered by a few different agencies and is small in size (by U.S. standards), it is viewed both externally (*2, 25*) and internally (*16*) as a single cohesive effort with a high potential for success. The companies involved must create their own basic research and development programs; government assistance is at the next level, helping to foster commercialization of products, manufacturing, and generic support, such as gene banks (*18*). In the United States, federal support for biotechnology is ten times greater in magnitude and is aimed at basic research. Although support of basic research programs in biotechnology should be continued and expanded to ensure maintained leadership in basic research, support for more applied areas is also needed (*2, 16*).

Another contrast between the two countries is in the availability of basic researchers in biotechnology and bioprocess engineering. There was a reported shortage in the United States of basic researchers trained in genetic engineering, but this problem appears to have abated (*2, 30*). Due to strong academic programs in this and related areas, the availability of basic researchers should continue to be sufficient (*2*). However, a paucity of academic programs in bioprocess engineering continues (*2*). As more companies generate products of biotechnology for scale-up, it is expected that there will be a severe shortage of personnel trained in production technologies, which may hamper commercial success (*2*). Japan has the opposite problem—an adequate supply of fermentation engineers but too few basic researchers with training in molecular genetics (*16*). This is another reason why Japanese companies have been borrowing U.S. basic research, but are predicted to outpace the United States in commercialization (*2, 3*).

Outlook

In January 1984 the U.S. Congress Office of Technology Assessment (OTA) published a 612-page analysis on commercial biotechnology (*2*). The report noted the importance of biotechnology both for its basic scientific benefit and for its potential commercial development. In assessing the competitive position for the United States, the OTA report stated the following (*2*, p. 7):

> Japan is likely to be the leading competitor of the United States for two reasons. First, Japanese companies in a broad range of industrial sectors have extensive experience in bioprocess technology. Japan does not have superior bioprocess technology, but it does have relatively more industrial experience using old biotechnology, more established bioprocessing plants, and more bioprocess engineers than the United States. Second, the Japanese Government has targeted biotechnology as a key technology of the future, is funding its commercial development, and is coordinating interactions among representatives from industry, universities, and government.

When the focus of analysis is narrowed to the pharmaceutical industry, it can also be concluded that the Japanese have the potential to be a leading competitor. An important factor in their success has been the borrowing of basic biotechnological research by Japanese companies from U.S. biotechnology firms. Although biotechnology licensed by U.S. firms to Japanese companies generally involves marketing rights in Japan or Asia (*2*), the Japanese market for pharmaceuticals is the second largest in the world. When added to other Asian markets, it becomes two-thirds the size of the North American or European markets (*9*). U.S. pharmaceutical companies have gained 40 percent of their revenues from foreign sales, and the loss of a foreign market may represent lost income (*9*).

In addition to basic biotechnology borrowed from the United States, Japan has been simultaneously building its own strength in this field. There are more and more frequent reports of new developments in basic biotechnology and discoveries of new drugs from Japanese industrial laboratories (Table 3) (*12*). It is thus possible that Japan's predicted future strength in pharmaceutical biotechnology will come both from internal developments and strategic government programs (*16*).

This is not to imply that with Japanese strength in biotechnology will come U.S. weakness in this area. As stated earlier, pharmaceutical and other companies in the United States are expanding their efforts in biotechnology and are nearing their goals of bringing new therapeutics and diagnostics to market. However, an analysis of Japanese strategies may help to understand how U.S. industry can optimize this process. In addition, U.S. industry will be strengthened if the U.S. government makes the commercialization of biotechnology a high priority and funds specific academic and other programs leading to that goal (*2*). As stated in the OTA report (*2*): "The United States may compete very favorably with Japan if it can direct more attention to research problems associated with the scaling-up of bioprocesses for production."

In addition, government activities that enhance cooperation between companies, decrease regulation, or provide centers to assist in biotechnology would help meet this goal (*2, 6, 31*). However, in the period since the OTA report was made public, no broad program of support to strengthen the U.S. position in biotechnology has been announced by the federal government.

Steps in the Right Direction

A few recent developments should prove useful to the future development of biotechnology in the United States. The first is the opening of biotechnology centers to assist in the transfer of biotechnology expertise from academia to industry. Two of these centers are at Pennsylvania State University and in Research Triangle Park, North Carolina. The Penn State Biotechnology Institute has planned research and educational facilities and will allow member companies access to "application-oriented research" and to a pilot production facility for assistance in scale-up (*32*).

The North Carolina Biotechnology Center currently receives $2.5 million in annual funding from state, federal, and industrial sources. The center funds specific programs, such as its Monoclonal Lymphocyte Technology Center, which involves academic research at the University of North Carolina and Duke University, the participation of industry, and funding by the National Science Foundation. The five industrial members agree on priorities for directed research to be funded by specific grants to participating laboratories. Although still in its infancy, the Monoclonal Lymphocyte Technology Center is fostering cooperation between companies in a university environment that probably would not have otherwise occurred (*33*).

The Center for Advanced Research in Biotechnology (CARB), to be built in Gaithersburg, Maryland, will combine federal, state, county, and university efforts (*34*). With CARB, the National Bureau of Standards will add its analytical expertise to molecular biology expertise from the University of Maryland. A CARB research facility to be completed

Table 2. Equity purchased in firms with a major focus on biotechnology. Equity purchases selected from database (*12*).

Large company (purchaser)	Biotechnology firm	Year
Purchased by U.S. pharmaceutical companies		
Abbott	Amgen	1980
Baxter Travenol	Genetics Institute	1982
Becton Dickenson	Applied Biosystems	1984
Johnson & Johnson	Enzo Biochem	1982
Lederle	Molecular Genetics	1981
Lederle	Cytogen	1983
Lilly	Synergen	1984
Schering-Plough	Biogen	1982
Schering-Plough	DNAX Ltd.*	1982
SmithKline	Beckman*	1982
Syntex	Genetic Systems	1982
Purchased by other U.S. companies		
Dow	Collaborative Research	1981
Du Pont	New England Nuclear*	1981
Fluor	Genentech	1981
W. R. Grace	Amicon*	1983
Martin Marietta	Molecular Genetics	1982
Monsanto	Biogen	1980
Monsanto	Collagen Corporation	1980
Purchased by Japanese companies		
Green Cross	Collaborative Research	1981
Mitsubishi	BioVec	1984

*Acquisition. Each nonacquisition purchase involved an average of $8 million.

Table 3. Comparison of U.S. and Japanese pharmaceutical industries and involvement in biotechnology. All 1983 data, except as noted. [Sources: (*1*, *2*, *9*, *15*)]

Data category	United States	Japan
Population (millions)	234.5	119.2
Gross national product	$3.3 trillion	$1.2 trillion
Domestic pharmaceutical market (world rank)	$21.3 billion (1)	$13.4 billion (2)
Number of pharmaceutical companies with sales over $1 billion*	11	1
Total pharmaceutical sales of ten largest pharmaceutical companies†	$16.7 billion	$6 billion
Pharmaceutical sales as percent of total sales‡	50.1	74.1
Number of new pharmaceutical products introduced:		
1961–1980	353	155
1981–1983	24	41
R&D expenditures as percent of sales‡	6.8	9.2
Scientists and engineers in industrial R&D§:		
Total number	573,900	272,000
Percent of work force	0.58	0.50
Government-funded research in biotechnology:		
Total	$520 million	$60 million
Percent of basic research	>98	<50
Targets of funding in biotechnology	Basic research	Basic research, scale-up, industrial projects, government laboratory facilities, manufacturing technology

*Pharmaceutical sales only. †Total world pharmaceutical sales in 1983 were approximately $60 billion. ‡Average of top ten companies. §All industries, 1977 data.

the Ministry of Agriculture, Forestry and Fisheries (MAFF) (*2*, *18*). The total government support for biotechnology, $50 million to $60 million in 1984, is only about one-tenth of that spent by the U.S. government (Table 3) (*2*, *18*), but Japanese funding is much more focused on specific projects. For example, MITI, in a 10-year strategic program beginning in 1981, has targeted next-generation technologies to foster scale-up techniques, aimed at assisting in the commercialization of biotechnology (*2*). The STA is also funding applied research, such as the development of bioreactors (*2*). The latest announced budgets of STA, MAFF, and MITI are emphasizing national centers related to biotechnology research, including the development of cell line and gene banks (*18*). Very little of the Japanese government's support for biotechnology is for basic research (*2*). In contrast, the U.S. government's support of biotechnology is almost ten times more, but support of applied research makes up only 1 to 2 percent of this total, with far less specificity than in Japan (Table 3) (*2*).

Another emphasis in Japan is to foster cooperation between companies and between industry and academia. There are more than a dozen joint ventures on record involving two or more Japanese companies that are aimed at developing therapeutics through research in biotechnology (*2*, *19*). Similar cooperation between large U.S. companies does not (or cannot) exist (*2*).

In order to further foster cooperation between Japanese companies, a trade association, tentatively called the Society for Advanced Pharmaceutical Research, was formed in 1985 with 31 member companies and the support of Japan's Ministry of Health and Welfare (*19*). A trade group, the Industrial Biotechnology Association, exists in the United States with 46 member companies, but is not supported by the federal government (*20*).

Because government funding in Japan is focused on applied research, Japanese companies are also in the process of expanding in-house expertise in basic research and development in biotechnology. Many companies have announced the expansion of research facilities, such as Sankyo's new $53-million biotechnology laboratory to be completed by 1986 (*21*). The availability of personnel to staff basic research laboratories in Japan has been a problem, primarily owing to a paucity of university programs in molecular genetics (*2*, *16*). To fill the need for researchers, some Japanese companies

25. A. C. Olson and R. A. Korus, in *Enzymes in Food and Beverage Processing*, R. L. Ory and A. J. St. Angelo, Eds. (American Chemical Society, Washington, D.C., 1977), pp. 100–131; A. Kilara and K. M. Shahan, *CRC Crit. Rev. Food Sci. Nutr.* **10**, 161 (1979); H. O. Hultin, *Food Technol.* **37** (No. 10), 66 (1983).
26. M. L. Shuler, O. P. Sahai, G. A. Hallsby, in *Biochemical Engineering III*, K. Venkatsubramanian, A. Constantinides, W. R. Vieth, Eds. (New York Academy of Sciences, New York, 1983), pp. 373–382; S. M. Miazga and D. Knorr, paper presented at the 1984 International Congress of Pacific Basin Societies, Honolulu, December 1984.
27. J. E. Prenosil and H. Pedersen, *Enzyme Microbiol. Technol.* **5**, 323 (1983); P. Brodelius and K. Nilsson, *Eur. J. Appl. Microbiol. Biotechnol.* **17**, 275 (1983).
28. B. Wasserman, *Food Technol.* **38** (No. 2), 78 (1984).
29. A. M. Klibanov, *Science* **219**, 722 (1983); W. Carasik and J. O. Carroll, *Food Technol.* **37** (10), 85 (1983).
30. D. N. Bull, R. W. Thoma, and T. E. Stinnet, *Adv. Biotechnol. Process* **1**, 1 (1985); E. Bjurstrom, *Chem. Eng.* **92**, 126 (1984); B. C. Buckland, *Bio/Technology* **2**, 875 (1984).
31. C. L. Cooney, *Science* **219**, 728 (1983).
32. M. L. Shuler, J. W. Pyne, G. A. Hallsby, *J. Am. Oil Chem. Soc.*, **61**, 1724 (1984); M. W. Glacken, R. J. Fleischaker, A. J. Sinskey, in *Biochemical Engineering III*, K. Venkatsubramanian, A. Constantinides, W. R. Vieth, Eds. (New York Academy of Sciences, New York, 1983), pp. 355–372; W. E. Goldstein, *ibid.*, pp. 394–408.
33. D. N. Bull, *Bio/Technology* **1**, 847 (1983); H. R. Lerner, D. Ben-Bassat, L. Reinhold, A. Poljokoff-Mayber, *Plant Physiol.* **61**, 213 (1978); J. Feder and W. R. Tolbert, *Am. Biotechnol. Lab.* **3**(1), 24 (1985); P. Brodelius and K. Nilsson, *Eur. J. Appl. Microbiol. Biotechnol.* **17**, 275 (1983).
34. M. W. Fowler, in *Plant Biotechnology*, S. M. Manteil and H. S. Smith, Eds. (Cambridge Univ. Press, Cambridge, 1983), pp. 3–37; P. Hedman, *Am. Biotech. Lab.* **2** (No. 3), 29 (1984); O. Sahai and M. Knuth, *Biotechnol. Prog.* **1**, 1 (1985).
35. B. H. Kirsop, *Chem. Ind.* **7**, 218 (1981); J. W. Lee and A. Lopez, *CRC Crit. Rev. Food Sci. Nutr.* **21**, 289 (1984); K. M. Ulmer, *Science* **219**, 666 (1983).
36. B. Wolnak, in *Enzymes*, J. P. Danehy and B. Wolnak, Eds. (Dekker, New York, 1980), pp. 3–10; S. Hasegawa, U.S. Patent 4,447,456 (8 May 1984).
37. R. Aneja, *J. Am. Oil Chem. Soc.* **61**, 661 (1984); A. H. Rose, *Sci. Am.* **245**, 127 (September 1981); J. B. M. Rattray, *J. Am. Oil Chem. Soc.* **61**, 1701 (1984); D. L. Gierhart, U.S. Patents 4,485,172 and 4,485,173 (27 November 1984).
38. B. Jarvis and K. Paulus, *J. Chem. Techn. Biotechnol.* **32**, 233 (1982); L. R. Beuchat, *Food Technol.* **34** (No. 6), 65 (1984); D. Tuse, *CRC Crit. Rev. Food Sci. Nutr.* **19**, 273 (1983); S. Matz, *Sci. Am.* **251**, 123 (November 1984).
39. F. L. Davies and M. J. Casson, *J. Dairy Res.* **48**, 363 (1981); L. McKay, *Antonie van Leeuwenhoek*, **49**, 259 (1983); C. A. Batt and A. J. Sinskey, paper presented at the Symposium on the Importance of Lactic Acid Fermentation, Mexico City, December 1984; A. R. Huggins, *Food Technol.* **38** (No. 6), 41 (1984).
40. A. Kramer and B. A. Twigg, *Quality Control for the Food Industry* (AVI, Westport, Conn., 1970); R. D. Middlekauff, *Food Technol.* **38** (No. 10), 97 (1984); Y. Pomeranz and C. E. Meloan, *Food Analysis: Theory and Practice* (AVI, Westport, Conn., 1978).
41. R. L. Gatz, B. A. Young, T. J. Facklam, and D. A. Scantland, *Bio/Technology* **1**, 337 (1983).
42. H. J. Neujahr, in *Biotechnology and Genetic Engineering Reviews*, G. E. Russell, Ed., (Intercept, Newcastle-upon-Tyne, 1984), vol. 1, pp. 167–186; N. Smit and G. A. Rechnitz, *Biotechnol. Lett.* **6**, 209 (1984).
43. R. Dagani, *Chem. Eng. News* **62** (No. 46), 25 (1984).
44. E. L. Korwek, *Food Drug Cosmetic Law J.* **37**, 289 (1982); D. D. Jones, *Food Technol.* **39** (No. 6), 59 (1985).
45. H. Hemfort and W. Kohlstette, *Starch* **36**, 109 (1984); V. Wiesboden and H. Binder, in *Advances in Biochemical Engineering*, A. Fiechter, Ed. (Springer Verlag, Berlin, 1982), pp. 120–171.
46. W. A. Bough, *Process Biochem.* **11** (No. 1), 13 (1976); P. R. Austin, C. J. Brine, J. E. Castle, J. P. Zikakis, *Science* **212**, 749 (1981); S. Latlief and D. Knorr, *J. Food Sci.* **48**, 1587 (1983).
47. M. R. Kula, K. H. Kroner, H. Hustedt, in *Advances in Biochemical Engineering*, A. Fiechter, Ed. (Springer Verlag, Berlin, 1982), pp. 73–118.
48. E. Stahl and K. W. Quirin, *Naturwissenschaften* **71**, 181 (1984); L. G. Randall, *Separation Sci. Technol.* **17**, 1 (1982).
49. E. Stahl, E. Schütz, H. K. Mangold, *J. Agric. Food Chem.* **28**, 1153 (1980); J. P. Friedrich and E. H. Pryde, *J. Am. Oil Chem. Soc.* **61**, 223 (1984); H. J. Gährs, *ZFL Int. J. Food Technol. Food Process. Eng.* **35**, 302 (1984).
50. J. L. Dwyer, *Bio/Technology* **2**, 957 (1984).
51. P. D. Fullbrook, *J. Am. Oil Chem. Soc.* **60**, 476 (1983).
52. H. Ruttloff, J. Huber, F. Zicker, K. Mangold, *Industrielle Enzyme* (VEB, Leipzig, 1983).
53. W. Hartmeier, *Process. Biochem.* Feb. 40 (1984); B. Dixon, *Biotechnology* **2**, 594 (1984); D. Knorr, S. M. Miazga, R. A. Teutonico, *Food Technol.*, in press.
54. C. V. Morr, *Food Technol.* **38** (No. 6), 39 (1984).
55. R. R. Zall, in *Food Processing Waste Management*, J. H. Green and A. Kramer, Eds. (AVI, Westport, Conn., 1979), pp. 175–201.
56. D. Knorr, *J. Food Technol.* **12**, 563 (1977); F. Holm and S. Eriksen, *ibid.* **15**, 71 (1980); D. Knorr, *Food Technol.* **37** (No. 2), 71 (1983); J. R. Rosenau, L. F. Whitney, J. R. Haight, *ibid.* **32** (No. 6), 37 (1978).
57. R. S. Tutunjian, in *Biochemical Engineering III*, K. Venkatsubramanian, A. Constantinides, W. R. Vieth, Eds. (New York Academy of Sciences, New York, 1983), pp. 238–253; P. Jelen, *Agric. Food Chem.* **27**, 658 (1979).
58. G. G. Birch, K. J. Parker, J. T. Worgan, *Food From Waste* (Applied Sciences, London, 1976); J. H. Green and A. Kramer, *Food Processing Waste Management* (AVI, Westport, Conn., 1980); M. W. M. Bewick, *Handbook of Organic Waste Conversion* (Van Nostrand Reinhold, New York, 1980); D. Knorr, in *Sustainable Food Systems*, D. Knorr, Ed. (AVI, Westport, Conn., 1983), pp. 249–78.
59. D. Knorr, *Food Technol.* **38** (No. 1), 85 (1984); D. Rodriquez-Sanchez and C. Rha, *J. Food Technol.* **16**, 469 (1981); K. D. Vorlop and J. Klein, *Biotechnol. Letters.* **3** (No. 1), 9 (1981).
60. S. Revah-Moiseev and A. Carroad, *Biotechnol. Bioeng.* **23**, 1067 (1981); I. G. Casio, R. A. Fisher, P. A. Carroad, *J. Food Sci.* **47**, 901 (1982); J. Zikakis, Ed., *Chitin, Chitosan and Related Enzymes* (Academic Press, Orlando, Fla., 1984); papers presented at the Third International Conference on Chitin/Chitosan, Senigellia, Italy, 1 to 4 April 1985; R. L. Rawin, *Chem. Eng. News* **62** (No. 20), 42 (1984).
61. H. Skogman, in *Food From Waste*, G. G. Birch, K. J. Parker, J. T. Worgan, Eds. (Applied Science, London, 1976), pp. 167–179; Z. G. Moulin and P. Galzi, in *Biotechnology and Genetic Engineering Reviews*, G. E. Russell, Ed. (Intercept, Newcastle-upon-Tyne, 1984), pp. 347–374.
62. D. L. Wise, Ed., *Fuel Gas Development* (CRC Press, Boca Raton, Fla., 1984); D. A. Stafford *et al.*, *Methane Production from Waste Organic Matter* (CRC Press, Boca Raton, Fla., 1984).
63. Institute of Food Technologists (IFT) Workshop on Research Needs, Arlington Heights, Ill., 11 to 14 November 1984; B. J. Liska and W. W. Marion, *Food Technol.* **39** (No. 6), 81 (1985).
64. We thank the participants of the biotechnology topic at the IFT workshop on research needs, especially A. J. Stevens. Valuable comments on drafts of this article were provided by S. P. Shoemaker, M. J. Haas, K. Venkat, P. M. Walsh, and D. Kukich.

Spatially Regulated Expression of Homeotic Genes in *Drosophila*

Katherine Harding, Cathy Wedeen
William McGinnis, Michael Levine

Abstract. *The sites of transcript accumulation for six different homeotic loci of the Antennapedia and bithorax gene complexes (ANT-C and BX-C) were identified within embryo tissue sections by in situ hybridization. These six loci belong to the Antennapedia class of the homeo box gene family. Transcripts encoded by each locus are detected primarily in discrete, nonoverlapping regions of the embryonic central nervous system (CNS). The regions of the CNS that contain transcripts encoded by each of these loci correspond to the embryonic segments that are disrupted in mutants for these genes. The maintenance of spatially restricted expression of each ANT-C and BX-C locus could involve hierarchical, cross-regulatory interactions that are mediated by the homeo box protein domains encoded by these genes.*

A fundamental problem of development is how embryonic cells acquire their particular developmental fates as a result of their location within a developing embryo. A model system for analyzing the elaboration of this positional information during *Drosophila* development involves the morphogenesis of body segments. The adult fruit fly is composed of eight abdominal, three thoracic, and four to six head segments (*1*). Several of the constituent tissues of a given segment have morphological properties specific for that segment. For example, the epidermis elaborates cuticular structures, such as legs and antennae, that are distinct for a particular segment. In addition, the morphology of some of the mesodermal (*2*) and neural tissues (*3, 4*) may be specific for a given segment.

Homeotic genes are those that establish the diverse pathways by which each embryonic segment primordium develops a distinct adult phenotype (*5, 6*). Mutations of homeotic loci result in partial or complete transformations of the epidermal tissues of one segment into those of another. Homeotic transformations may include the neural and mesodermal tissues of the affected segment as well (*2, 3, 7*). For example, embryos that lack the *Antennapedia* (*Antp*) gene function display a transformation of the meso- and metathorax (T2 + T3) into homologous tissues of the prothorax (T1) (*8*).

Many homeotic genes appear within one of two clusters in the *Drosophila* genome, the bithorax complex (BX-C) (*5, 9*) or the Antennapedia complex (ANT-C) (*10, 11*). Genes of the BX-C are required for the specification of segments in the posterior regions of the fly (*5, 12, 13*). Lewis has identified a number of homeotic loci within the BX-C on the basis of embryonic and adult mutant phenotypes (*5*). Recently, a minimum of three essential domains of homeotic function within the BX-C have been identified by means of lethal complementation analyses: *Ultrabithorax (Ubx), Abdominal-A (abd-A), and Abdominal-B(Abd-B)* (*9*). The ANT-C is required for the specification of anterior body segments (*8, 14*). Several homeotic lethal complementation groups have been identified for the ANT-C (*8, 11, 14, 15*). These include the *Antp, Sex combs reduced (Scr), and Deformed* (*Dfd*) loci. Each ANT-C and BX-C homeotic lethal complementation group controls the development of a different subset of the embryonic segment primordia (Fig. 1a).

K. Harding, C. Wedeen, and M. Levine are in the Department of Biological Sciences, Fairchild Center, Columbia University, New York 10027. W. McGinnis is in the Department of Molecular Biophysics and Biochemistry, Yale University, New Haven, Connecticut 06520.

A central problem in elucidating the genetic control of segment morphogenesis is how the different ANT-C and BX-C loci come to function in primarily nonoverlapping domains along the body axis of the fly. The molecular cloning of ANT-C and BX-C loci has permitted a direct assessment of the spatial and temporal limits of homeotic gene expression. The previous demonstration that *Ubx* and *Antp* share direct nucleotide sequence homology (*16-19*) facilitated the isolation of ANT-C and BX-C loci. This homology occurs within a conserved protein coding region designated the homeo box. A total of seven genomic DNA fragments cross-hybridizes strongly with the *Antp* and *Ubx* homeo boxes (*20*). These seven regions correspond to the Antennapedia class of the homeo box gene family, all of which are located within either the ANT-C or the BX-C (*20*). It appears that each of the six lethal complementation groups of the ANT-C and BX-C (Fig. 1) contains an Antennapedia class homeo box. However, there are additional homeotic loci within the BX-C that do not contain the homeo box (Fig. 1a) (*21*).

We show that each of the ANT-C and BX-C homeotic loci that contains a homeo box specifies transcripts that accumulate in discrete regions of the embryonic central nervous system (CNS). To a close approximation, the regions of the CNS that contain transcripts encoded by each of these loci correspond to the embryonic segments that are disrupted in mutants for these genes. We propose that spatially restricted expression of each ANT-C and BX-C locus involves hierarchical, cross-regulatory interactions that are mediated by the homeo box protein domains encoded by these genes. Support for this model is based on analysis of the distribution patterns of *Antp* transcripts in mutant embryos that lack BX-C loci.

Isolation of a new ANT-C homeo box locus. Molecular clones for the *Dfd, Antp, Ubx, iab-2*, and *iab-7* loci have been previously isolated (*16, 20, 22–25*). In order to determine the spatial limits of expression for each homeotic lethal complementation group within the ANT-C and BX-C by in situ hybridization, it was necessary to obtain a molecular probe for the *Scr* locus. A genomic DNA fragment that appears to derive from *Scr* was isolated on the basis of homeo box sequence homology as described below.

A total of 6×10^4 recombinants from a *Drosophila*–Charon 4 DNA library (approximately six genome equivalents) were screened with the homeo box se-

differ is in the type and amount of government support for the development of biotechnology. In Japan there is a clear effort by government to enhance the future commercial success of the pharmaceutical industry by assisting in the development of biotechnology. Although this support is administered by a few different agencies and is small in size (by U.S. standards), it is viewed both externally (*2*, *25*) and internally (*16*) as a single cohesive effort with a high potential for success. The companies involved must create their own basic research and development programs; government assistance is at the next level, helping to foster commercialization of products, manufacturing, and generic support, such as gene banks (*18*). In the United States, federal support for biotechnology is ten times greater in magnitude and is aimed at basic research. Although support of basic research programs in biotechnology should be continued and expanded to ensure maintained leadership in basic research, support for more applied areas is also needed (*2*, *16*).

Another contrast between the two countries is in the availability of basic researchers in biotechnology and bioprocess engineering. There was a reported shortage in the United States of basic researchers trained in genetic engineering, but this problem appears to have abated (*2*, *30*). Due to strong academic programs in this and related areas, the availability of basic researchers should continue to be sufficient (*2*). However, a paucity of academic programs in bioprocess engineering continues (*2*). As more companies generate products of biotechnology for scale-up, it is expected that there will be a severe shortage of personnel trained in production technologies, which may hamper commercial success (*2*). Japan has the opposite problem—an adequate supply of fermentation engineers but too few basic researchers with training in molecular genetics (*16*). This is another reason why Japanese companies have been borrowing U.S. basic research, but are predicted to outpace the United States in commercialization (*2*, *3*).

Outlook

In January 1984 the U.S. Congress Office of Technology Assessment (OTA) published a 612-page analysis on commercial biotechnology (*2*). The report noted the importance of biotechnology both for its basic scientific benefit and for its potential commercial development. In assessing the competitive position for the United States, the OTA report stated the following (*2*, p. 7):

> Japan is likely to be the leading competitor of the United States for two reasons. First, Japanese companies in a broad range of industrial sectors have extensive experience in bioprocess technology. Japan does not have superior bioprocess technology, but it does have relatively more industrial experience using old biotechnology, more established bioprocessing plants, and more bioprocess engineers than the United States. Second, the Japanese Government has targeted biotechnology as a key technology of the future, is funding its commercial development, and is coordinating interactions among representatives from industry, universities, and government.

When the focus of analysis is narrowed to the pharmaceutical industry, it can also be concluded that the Japanese have the potential to be a leading competitor. An important factor in their success has been the borrowing of basic biotechnological research by Japanese companies from U.S. biotechnology firms. Although biotechnology licensed by U.S. firms to Japanese companies generally involves marketing rights in Japan or Asia (*2*), the Japanese market for pharmaceuticals is the second largest in the world. When added to other Asian markets, it becomes two-thirds the size of the North American or European markets (*9*). U.S. pharmaceutical companies have gained 40 percent of their revenues from foreign sales, and the loss of a foreign market may represent lost income (*9*).

In addition to basic biotechnology borrowed from the United States, Japan has been simultaneously building its own strength in this field. There are more and more frequent reports of new developments in basic biotechnology and discoveries of new drugs from Japanese industrial laboratories (Table 3) (*12*). It is thus possible that Japan's predicted future strength in pharmaceutical biotechnology will come both from internal developments and strategic government programs (*16*).

This is not to imply that with Japanese strength in biotechnology will come U.S. weakness in this area. As stated earlier, pharmaceutical and other companies in the United States are expanding their efforts in biotechnology and are nearing their goals of bringing new therapeutics and diagnostics to market. However, an analysis of Japanese strategies may help to understand how U.S. industry can optimize this process. In addition, U.S. industry will be strengthened if the U.S. government makes the commercialization of biotechnology a high priority and funds specific academic and other programs leading to that goal (*2*). As stated in the OTA report (*2*): "The United States may compete very favorably with Japan if it can direct more attention to research problems associated with the scaling-up of bioprocesses for production."

In addition, government activities that enhance cooperation between companies, decrease regulation, or provide centers to assist in biotechnology would help meet this goal (*2*, *6*, *31*). However, in the period since the OTA report was made public, no broad program of support to strengthen the U.S. position in biotechnology has been announced by the federal government.

Steps in the Right Direction

A few recent developments should prove useful to the future development of biotechnology in the United States. The first is the opening of biotechnology centers to assist in the transfer of biotechnology expertise from academia to industry. Two of these centers are at Pennsylvania State University and in Research Triangle Park, North Carolina. The Penn State Biotechnology Institute has planned research and educational facilities and will allow member companies access to "application-oriented research" and to a pilot production facility for assistance in scale-up (*32*).

The North Carolina Biotechnology Center currently receives $2.5 million in annual funding from state, federal, and industrial sources. The center funds specific programs, such as its Monoclonal Lymphocyte Technology Center, which involves academic research at the University of North Carolina and Duke University, the participation of industry, and funding by the National Science Foundation. The five industrial members agree on priorities for directed research to be funded by specific grants to participating laboratories. Although still in its infancy, the Monoclonal Lymphocyte Technology Center is fostering cooperation between companies in a university environment that probably would not have otherwise occurred (*33*).

The Center for Advanced Research in Biotechnology (CARB), to be built in Gaithersburg, Maryland, will combine federal, state, county, and university efforts (*34*). With CARB, the National Bureau of Standards will add its analytical expertise to molecular biology expertise from the University of Maryland. A CARB research facility to be completed

Table 2. Equity purchased in firms with a major focus on biotechnology. Equity purchases selected from database (*12*).

Large company (purchaser)	Biotechnology firm	Year
Purchased by U.S. pharmaceutical companies		
Abbott	Amgen	1980
Baxter Travenol	Genetics Institute	1982
Becton Dickenson	Applied Biosystems	1984
Johnson & Johnson	Enzo Biochem	1982
Lederle	Molecular Genetics	1981
Lederle	Cytogen	1983
Lilly	Synergen	1984
Schering-Plough	Biogen	1982
Schering-Plough	DNAX Ltd.*	1982
SmithKline	Beckman*	1982
Syntex	Genetic Systems	1982
Purchased by other U.S. companies		
Dow	Collaborative Research	1981
Du Pont	New England Nuclear*	1981
Fluor	Genentech	1981
W. R. Grace	Amicon*	1983
Martin Marietta	Molecular Genetics	1982
Monsanto	Biogen	1980
Monsanto	Collagen Corporation	1980
Purchased by Japanese companies		
Green Cross	Collaborative Research	1981
Mitsubishi	BioVec	1984

*Acquisition. Each nonacquisition purchase involved an average of $8 million.

Table 3. Comparison of U.S. and Japanese pharmaceutical industries and involvement in biotechnology. All 1983 data, except as noted. [Sources: (*1, 2, 9, 15*)]

Data category	United States	Japan
Population (millions)	234.5	119.2
Gross national product	$3.3 trillion	$1.2 trillion
Domestic pharmaceutical market (world rank)	$21.3 billion (1)	$13.4 billion (2)
Number of pharmaceutical companies with sales over $1 billion*	11	1
Total pharmaceutical sales of ten largest pharmaceutical companies†	$16.7 billion	$6 billion
Pharmaceutical sales as percent of total sales‡	50.1	74.1
Number of new pharmaceutical products introduced:		
1961–1980	353	155
1981–1983	24	41
R&D expenditures as percent of sales‡	6.8	9.2
Scientists and engineers in industrial R&D§:		
Total number	573,900	272,000
Percent of work force	0.58	0.50
Government-funded research in biotechnology:		
Total	$520 million	$60 million
Percent of basic research	>98	<50
Targets of funding in biotechnology	Basic research	Basic research, scale-up, industrial projects, government laboratory facilities, manufacturing technology

*Pharmaceutical sales only. †Total world pharmaceutical sales in 1983 were approximately $60 billion. ‡Average of top ten companies. §All industries, 1977 data.

the Ministry of Agriculture, Forestry and Fisheries (MAFF) (*2, 18*). The total government support for biotechnology, $50 million to $60 million in 1984, is only about one-tenth of that spent by the U.S. government (Table 3) (*2, 18*), but Japanese funding is much more focused on specific projects. For example, MITI, in a 10-year strategic program beginning in 1981, has targeted next-generation technologies to foster scale-up techniques, aimed at assisting in the commercialization of biotechnology (*2*). The STA is also funding applied research, such as the development of bioreactors (*2*). The latest announced budgets of STA, MAFF, and MITI are emphasizing national centers related to biotechnology research, including the development of cell line and gene banks (*18*). Very little of the Japanese government's support for biotechnology is for basic research (*2*). In contrast, the U.S. government's support of biotechnology is almost ten times more, but support of applied research makes up only 1 to 2 percent of this total, with far less specificity than in Japan (Table 3) (*2*).

Another emphasis in Japan is to foster cooperation between companies and between industry and academia. There are more than a dozen joint ventures on record involving two or more Japanese companies that are aimed at developing therapeutics through research in biotechnology (*2, 19*). Similar cooperation between large U.S. companies does not (or cannot) exist (*2*).

In order to further foster cooperation between Japanese companies, a trade association, tentatively called the Society for Advanced Pharmaceutical Research, was formed in 1985 with 31 member companies and the support of Japan's Ministry of Health and Welfare (*19*). A trade group, the Industrial Biotechnology Association, exists in the United States with 46 member companies, but is not supported by the federal government (*20*).

Because government funding in Japan is focused on applied research, Japanese companies are also in the process of expanding in-house expertise in basic research and development in biotechnology. Many companies have announced the expansion of research facilities, such as Sankyo's new $53-million biotechnology laboratory to be completed by 1986 (*21*). The availability of personnel to staff basic research laboratories in Japan has been a problem, primarily owing to a paucity of university programs in molecular genetics (*2, 16*). To fill the need for researchers, some Japanese companies

25. A. C. Olson and R. A. Korus, in *Enzymes in Food and Beverage Processing*, R. L. Ory and A. J. St. Angelo, Eds. (American Chemical Society, Washington, D.C., 1977), pp. 100–131; A. Kilara and K. M. Shahan, *CRC Crit. Rev. Food Sci. Nutr.* **10**, 161 (1979); H. O. Hultin, *Food Technol.* **37** (No. 10), 66 (1983).
26. M. L. Shuler, O. P. Sahai, G. A. Hallsby, in *Biochemical Engineering III*, K. Venkatsubramanian, A. Constantinides, W. R. Vieth, Eds. (New York Academy of Sciences, New York, 1983), pp. 373–382; S. M. Miazga and D. Knorr, paper presented at the 1984 International Congress of Pacific Basin Societies, Honolulu, December 1984.
27. J. E. Prenosil and H. Pedersen, *Enzyme Microbiol. Technol.* **5**, 323 (1983); P. Brodelius and K. Nilsson, *Eur. J. Appl. Microbiol. Biotechnol.* **17**, 275 (1983).
28. B. Wasserman, *Food Technol.* **38** (No. 2), 78 (1984).
29. A. M. Klibanov, *Science* **219**, 722 (1983); W. Carasik and J. O. Carroll, *Food Technol.* **37** (10), 85 (1983).
30. D. N. Bull, R. W. Thoma, and T. E. Stinnet, *Adv. Biotechnol. Process* **1**, 1 (1985); E. Bjurstrom, *Chem. Eng.* **92**, 126 (1984); B. C. Buckland, *Bio/Technology* **2**, 875 (1984).
31. C. L. Cooney, *Science* **219**, 728 (1983).
32. M. L. Shuler, J. W. Pyne, G. A. Hallsby, *J. Am. Oil Chem. Soc.*, **61**, 1724 (1984); M. W. Glacken, R. J. Fleischaker, A. J. Sinskey, in *Biochemical Engineering III*, K. Venkatsubramanian, A. Constantinides, W. R. Vieth, Eds. (New York Academy of Sciences, New York, 1983), pp. 355–372; W. E. Goldstein, *ibid.*, pp. 394–408.
33. D. N. Bull, *Bio/Technology* **1**, 847 (1983); H. R. Lerner, D. Ben-Bassat, L. Reinhold, A. Poljokoff-Mayber, *Plant Physiol.* **61**, 213 (1978); J. Feder and W. R. Tolbert, *Am. Biotechnol. Lab.* **3**(1), 24 (1985); P. Brodelius and K. Nilsson, *Eur. J. Appl. Microbiol. Biotechnol.* **17**, 275 (1983).
34. M. W. Fowler, in *Plant Biotechnology*, S. M. Mantell and H. S. Smith, Eds. (Cambridge Univ. Press, Cambridge, 1983), pp. 3–37; P. Hedman, *Am. Biotech. Lab.* **2** (No. 3), 29 (1984); O. Sahai and M. Knuth, *Biotechnol. Prog.* **1**, 1 (1985).
35. B. H. Kirsop, *Chem. Ind.* **7**, 218 (1981); J. W. Lee and A. Lopez, *CRC Crit. Rev. Food Sci. Nutr.* **21**, 289 (1984); K. M. Ulmer, *Science* **219**, 666 (1983).
36. B. Wolnak, in *Enzymes*, J. P. Danehy and B. Wolnak, Eds. (Dekker, New York, 1980), pp. 3–10; S. Hasegawa, U.S. Patent 4,447,456 (8 May 1984).
37. R. Aneja, *J. Am. Oil Chem. Soc.* **61**, 661 (1984); A. H. Rose, *Sci. Am.* **245**, 127 (September 1981); J. B. M. Rattray, *J. Am. Oil Chem. Soc.* **61**, 1701 (1984); D. L. Gierhart, U.S. Patents 4,485,172 and 4,485,173 (27 November 1984).
38. B. Jarvis and K. Paulus, *J. Chem. Techn. Biotechnol.* **32**, 233 (1982); L. R. Beuchat, *Food Technol.* **34** (No. 6), 65 (1984); D. Tuse, *CRC Crit. Rev. Food Sci. Nutr.* **19**, 273 (1983); S. Matz, *Sci. Am.* **251**, 123 (November 1984).
39. F. L. Davies and M. J. Casson, *J. Dairy Res.* **48**, 363 (1981); L. McKay, *Antonie van Leeuvenhoek*, **49**, 259 (1983); C. A. Batt and A. J. Sinskey, paper presented at the Symposium on the Importance of Lactic Acid Fermentation, Mexico City, December 1984; A. R. Huggins, *Food Technol.* **38** (No. 6), 41 (1984).
40. A. Kramer and B. A. Twigg, *Quality Control for the Food Industry* (AVI, Westport, Conn., 1970); R. D. Middlekauff, *Food Technol.* **38** (No. 10), 97 (1984); Y. Pomeranz and C. E. Meloan, *Food Analysis: Theory and Practice* (AVI, Westport, Conn., 1978).
41. R. L. Gatz, B. A. Young, T. J. Facklam, and D. A. Scantland, *Bio/Technology* **1**, 337 (1983).
42. H. J. Neujahr, in *Biotechnology and Genetic Engineering Reviews*, G. E. Russell, Ed., (Intercept, Newcastle-upon-Tyne, 1984), vol. 1, pp. 167–186; N. Smit and G. A. Rechnitz, *Biotechnol. Lett.* **6**, 209 (1984).
43. R. Dagani, *Chem. Eng. News* **62** (No. 46), 25 (1984).
44. E. L. Korwek, *Food Drug Cosmetic Law J.* **37**, 289 (1982); D. D. Jones, *Food Technol.* **39** (No. 6), 59 (1985).
45. H. Hemfort and W. Kohlstette, *Starch* **36**, 109 (1984); V. Wiesboden and H. Binder, in *Advances in Biochemical Engineering*, A. Fiechter, Ed. (Springer Verlag, Berlin, 1982), pp. 120–171.
46. W. A. Bough, *Process Biochem.* **11** (No. 1), 13 (1976); P. R. Austin, C. J. Brine, J. E. Castle, J. P. Zikakis, *Science* **212**, 749 (1981); S. Latlief and D. Knorr, *J. Food Sci.* **48**, 1587 (1983).
47. M. R. Kula, K. H. Kroner, H. Hustedt, in *Advances in Biochemical Engineering*, A. Fiechter, Ed. (Springer Verlag, Berlin, 1982), pp. 73–118.
48. E. Stahl and K. W. Quirin, *Naturwissenschaften* **71**, 181 (1984); L. G. Randall, *Separation Sci. Technol.* **17**, 1 (1982).
49. E. Stahl, E. Schütz, H. K. Mangold, *J. Agric. Food Chem.* **28**, 1153 (1980); J. P. Friedrich and E. H. Pryde, *J. Am. Oil Chem. Soc.* **61**, 223 (1984); H. J. Gährs, *ZFL Int. J. Food Technol. Food Process. Eng.* **35**, 302 (1984).
50. J. L. Dwyer, *Bio/Technology* **2**, 957 (1984).
51. P. D. Fullbrook, *J. Am. Oil Chem. Soc.* **60**, 476 (1983).
52. H. Ruttloff, J. Huber, F. Zicker, K. Mangold, *Industrielle Enzyme* (VEB, Leipzig, 1983).
53. W. Hartmeier, *Process. Biochem.* Feb. 40 (1984); B. Dixon, *Biotechnology* **2**, 594 (1984); D. Knorr, S. M. Miazga, R. A. Teutonico, *Food Technol.*, in press.
54. C. V. Morr, *Food Technol.* **38** (No. 6), 39 (1984).
55. R. R. Zall, in *Food Processing Waste Management*, J. H. Green and A. Kramer, Eds. (AVI, Westport, Conn., 1979), pp. 175–201.
56. D. Knorr, *J. Food Technol.* **12**, 563 (1977); F. Holm and S. Eriksen, *ibid.* **15**, 71 (1980); D. Knorr, *Food Technol.* **37** (No. 2), 71 (1983); J. R. Rosenau, L. F. Whitney, J. R. Haight, *ibid.* **32** (No. 6), 37 (1978).
57. R. S. Tutunjian, in *Biochemical Engineering III*, K. Venkatsubramanian, A. Constantinides, W. R. Vieth, Eds. (New York Academy of Sciences, New York, 1983), pp. 238–253; P. Jelen, *Agric. Food Chem.* **27**, 658 (1979).
58. G. G. Birch, K. J. Parker, J. T. Worgan, *Food From Waste* (Applied Sciences, London, 1976); J. H. Green and A. Kramer, *Food Processing Waste Management* (AVI, Westport, Conn., 1980); M. W. M. Bewick, *Handbook of Organic Waste Conversion* (Van Nostrand Reinhold, New York, 1980); D. Knorr, in *Sustainable Food Systems*, D. Knorr, Ed. (AVI, Westport, Conn., 1983), pp. 249–78.
59. D. Knorr, *Food Technol.* **38** (No. 1), 85 (1984); D. Rodriquez-Sanchez and C. Rha, *J. Food Technol.* **16**, 469 (1981); K. D. Vorlop and J. Klein, *Biotechnol. Letters.* **3** (No. 1), 9 (1981).
60. S. Revah-Moiseev and A. Carroad, *Biotechnol. Bioeng.* **23**, 1067 (1981); I. G. Casio, R. A. Fisher, P. A. Carroad, *J. Food Sci.* **47**, 901 (1982); J. Zikakis, Ed., *Chitin, Chitosan and Related Enzymes* (Academic Press, Orlando, Fla., 1984); papers presented at the Third International Conference on Chitin/Chitosan, Senigellia, Italy, 1 to 4 April 1985; R. L. Rawin, *Chem. Eng. News* **62** (No. 20), 42 (1984).
61. H. Skogman, in *Food From Waste*, G. G. Birch, K. J. Parker, J. T. Worgan, Eds. (Applied Science, London, 1976), pp. 167–179; Z. G. Moulin and P. Galzi, in *Biotechnology and Genetic Engineering Reviews*, G. E. Russell, Ed. (Intercept, Newcastle-upon-Tyne, 1984), pp. 347–374.
62. D. L. Wise, Ed., *Fuel Gas Development* (CRC Press, Boca Raton, Fla., 1984); D. A. Stafford *et al.*, *Methane Production from Waste Organic Matter* (CRC Press, Boca Raton, Fla., 1984).
63. Institute of Food Technologists (IFT) Workshop on Research Needs, Arlington Heights, Ill., 11 to 14 November 1984; B. J. Liska and W. W. Marion, *Food Technol.* **39** (No. 6), 81 (1985).

64. We thank the participants of the biotechnology topic at the IFT workshop on research needs, especially A. J. Stevens. Valuable comments on drafts of this article were provided by S. P. Shoemaker, M. J. Haas, K. Venkat, P. M. Walsh, and D. Kukich.

Space Arms Scientists in U.S. Selling Rights to Discoveries

By WILLIAM J. BROAD

A handful of Federal scientists quietly at work in their laboratories have touched off a heated national debate.

These inventors are selling their research on President Reagan's proposed system of missile defense for

First of two articles.

their private gain. They are being encouraged to do so by the Administration and hundreds of their scientific colleagues are expected to follow suit.

White House officials strongly defend the practice, which is permitted under the law and has grown rapidly since Mr. Reagan took office in 1981. The officials say the public interest is best served when Federal scientists can commercialize aspects of their work. This is particularly true, they say, of research on the Strategic Defense Initiative, known popularly as "Star Wars."

These officials say the policy spurs scientific incentive, industrial productivity and the realization of Government goals. Under previous Federal practice, Government inventions often went unused and undeveloped, they assert.

But critics, increasingly angry about the new approach, say conflicts of interests can arise when Federal scientists seek private gain from publicly financed research, resulting in distorted judgments and skewed aims.

Dr. Hugh DeWitt, a physicist at the Lawrence Livermore National Laboratory, said in an interview: "You're being asked to serve two masters. The temptation is to conduct your research in such a way that it satisfies monetary goals."

In response, Dr. Jack B. Marling, a Livermore physicist who has sold the

Continued on Page A12, Column 1

NY Times 11-4-85

Scientists Selling Space Arms Work

Continued From Page 1

rights of his laser invention to a private concern, said "serving two masters" was not the right way to look at Federal scientists who are engaged in commercial ventures.

"They're really serving one master, the human race," he said. "It doesn't matter whether they're working for the Government, the private sector, or both. The ultimate beneficiary will be the people, one way or another."

Patents and Industry

The debate is aggravated by two trends, according to both defenders and detractors of the commercialization of the missile defense research.

The first is the widening search for all kinds of spinoffs at the nation's Federal labs — a network of 755 facilities that spend about $15 billion a year. Instead of retaining all rights to inventions, as it did in the past, the Government today is encouraging Federal scientists to sell patents to industry, to accept private funds for research projects, to work with industry scientists in exchange programs and to found business ventures.

The second trend involves the expansion of research on missile defenses. Since Mr. Reagan's speech in March 1983 outlining his missile defense initiative, his vision has grown into a five-year, $26 billion program in which Federal laboratories play a pivotal role. Government scientists are pursuing not only exotic weapons but also advanced computers, optics, sensors, microcircuits, mirror coatings, nuclear reactors, rocket engines and industrial processes in dozens of areas. Last week the Pentagon disclosed that the plan for the missile shield, developed after a year of design work, calls for thousands of space satellites in a system with seven layers of weapons.

The debate is likely to intensify as more Federal scientists seek to profit from commercial spinoffs of missile defense research. In September, the director of the Strategic Defense Initiative Organization, Lieut. Gen. James A. Abrahamson of the Air Force, created a new office to encourage civilian spinoffs from the military program. On Oct. 8 he told a Congressional committee that missile-defense scientists have a "splendid opportunity to capitalize on the results of the research of the S.D.I. and apply it across all facets of our economy and society."

The New York Times/Jose R. Lopez

Dr. John P. McTague, a White House science official, said that Federal scientists today seldom commercialized their ideas.

Livermore Is Key Site

Although commercialization of missile defense research is still in its early stages, Federal scientists are excitedly planning to capitalize on their Government research and in some cases have already made financial gains. One center for such spinoffs is the Livermore laboratory in California, a facility for the design of nuclear weapons that was founded in the 1950's. Today the weapons laboratory, which employs 8,000 workers, is creating some of the most advanced technologies for the missile defense program.

According to Livermore scientists, one defensive technology with potential for spinoffs is a supercomputer known as S-1. In April 1983, shortly after Mr. Reagan's missile defense speech, Dr. Edward Teller, a founder of the Livermore laboratory, told Congress that the Livermore's S-1 supercomputer project was a key to making a defense against enemy missiles. "By using these upcoming supercomputers," he said, "we can make decisions in proper time so that we can orchestrate our defenses, and we can make sure that we do the best possible job in shielding ourselves from any strategic attack."

In addition to its defensive role, Livermore scientists say S-1 technology has wide commercial applications. One is a technique by which a laser can etch the circuitry of a room-sized supercomputer onto a single wafer of silicon. According to S-1 project scientists who are pioneering the process, such American companies as Magnavox are negotiating with Livermore scientists for the rights to commercial applications of the technology. The miniaturization goal is generically known as wafer-scale integration.

Potential for Industry

"The big companies realize they're going to have to go this way or be out of the business in 10 years," said Dr. Bruce M. McWilliams, who heads Livermore's laser approach to wafer-scale integration. He added that he and other members of his Livermore team had patented parts of the laser process.

Weapons, like lasers, that direct concentrated beams of energy are another missile defense technology being evaluated for commercial application. For instance, Livermore physicists have developed a powerful miniature accelerator to fire subatomic particles into special lasers that use electrons freed from atomic substance, potentially one of the Pentagon's most powerful space weapons.

The accelerator is also being promoted by its developer, Dr. Stephen M. Matthews, a physicist at Livermore, for use as a commercial radiation source for sterilizing fruits, vegetables, and processed food products. It would be safer than the chemicals used on many crops, according to Dr. Matthews.

The accelerator is six feet long and could be manufactured to sell for about $1.5 million, Dr. Matthews said, adding that its commercial utility is being evaluated by the Food Science Department of the University of California at Davis and that industrial contractors have shown interest.

"The benefits of big science should be channeled back to the taxpayer," he said. "The best way to do that is through the commercialization of the technology."

Communications Laser

A device related to the missile defense project from which Federal scientists have already profited is the blue-green laser, which is meant to beam messages from orbiting satellites to submerged submarines. The device is viewed by Livermore scientists as crucial for strategic defense because of its ability to transmit large amounts of information with great speed. Blue-green lasers could relay urgent messages about the size, direction and speed of a Soviet attack, allowing submarines to quickly fire interceptor weapons into space to try to knock out enemy missiles.

Last year, Dr. Marling, a key researcher, sold the rights for a blue-green laser detector to Helionetics Inc. of Irvine, Calif., which has contracts with the Navy for developing the communications system. The money Helionetics has paid for the rights to the laser will undoubtably be passed on to the Navy in increased costs for the communications system.

"The really good inventions have a wide impact only after they enter the commercial sector," Dr. Marling said. He added that in such highly productive countries as Japan there has been more interaction between the public and private sectors than in the United States.

Until 1980, the American Government tended to discourage Federal scientists from seeking private financial gains from their work, according to Government officials. It did this by issuing nonexclusive licenses for ideas patented at national laboratories and returning any profits to the treasury. Nearly anyone could pay a fee and receive rights to a Federal invention.

U.S. Holds Patents

Over the years the Government came to own 25,000 patents, but only 5 percent of them were commercially licensed. Policymakers in Washington said the problem was risk: No entrepreneur was willing to perfect a process that anybody could copy.

The emphasis on increased commercialization started around 1980 when two laws were passed encouraging the transfer of Government technology into the private sector by allowing Federal laboratories and employees to retain title to inventions and by encouraging the issuing of exclusive licenses to patents. This practice varies from the situation in private industry, where researchers normally retain no rights to their inventions.

Regulations are being written for recent amendments to the acts. There are also wide differences in how policies are applied at various Federal laboratories, since they are managed by universities, private contractors, and the Government itself under different sets of rules. In some cases, a researcher may receive nearly all the profits from the sale of the rights to a government invention. Other times, the sponsoring institution may retain much of the profit.

According to its proponents, commercialization has only recently come

Arms Work

$1.5 million, Dr. Matthews said, adding that its commercial utility is being evaluated by the Food Science Department of the University of California at Davis and that industrial contractors have shown interest.

"The benefits of big science should be channeled back to the taxpayer," he said. "The best way to do that is through the commercialization of the technology."

Communications Laser

A device related to the missile defense project from which Federal scientists have already profited is the blue-green laser, which is meant to beam messages from orbiting satellites to submerged submarines. The device is viewed by Livermore scientists as crucial for strategic defense because of its ability to transmit large amounts of information with great speed. Blue-green lasers could relay urgent messages about the size, direction and speed of a Soviet attack, allowing submarines to quickly fire interceptor weapons into space to try to knock out enemy missiles.

Last year, Dr. Marling, a key researcher, sold the rights for a blue-green laser detector to Helionetics Inc. of Irvine, Calif., which has contracts with the Navy for developing the communications system. The money Helionetics has paid for the rights to the laser will undoubtably be passed on to the Navy in increased costs for the communications system.

"The really good inventions have a wide impact only after they enter the commercial sector," Dr. Marling said. He added that in such highly productive countries as Japan there has been more interaction between the public and private sectors than in the United States.

Until 1980, the American Government tended to discourage Federal scientists from seeking private financial gains from their work, according to Government officials. It did this by issuing nonexclusive licenses for ideas patented at national laboratories and returning any profits to the treasury. Nearly anyone could pay a fee and receive rights to a Federal invention.

U.S. Holds Patents

Over the years the Government came to own 25,000 patents, but only 5 percent of them were commercially licensed. Policymakers in Washington said the problem was risk: No entrepreneur was willing to perfect a process that anybody could copy.

The emphasis on increased commercialization started around 1980 when two laws were passed encouraging the transfer of Government technology into the private sector by allowing Federal laboratories and employees to retain title to inventions and by encouraging the issuing of exclusive licenses to patents. This practice varies from the situation in private industry, where researchers normally retain no rights to their inventions.

Regulations are being written for recent amendments to the acts. There are also wide differences in how policies are applied at various Federal laboratories, since they are managed by universities, private contractors, and the Government itself under different sets of rules. In some cases, a researcher may receive nearly all the profits from the sale of the rights to a government invention. Other times, the sponsoring institution may retain much of the profit.

According to its proponents, commercialization has only recently come under fire because of its association with the politically sensitive missile defense program. They say potential problems have been exaggerated. They insist, for instance, that it is difficult for discoveries to be instantly profitable — a financial barrier that helps keep research from being skewed.

"One of the illusions of technology transfer is that there's a stock of technology on the shelf," said Albert H. Teich, head of public sector programs at the American Association for the Advancement of Science. "Most often there isn't a dual use — both 'Star Wars' and the corner store, for instance. It takes a lot of work to adapt something. It's not a widget that gets transfered. It's a much broader kind of thing."

Associated Press

Albert H. Meyerhoff, a lawyer at the Natural Resources Defense Council in San Francisco, said, "We rely on these scientists to be our brain trusts."

Chance of Abuse

The potential for abuse is very small, according to Dr. Eugene Stark, director of the industrial liaison office at the Los Alamos National Laboratory in New Mexico. He said one protection was the tiny amount of money to be made. At the Los Alamos National Laboratory in New Mexico, he said, officials estimate that five years from now, after the revolution in commercialization has become routine, royalties from the private licensing of patents might amount to $2 to $3 million a year spread among 7,000 scientists. Currently, he noted, Los Alamos has an annual budget of about $600 million.

Dr. John P. McTague, deputy director of President's Office of Science and Technology Policy, said the Government had to finish the job of opening the Federal labs before turning its attention to potential conflicts of interests.

"In principle there might be a problem if we had a large number of people engaged in garage-type ventures," he said. He added, however, that Federal scientists currently fail to commercialize enough of their ideas. "We clearly need greater linkages to the private sector. If that leads to other problems, so be it. I would like to have too much technology transfer. There are certainly ways to deal with problems when they come along, such as having local managers look into conflicts. But we need to deal with the first problem first."

In contrast, critics say commercialization has serious potential pitfalls that should be addressed from the start. "Federal servants are paid to be impartial," said Dr. Charles Schwartz, a physicist at the University of California at Berkeley. "If there are financial interests or conflicts, it raises questions of whether it's really disinterested advice coming from the labs."

One danger, critics say, is the great disparity in the evaluation of different kinds of projects. They say commercial spinoffs are easy to test — they work or they don't. But short of actual war, a missile defense system is too complex to ever be thoroughly assessed. The result, they say, is that a researcher making private profits might be tempted to cut cornors in evaluating the feasibility of complex public projects.

"Who's to say whether this stuff works?" asked John E. Pike, head of space policy at the Federation of American Scientists, a private, nonprofit group in Washington that has opposed the missile defense program. "With a vaccine it's really clear. But with 'Star Wars' there's not much opportunity for consumer feedback. You have to take somebody's word on it."

Previous Government policy, the critics say, served the public interest much better than is often claimed. It avoided the risk of diminished Federal efforts as Government scientists pursue monetary goals. Moreover, critics say the engines of commercialization may eventually run low on fuel. Some Government patents, they assert, are essentially worthless, having been filed defensively or as status symbols.

A final objection of the critics is that public monitoring of conflicts of interest under the new policy may be difficult or nearly impossible because of antiquated laws and regulations. A Federal researcher who sells the rights of an invention, for instance, might not have to reveal publicly whether he also owns stock in the recipient company.

"No one objects to technology transfer in general," said Albert H. Meyerhoff, an attorney at the Natural Resources Defense Council in San Francisco. "But you want it in a way that protects the public trust. At a minimum there should be full disclosure of any financial benefits accruing to government scientists from the for-profit use of their work products."

He added: "In general you're playing with fire when you mix the goals of the private sector, which is for profit, with the goals of the public sector, which should be devoted to finding new knowledge and benefiting society as a whole."

Next: Contractor's potential conflicts.

Inside the Administration

An Inside Washington Publication

An exclusive report on the Reagan Administration's economic, regulatory and management policies

Vol. 4 No. 38, September 19, 1985 Vol. 4

With costs exceeding $100-billion annually

OMB DRAFTS EXECUTIVE ORDER TO CRACK DOWN ON ABUSES IN FEDERAL GRANTS

The Office of Management & Budget is attempting to crackdown on abuses in the $100-billion federal grants program and has drafted an Executive Order that will prohibit government agencies and states receiving federal aid from issuing public funds to parties involved in "illegal" grant activities. Sources said the draft OMB order would create a consolidated federal list of all parties that have been "debarred, suspended or deemed ineligible" to participate in federal assistance programs, a prospect that is raising concerns from state and local groups who are the major recipients of federal grant money. State sources said they fear OMB may attempt to use the contemplated order for political purposes to cut-off assistance for grants that OMB does not want to fund. However, one OMB source denied this accusation maintaining the Executive Order would only be used in cases where a court or administrative law judge

(continued on page 9)

DRAFT OF REAGAN TRADE PLAN WOULD FIGHT UNFAIR TRADE, SUBSIDIZE EXPORTS

An internal policy paper prepared by the Reagan Administration's Trade Policy Review Group (TPRG), and made available to *Inside the Administration*, says the White House is considering a trade bill, expected to be formally announced by President Reagan this week, that would fight unfair trade practices by proposing major changes to U.S. trade remedy laws. At the same time, the paper pushes aggressive promotion of U.S. exports with subsidized financing and proposes the creation of a new export promotion agency. The paper proposes trade remedy law changes covering sections 201 and 301 of the trade act, as well as antidumping and countervailing duty laws. Administration proposals to change sections 201 and 302 of the trade act have been carefully avoided by the White House up to now because

(continued on page 5)

DOD LIKELY TO WITHDRAW TECHNICAL DATA REGS UNDER PRESSURE FROM INDUSTRY

The Dept. of Defense, under intense industry pressure, is likely to withdraw technical data regulations it proposed only last week to govern the ownership of proprietary technical data, computer software and copyrights used in billions of dollars worth of defense contracts, according to a Pentagon source, who said an onslaught of industry complaints may prompt DOD to rewrite the rules. The technical data regulations are significant to the Defense Dept. because they enable defense agencies to purchase spare parts on a competitive basis. Industry is concerned the proposed rules will require DOD contractors to give up virtually all of their rights to technical data. Industry complaints about the regulations were so intense last week that DOD called a select group of defense industry officials to the Pentagon to discuss the regulations. Source said after the meeting, DOD appeared to be ready to "start over" and redraft the rules.

The defense industry asserted the proposed regulations are so "flawed as to be unworkable [and]

(continued on page 7)

WHITE HOUSE REJECTS FDA POWER PLAY FOR EXPANDED ROLE IN BIOTECHNOLOGY

A White House work group recently rejected a request by the Food & Drug Administration to expand the role of the proposed Biotechnology Science Board (BSB) by usurping the National Institutes of Health's oversight authority for human gene therapy, one of biotechnology's newest frontiers. White House insiders explain that FDA would benefit from vesting greater biotechnology authority in the BSB since, under the most recent Administration draft plan for the board, FDA is slated to chair the board.

The Reagan Administration plans to establish the board as an interagency oversight mechanism to coordinate federal policy on biotechnology research but has not yet finalized the proposed make-up of the board. The work group, chaired by the Office of Science & Technology Policy (OSTP), has been grappling with how to incorporate the role of NIH's recombinant DNA advisory committee (RAC), which is the longest standing federal entity to review the safety of biotechnology research. Administration sources said the decision to reject BSB authority over human gene therapy may "have settled the question of where to

FULL TEXT OF REAGAN TRADE PROPOSAL, SEE PAGE 6

4. **Section 301.**

Two amendments to section 301 would include:

— enactment of a 24-month deadline on dispute settlement; and

— provision of extensions at petitioner's request.

5. **Section 201***

We could usefully amend section 201 in two ways:

— provision of some type of "fast track" procedure for perishable agricultural items; and

— promotion of structural adjustment, by requiring the International Trade Commission to assess the petitioning industry's prospects for adjustment to changing conditions of competition.

* Some in the TPRG noted that proposing amendments to section 201 in particular may aggravate the risk (already inherent in any Administration trade package) of inviting protectionist riders.

6. **Export Promotion Activities.**

An Administration bill would promote U.S. exports through, for example:

— authorization and appropriation of funds to enable the Administration to offer $1 billion in mixed credit loans, to enable U.S. exports to compete in third country markets until we can eliminate predatory mixed credit competition through negotiations; and

— creation of a semiprivate, non-profit U.S. export promotion organization funded by private contributions and user fees, and managed by business representatives with the support of state and local government trade development groups.

We could also include in an Administration bill two proposals of the House Republican leadership that we support, although the goals are already being achieved and do not require legislation:

— review of Foreign Commercial Service personnel to ensure their maximum effectiveness; and

— a requirement for U.S. ambassadors to provide annual reports on their embassies' export expansion strategy and accomplishments.

7. **Reduction of Export Disincentives.**

An Administration bill would include a longstanding proposal also supported by House Republican leadership, as well as a House proposal whose implementation does not require legislation, but which we could support. They are, respectively:

— clarification of the accounting provisions and of the liabilities of foreign agents under the Foreign Corrupt Practices Act of 1977; and

— improvement of the export licensing process for small business.

8. **Statement of National Trade Policy Objectives.**

The preface to any Administration trade bill would be a clear, forceful statement of the Administration's trade policy objectives.

DOD LIKELY TO WITHDRAW TECH DATA REGS. . . begins on page 1

would violate rather than implement" a 1984 procurement law that directed DOD to draft the regulations by October 19. But now because of the flap over the regulations, DOD is likely to ask Congress to extend the deadline so it can draft new regulations to meet the concerns of defense contractors. The proposed regulations have angered Commerce Dept. officials with sources saying the agency may appeal to Congress for oversight hearings. DOD and Commerce have had a long standing disagreement over the degree to which a government contractor should be required to relinguish technical data rights to DOD. Traditionally, DOD has sought more access to the data than Commerce thought was warranted.

To address the spare parts issue, Congress last year passed the Defense Procurement Act of 1984 (DPA) to authorize DOD to broaden, and in many cases require, access to technical data generated under federal contracts. But critics said DOD, in proposing the regulations, has gone far beyond the intent of Congress. A chief critic complained that DOD has "gone so far as to make awarding a contract contingent on a contractor giving up all rights to technical data."

DOD's deputy under secretary for acquisition management Eleanor Specter last week called key industry officials to the Pentagon to discuss their complaints according to informed sources who said she indicated a willingness to work with industry in revising the regulations. The defense industry, in a number of "marathon" sessions, has prepared a working response to the proposed regulations which sources said includes the following points:

Industry officials said DOD appears to be using government access to technical data rights as a bribe, pointing to the regulations' inclusion of a provision to allow the government to consider how much a contractor is willing to give up rights in data when awarding a contract. The officials charged this is in blatant disregard of Congress' intent to create a "balance of interest" between the government's need for access to technical data and a contractor's proprietary rights to keep that data, as stipulated in the DPA. The DPA does not permit the government to make that consideration.

The definitions used in the proposed regulations do not coincide with those of the statute, according to industry sources. For example, the DPA uses "commercial" to mean "offered for sale to the public" while DOD broadened its meaning to include "used regularly for other than government purposes." Similarly, DOD excludes technical data that has been developed with both federal and private funds from its definition of "developed at private expense" even though the DPA makes it clear that such data is included in this definition.

DOD's new policy statement appears to make broad demands for access to technical data according to industry sources who said the proposed regulations require access to data needed to meet the "government's mission" rather than limiting access to that data needed to meet "DOD's needs" as expressed in the contract. Industry sources also said the policy statement preceding the proposed regulations fails to include statements contained in the DPA pertaining to preserving the contractors' rights and restricting access only to form, fit and function data when possible or avoiding the acquisition of unnecessary data.

A key Administration official, conceding that DOD "probably went too far with the" proposed regulations, attributed the broad scope of the regulations to DOD's "natural response" to recent spare parts scandals. This official predicted that DOD would withdraw its Sept. 10 proposal, issue temporary regulations and, at the same time, ask Congress to extend the Oct. 19 deadline for implementing final regulations.

FIVE SECTION 301 TRADE INVESTIGATIONS AT CENTER OF NEW REAGAN POLICY

Preident Reagan, as part of his tougher trade policy stance, plans to use the broad authority vested to him under the trade act to inititate three investigations of alleged unfair trade practices to retaliate against countries that are closing their markets to the U.S. Reagan is calling for expedited resolution of two pending cases, but cautioned that while he will use the 301 powers, "as a lever to open closed doors abroad, we will continue to resist protectionist measures that would only raise prices, lock out trade and destroy the jobs and prosperity trade brings to all."

The three new cases mark the first time the President has inititated a 301 investigation under the trade act. The three cases allege unfair restrictions against foreign computers and related products from Brazil, tobacco trade restrictions in Japan, and access barriers in the Korean insurance market that lock out U.S. firms. They are joined by the two previous cases on European Community (EC) canned fruit subsidies and efforts to open the Japanese leather and leather footwear markets. While five cases are being investigated now, U.S. Trade Representative Clayton Yeutter also said the list is not inclusive and more cases could be added to it.

Under section 301, Reagan has the authority to take any "appropriate and feasible actions within his power to obtain elimination of unfair trade practices," said a White House spokesman. Specifically, he may impose duties, fees or restrictions on products and services of the offending country, and not necessarily ones related to those under investigation. Reagan may also deny licenses issued by federal regulatory agencies to foreign service suppliers. The degree and duration of these actions are up to the President, and he is even allowed to initiate them summarily without any investigation at all. However, Yeutter ruled out Reagan's use of the authority under 301 to impose trade sanctions without an investigation. "You do not treat trading partners this way," he said.

Brazilian informatics. The Office of the U.S. Trade Representative (USTR) will initiate 301 proceedings against "Brazil's unfair trade practices in informatics." According to a White House spokesman, Brazil's new "informatics policy" has tightly restricted imports over an eight-year period while allowing only wholly owned Brazilian firms to sell computers and computer products in the domestic market. This, the spokesman said, has unfairly locked out U.S. imports and forced several U.S. firms in Brazil to shut down and leave the country. Before a 1984 Brazilian law took effect, the Brazilian market increased by 30% annually between 1980-82, primarily due to the microcomputer segment, and U.S. exports only increased by 14% annually.

Japanese restrictions on U.S. tobacco exports. Tight Japanese restrictions against foreign imports of tobacco products will be the subject of this new 301 investigation. According to the White House, "U.S. cigarette exporters have faced significant barriers in the Japanese market, including high tariffs and excise taxes, a prohibition on manufacturing by foreign firms . . . and restrictions on distribution." In spite of "intensive efforts" by U.S. officials and exporters, the U.S. share in the $10-billion Japanese cigarette market has only risen from 1.4% in 1979 to 2.1% this year. Repeated promises by Japanese officials for an increase in the market share have not been acted upon.

Korean restrictions on U.S. insurance firms. The third new case will attempt to find ways for U.S. insurance companies to break into the Korean market. Private and diplomatic efforts over the past six years have "had only limited success," a White House spokesman said. Korean law still prohibits foreign firms from writing life insurance for Korean nationals as well as the most lucrative types of fire insurance. This is true despite Korea's "obligation to provide national (non-discriminatory) treatment to foreign firms under the Treaty of Friendship, Commerce and Navigation," he said. In 1984, the total value of premiums for insurance other than life was over $1-billion, and for life insurance, nearly $4-billion.

Stepped up negotiations on canned fruit and Japanese leather cases. Besides initiating three cases, the

THE BOOMERANG EXECUTIVE: NOW YOU CAN GO HOME AGAIN AFTER LEAVING THE CORPORATE FOLD

BUSINESS MONTH

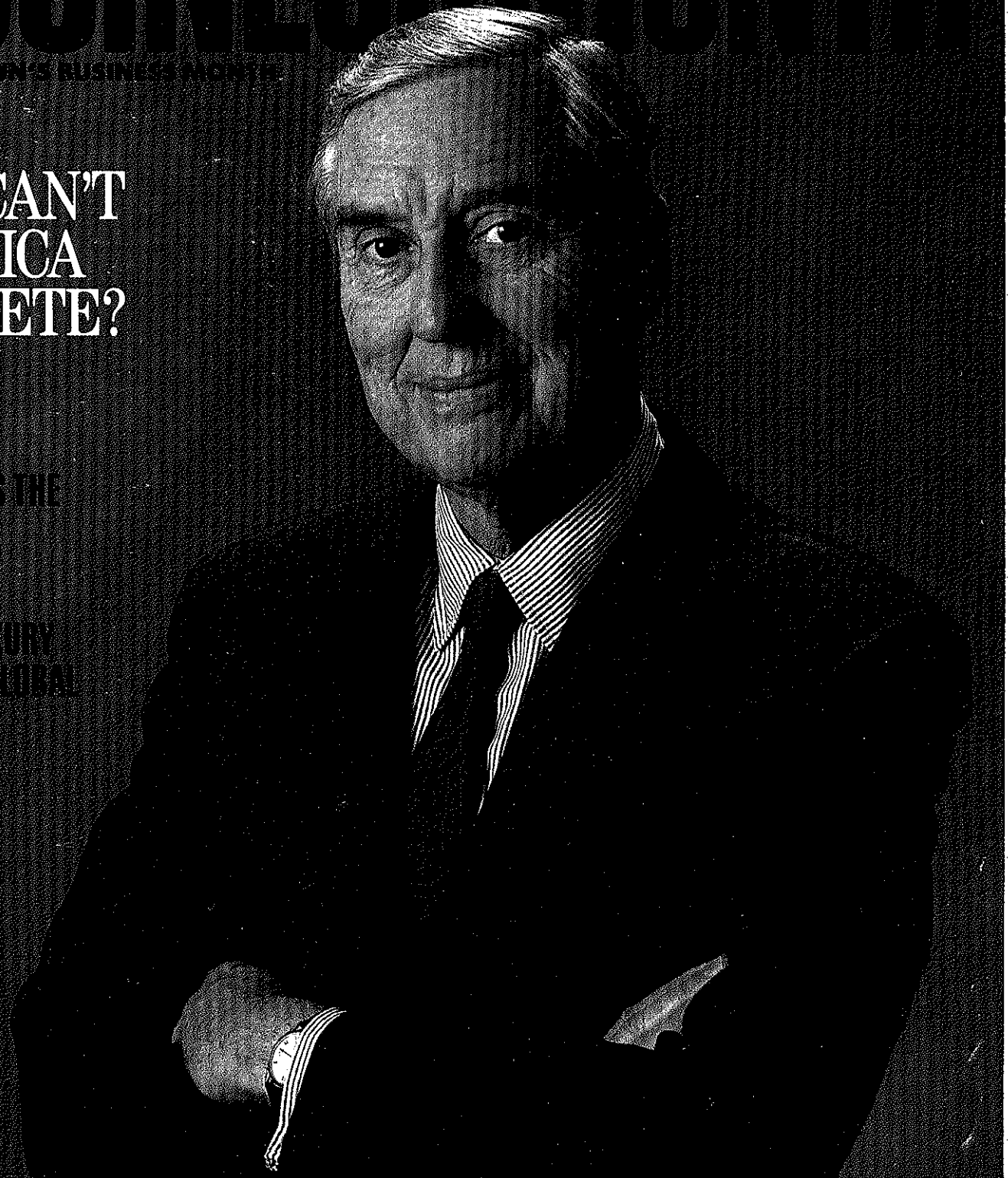
FORMERLY DUN'S BUSINESS MONTH

WHY CAN'T AMERICA COMPETE?

CFOS IN THE TRENCHES

U.S. STOCKS THE JAPANESE ARE BUYING

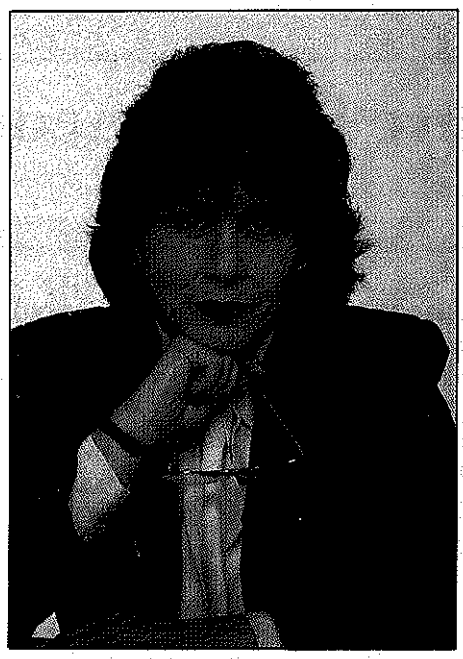
FRENCH LUXURY GOODS GO GLOBAL



LLOYD BENTSEN
CONGRESS' TOP MAN ON TRADE

FROM THE EDITOR

To Our Readers:



Welcome to BUSINESS MONTH. Under our new name and ownership, we will continue to report and analyze trends in business and the economy for senior executives.

New developments do not spring forth full-born in a day, a week or even a month. But once trends emerge, they become news that businessmen want to read about as quickly as possible. It is our editorial challenge to identify in February what you will want to read in April. Our aim is to be the first to pinpoint the trends that will have the most wide-ranging consequences for corporate management and to examine them in a concise, unbiased way.

Just as corporate America must continually renew itself to keep pace with ever-changing business conditions, a magazine must grow to remain relevant to its audience. We will be enriching the magazine's research and reporting with the additional resources invested by our new owners, the Goldhirsh Group, publisher of INC. magazine, *High Technology* magazine and *World Executive Digest*. We will travel farther to cover our beat and pack more information and insights into each article.

We will also offer new features in the months ahead. We have already responded to your requests for more Personal Finance coverage. Last month, we ran an article that discussed the impact of the new tax law on company perks; in the current issue, we reveal how executives are negotiating a better deal for themselves on early retirement offers.

We are very excited about the future of BUSINESS MONTH. We hope you will continue to enjoy the magazine and to profit from it.

Sincerely,

Gerald Hershman

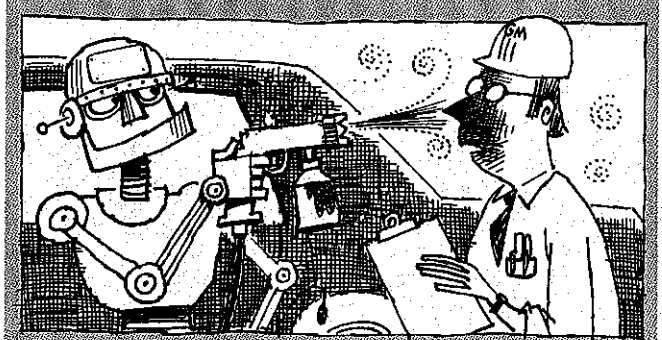
PHOTOGRAPH BY ROBERT CASS

60

March 1987, Vol. 129, No.3

MARKETING

The Business Month



20

BUSINESS MONTH

Editor:
ARLENE HERSHMAN
Managing Editor: CAROL LEVY
Executive Editor: GERALD R. ROSEN
Senior Editors: ROBERT LEVY, JOHN C. PERHAM, LYNN ADKINS (Chicago), MARC LEVINSON
Art Director: CYNTHIA FRIEDMAN
Copy Editor: GEORGE LUBASZ
Washington Editor: JOHN M. BARRY
West Coast Editor: THOMAS J. MURRAY
Foreign Editor: DAVID FAIRLAMB
Senior Writers: FRED V. GUTERL, AIMÉE L. STERN, DANIEL J. FORBES
Associate Editor: LEAH NATHANS
Assistant Editor: DAVID KILEY
Production Assistant: JOHN TIDWELL
Contributing Editor: LATON McCARTNEY
Production Manager: DOLLIE VIEBIG
Research Manager: ELAINE KINGOFF

Publisher: ROBERT A. POTTS
Assistant Publisher: EVELYN HURDY
Director of Circulation: JOE ZACCARIA
Reprints Manager: ELIZABETH LONGSWORTH
(For reprints, call 617-227-4700)

EXECUTIVE, EDITORIAL, SUBSCRIPTION, ADVERTISING OFFICES
875 Third Avenue, New York, N.Y. 10022
(Phone: 212-605-9400)

Editorial Bureaus:
Washington: 1225 "I" Street, N.W., Washington, D.C. 20005 (Phone: 202-289-1399)
Midwest: 405 N. Wabash Avenue, Chicago, Ill. 60611 (Phone: 312-661-1566)
West Coast: 3042 Country Club Drive, Costa Mesa, Calif. 92626 (Phone: 714-540-5518)
Europe: 27-33 Paul Street, London EC2A 4JU, England (Phone: 011-441-628-7030)

BUSINESS MONTH, Publication Number (USPS-921-160), March 1987, Vol.129, No.3. EXECUTIVE, EDITORIAL AND ADVERTISING OFFICES: 875 Third Avenue, New York, N.Y. 10022. Address all mail to: 875 Third Avenue, New York, N.Y. 10022. London Office: 27-33 Paul Street, London EC2A 4JU, England. West Coast Office: 2061 Business Center Drive, Suite 111, Irvine, Calif. 92715. Printed by Brown Printing Company, East Greenville Div., Route 29, RD1, East Greenville, Pa. 18041. Telex ITT 429073 techpub. Tel 212-605-9400. ISSN #0892-4090.

Member Audit Bureau of Circulations. Published monthly by Business Magazine Corporation.

SUBSCRIPTIONS: Please state title and company when subscribing. Publisher reserves the right to refuse nonqualified controlled subscriptions. Address correspondence regarding subscriptions, including change of address, to: BUSINESS MONTH, Circulation Dept., 875 Third Avenue, New York, N.Y. 10022. Please include your Zip Code, and in case of change of address, copy of old address label. Single copy price: $3. Subscriptions: U.S. Possessions, one year $32, two years $58; elsewhere, one year $45, two years $76. Air Mail, one year, $90. Second-class postage paid at New York, N.Y. 10001 and at additional mailing office. Printed in U.S.A. BUSINESS MONTH, Trademark® in U.S. Patent Office.

Prices on bulk reprints of articles available on request. This issue is published in Eastern, Central, Southern and Western editions as indicated by folio prefixes, E, C, S or W. This magazine is indexed in the Business Periodicals Index, in the Public Affairs Information Service, and also by volumes in an index available upon request to the Editorial Office. POSTMASTER: Send address changes to BUSINESS MONTH, 875 Third Avenue, New York, N.Y. 10022.

LETTERS

LOBBYISTS' BATTLE

"Business Lobbyists Battle Each Other" *(January)* was totally off the mark in its account of the Pharmaceutical Manufacturers Association's 1984 legislative travails. The eleven companies (including Schering-Plough) that split off from PMA's majority position on the legislation in question [to lengthen patent protection] believed that the "deal" cut by the then PMA president was not as good as could be gotten. The effort to win a better deal was successful and benefited all PMA members. The PMA president and chief lobbyist were fired only after the improved legislation was enacted.

ALLAN S. KUSHEN
Senior VP Public Affairs
Schering-Plough Corp.
Madison, N.J.

ECONOMIC TOOLS

"Economic Policy: The Old Tools Won't Work" *(January)* presented a detailed enough picture of the scope of the problem. However, it (or, rather, those economists interviewed) offered no meaningful insights into the causes, except to show that the domestic interests of each national government are in conflict. . . .

As the West has experienced in its decade-long struggle with the world's oil controllers, when the supply of an essential resource is monopolized, even price does not necessarily rule. Politics dictates economics; and, in the case of OPEC, the flow of oil became a weapon against the West. . . .

The reason, then, that national fiscal and monetary policies are ineffective is because they are not directed toward reducing the concentrated control over nature. Political directives, if they are to be in the interest of sustained economic growth, must provide incentives to produce and disincentives to hoard nature. Importantly, this must be accomplished without further destroying the institution of private property. Wherever land redistribution or nationalization of business has occurred, inefficiencies have resulted and the production of wealth impeded.

EDWARD J. JOHNSON
President
Henry George School of Social Science
New York, N.Y.

The article reasons that because we cannot better understand our economy, we no longer control our own destiny. Which means we aren't responsible for what happens in the future.

We always have had limited knowledge, but we have also always had unlimited responsibility in my view. Therefore, we are compelled to plug away until we gain understanding in order to control our destiny.

L.W. ALLISON
Painesville, Ohio

EXECUTIVE DRESS

Concerning "The Ins and Outs of Executive Dress" (*November 1986*): Either women executives go to work naked, or your editors have not yet recognized that there are women executives. . . . The exclusive focus of articles such as this one keeps me from getting too comfortable or smug about the acceptance of women in business.

ROBYN SMITH CHAMPION
World Trade Center Coordinator
Massachusetts Port Authority

FAN MAIL

I read with great interest the announced change in the magazine's ownership and name. . . . Change the name, change the ownership, but don't change the magazine.

L.D. MYERS
Branch Manager
Wilkins Pipe & Supply Co.
Keokuk, Iowa

Address Letters to LETTERS EDITOR, Business Month, 875 Third Ave., New York, N.Y. 10022

MANAGERS IN THE NEWS

ELECTRONICS
INTEL CORP.

When **Andrew S. Grove** arrived in the U.S. as a twenty-year-old refugee from the Hungarian uprising of 1956, he had no notion of what to do with his life. Now, as the newly named CEO of Intel Corp., Grove, 50, has a clear ambition: to steer the pioneering semiconductor firm back on a profitable track.

In the steep computer slump last year, Intel lost $173.2 million despite shedding more than 25% of its work force. "It was a really terrible year for us," says Grove. Now, orders are rising for its 80286 microprocessor and the newer 80386. "Intel seems ready for a dramatic turnaround," says analyst Adam Cuhney of Kidder Peabody & Co.

But Grove won't make any grandiose projections. He hasn't forgotten that both 1985 and 1986 started off well but then went bad. "Our goal is to become profitable again early in the year and then to have a slow and steady growth throughout 1987," he says.

Grove, who is known around Intel as a demanding manager—"I think of myself as an aggressive coach," he says—is the author of two books and a syndicated newspaper column on management. He joined Intel at its founding in 1968 and, along with co-founders **Robert Noyce** and **Gordon Moore**, has been part of the triumvirate that has run it from the beginning.

ENERGY
TEXAS EASTERN CORP.

Texas Eastern Corp.'s restructuring wasn't formally announced until a year after it began, but its chief architect, **Dennis R. Hendrix**, 47, has been at it since he was hired as president and chief operating officer in November 1985. Now the chief architect has taken over as chief executive from **I. David Bufkin**, who will remain chairman of the Houston-based energy company.

Hendrix has pared the company down to three core businesses: natural gas and petroleum products pipelines, international exploration and production and global marketing of liquefied petroleum gas. In addition to cutting, he has beefed up the core with acquisitions such as Algonquin Energy, a Northeastern pipeline company.

Hendrix is a former CEO of Texas Gas Resources Corp. and executive vice president of Halliburton Co. "He is a very informal manager who encouraged strong personal relationships," recalls Tom Hoppin, vice president of corporate communications at CSX, who worked with Hendrix after CSX acquired Texas Gas. "He was not a memo writer." Hoppin says Hendrix habitually made the rounds of all 45 staff offices at the end of each day. "He wasn't the kind of guy who waited for you to come to him."

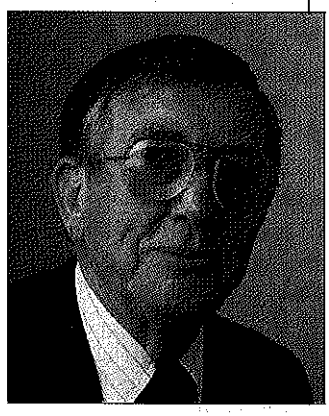
ENERGY
DIAMOND SHAMROCK

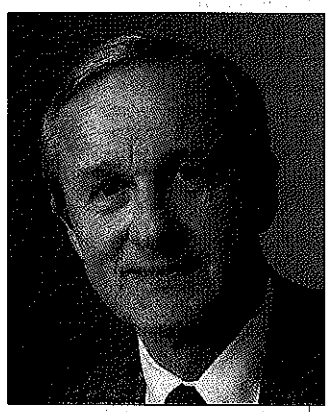
Two classic hands-on managers will replace the imperious **William Bricker** at Diamond Shamrock when T. Boone Pickens Jr.'s arch foe takes early retirement this spring at the age of 55. **Charles Blackburn,** 59, will head the as-yet unnamed exploration company to be created in Diamond's restructuring. **Roger R. Hemminghaus**, 50, will head the new refining and marketing company, which will retain the Diamond Shamrock name.

Blackburn joined Diamond Shamrock last year after 34 years at Shell Oil. At Shell, he was known for two big accomplishments: building it into the industry leader in finding low-cost reserves, and recommending that Shell buy Belridge Oil Co. in 1979, one of the great oil bargains of all time. He should help revive Diamond Shamrock's own flagging exploration. "Somebody's got to be the best," he told his managers recently. "We might as well be, and there's not any reason why we can't."

Hemminghaus has 25 years' experience in refining and marketing, including fourteen with Exxon, and has headed the division at Diamond Shamrock since 1985. He first learned to be a "walking around" manager as a young ensign under Admiral Hyman Rickover in the late 1950s. "I saw what an organization could accomplish when run by one very autocratic individual," he recalls. "But I don't think it accomplished as much as it could have had it captured the imagination of the people Rickover had working for him."

Grove: Orders are rising at Intel after "a terrible year," but he's not making any grandiose predictions





Blackburn (top) and Hemminghaus: Two hands-on managers pick up the pieces at Diamond Shamrock

Handel. With care.

Blue Cross and Blue Shield of the National Capital Area

CHRIS B. HALL

CERTIFICATE NUMBER
123 45 6789

GROUP NO. 00125

BC PLAN 240

COMPREHENSIVE

10/76 ISSUED

Your daughter has practiced long and hard for her recital. Unstopped by a broken leg. You took care to protect her with the card that can orchestrate an entire concert of health care services. In case of accident, or some other medical problem. For peace of mind, you carry the Blue Cross and Blue Shield caring card.

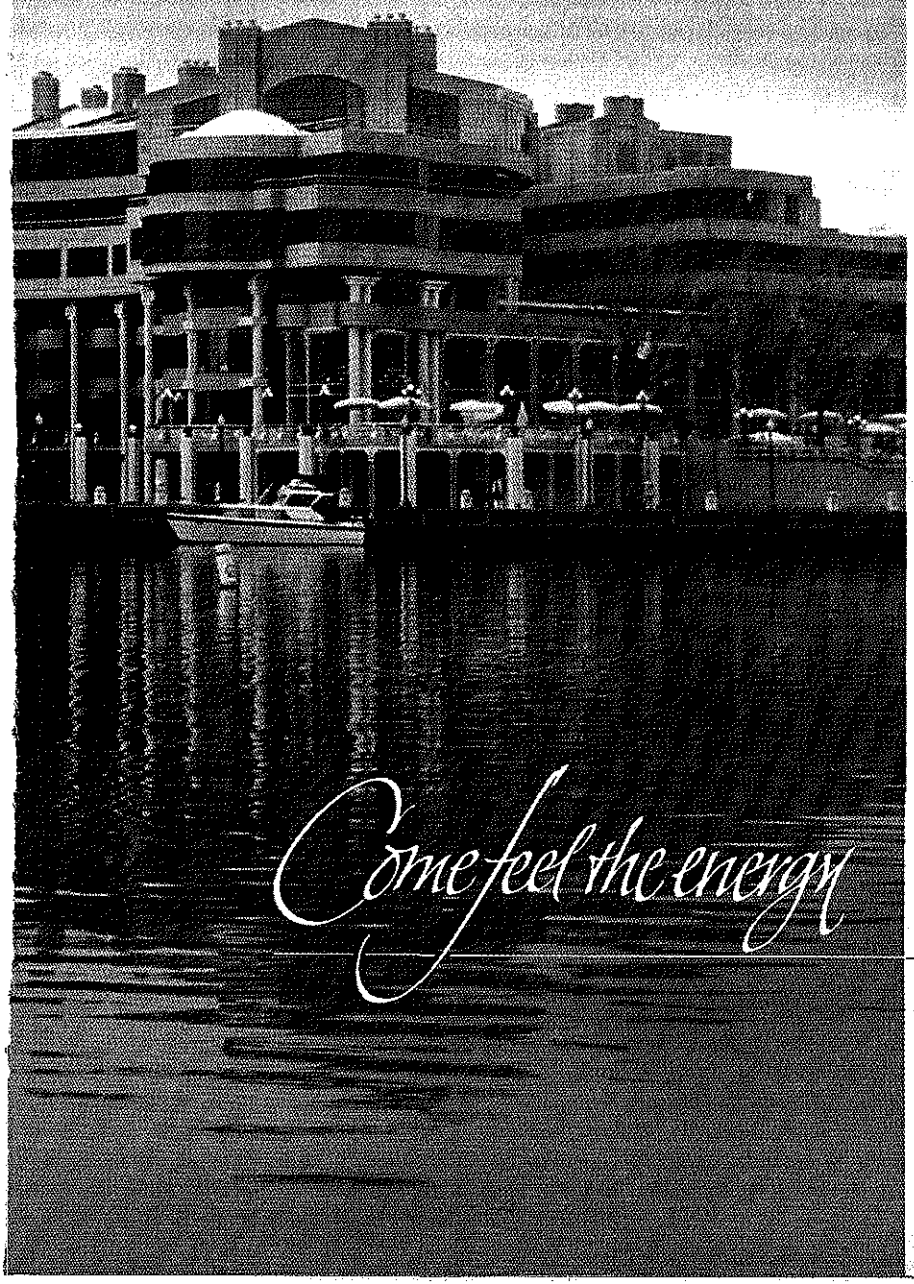
From Blue Cross and Blue Shield of the National Capital Area, 550 12th St., S.W., Washington, DC20065.

Because you care, carry the caring card.®

WASH/BE 1

THERE ARE LOTS OF GOOD REASONS TO LOCATE IN WASHINGTON.

ONLY ONE OF THEM HOLDS WATER.



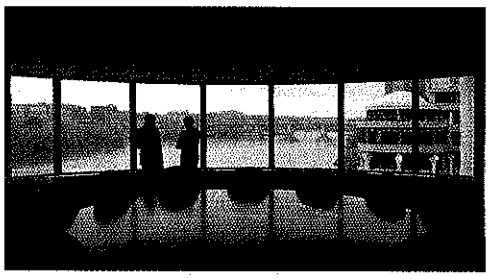
WORLD CLASS OFFICE LIVING.

Your Washington Harbour office. A very special business living environment. Where leadership and professional service can attain unparalleled excellence.

Where light streams in through sweeping expanses of glass...and windows open to panoramic sunsets on the banks of the Potomac.

Combine this with opulent lobbies, flowering promenades and the dancing waters of the largest fountain in the nation's capital. Where your every business need is met by impeccable concierge services. One of a kind restaurants. World class dining. Affordable bistros for lunch. A location that is accessible, uncongested. A location that exudes an atmosphere of success. Authority.

That is Washington Harbour. Those who are here will tell you...it's high-profile office living in world class style.



A Premier Location on the Banks of the Potomac River.

Easily Accessible to Downtown and Major Transportation / Office and Residential Concierge Staff / Private Parking / Seasoned Management / Elegant Lobbies / Limousine, Valet, Travel, Florist and Financial Services / Voice-Data Telecommunications Options / World Class Restaurants / Gourmet Cafés / Retail Space Available

WASHINGTON

WH

HARBOUR

Residences Also Available
For Office Leasing Contact
Barnes, Morris & Pardoe, Inc.
202/463-8200
Washington Harbour Marketing Center
202/944-4140
3050 K Street, N.W.
Washington, D.C. 20007 WASH/BE 5

THE BUSINESS MONTH

NEWS ROUNDUP

WASHINGTON

End of The Reagan Revolution?

How times have changed. After the 1984 Reagan landslide, some Democrats argued that political reality required the party to adopt a more conservative stance. But liberals objected, deriding the idea as "me-tooing" the GOP. Now, just two years later, the Republicans' are beginning to "me-too" the Democrats. The era of shrinking government is over, say the politicians of both parties, and new social programs will soon be the order of the day.

Indeed, both Senate Republican leader Bob Dole—a leading Presidential contender—and GOP Chairman Frank Fahrenkopf recently talked about the need for "compassion," and insisted Republicans were every bit as compassionate as Democrats. And Democrats have stopped sounding like Republicans.

The switch stems from the latest polls, which indicate voters are becoming uneasy about the economy, and are concerned that the middle class is shrinking. On the question of which party will better protect the middle class, Democrats led Republicans by 25 points. Democrats also led by 16 points on which party would handle unemployment better. Concludes House Democratic Whip Tony Coelho: "There's a tremendous opportunity for Democrats."

That translates directly into new policy directions. Concern for competitiveness is one, particularly the focus on education and worker retraining. The drive for catastrophic health insurance *(see below)* is another, and demonstrates a new Republican direction. And these shifts symbolize a return to activist government, an approach that was supposed to be ended by the Reagan Revolution.

The Red Hot Health Care Issue

The bandwagon for catastrophic health care is rolling through Washington. It has such political moxie that President Reagan has decided to go for the program fashioned by Health and Human Services Secretary Dr. Otis Bowen and reject the advice of the White House Domestic Policy Council, chaired by Attorney General Edwin Meese. Old-line Reaganauts, led by Meese, fought hard against the idea, which runs directly counter to the President's philosophy of curbing the role of government. But, in the end, White House political advisers won the day.

When Bowen announced his plan to provide catastrophic health insurance through Medicare late last year, it set off a firestorm of protest from conservatives. But it was immediately embraced by many mainstream Congressional Republicans, including GOP House Leader Bob Michel. These politicians were responding to grass roots pressure, not only from oldsters, but from their children. With the cost of medical care rising by almost seven times the rate of inflation, middle-aged Americans worry that catastrophic health costs could wipe out their parents' life savings.

Otis Bowen

WIDE WORLD

With Reagan on board and the Democrats determined to reap some of the political benefit, federal catastrophic health insurance should become law this year.

Trustbusters Begin to Stir

In just three months, the Justice Department's long quiescent antitrust division has opposed five proposed mergers. It is trying to block Rheem Manufacturing Co.'s acquisition of another water heater manufacturer, Bradford-White Corp., and the purchase of Lorimar-Telepictures Corp.'s Metrocolor film laboratories by a partnership in which a participant already controls competing Technicolor Inc. Justice has also demanded changes in the merger pact between oil service giants Baker International and Hughes Tool Co., in Domtar Inc.'s acquisition of Imasco Ltd's gypsum operations, and in the sale of Dow Chemical Co.'s bromide business to Ethyl Corp.

This sudden burst of activism has made business edgy about the new antitrust chief, 31-year old Charles Rule, who took over in December. But experts say these actions do not herald a reversal of antitrust policy. Rather, they reflect the large number of recent merger proposals. "Out of the tremendous number of filings at year-end, you would expect a greater number of situations where you had a problem," says James T. Halverson, an antitrust specialist at New York law firm Shearman & Sterling. ■

ECONOMY

The Economic Outlook Brightens for 1987

Suddenly there's good news. The dollar's sharp plunge last month against the deutschemark and the yen, combined with the apparent stabilization of oil prices at $18 per barrel, is bound to speed up the economic pace.

The lower dollar is likely to lead to a significant improvement in the trade picture, as the U.S. regains its attractiveness as a manufacturing base. More expensive oil should help revive the depressed economies of Loui-

priority must be answered. And because local service is still regulated, some tedious accounting is needed to allocate system costs between telephone and data services.

Bashing Big Blue

Digital Equipment Corp. has been besting International Business Machines Corp. recently on virtually every front: earnings, product positioning and stock performance. In the latest quarter, DEC's profits were much better than Wall Street analysts had expected, while IBM's were worse. DEC reported an 87% jump in earnings; IBM's were down 48% for the quarter and 27% for the year. Most analysts are now forecasting that DEC's full-year results in June will be up 50%.

Nobody, of course, is counting Big Blue out. But the company, industry analysts say, grew fat and sluggish in the top spot. "IBM simply lost touch with its customers," says Kimball Brown, computer analyst at technology research firm Dataquest Inc.

Now IBM is taking steps to get its house in order: an early retirement program for 10,000 employees, a $1.5 billion reduction in capital spending and the shutdown of a major distribution center. It also plans to buy up to 15 million of its own shares to shore up its lagging stock price.

Cost-cutting will help, but IBM's big challenge is to generate new revenue growth. That will not be easy, for it faces big problems in major markets.

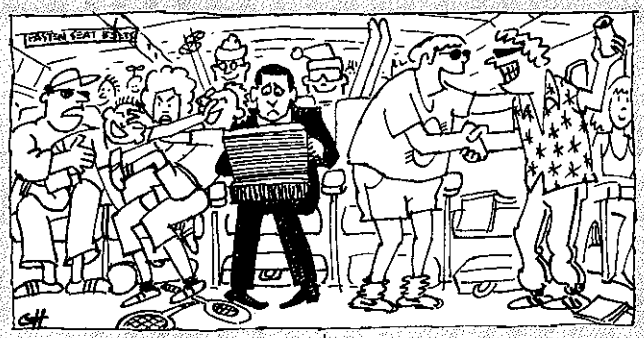
It is still not a player in the fast-growing office networking market that has proved so heady for DEC. While it still owns about 80% of the mainframe market, its historic foundation, it now faces competition from DEC's new mainframe, which competes directly with the powerful IBM 3090 model 400. The DEC machine undercuts IBM's prices by as much as 40% and is expected to sell well at a time when demand is soft, especially in combination with DEC's networking. Although IBM has countered with a more powerful version of the 3090, industry analysts say the new product lacks any major new features or functions. "It was just a way to breathe life into the only product that IBM had that made money last year," Brown says.

The outlook for IBM in personal computers is not particularly rosy either. While PC sales are slated to rise about 8% this year, most of the growth will be generated by Apple and IBM clones, according to a recent Dataquest report.

On a more upbeat note, IBM has told industry analysts that it already has big orders in hand for the new line of minicomputers it plans to introduce in the fall to compete with DEC's popular VAX machines.

Flying for Fun and Freebies

Last year, there was more pleasure flying on U.S. airlines than business flying. According to a Gallup Poll conducted for the Air Transport Association, 54% of all



airline trips in 1986 were personal. It was not that there was less business travel, analysts say, there was a lot more personal travel.

Major reasons: Deeply discounted Super Saver tickets, which made flying so inexpensive that many more people took advantage of it, and the airlines' frequent flyer programs, in which a specified number of miles flown qualifies the passenger for a free trip or a free upgrade to first class. Often, passengers would qualify for frequent flyer freebies on cheap Super Saver tickets.

So the airlines are tightening up on frequent-flyer qualifications. United Airlines has raised the miles needed for a first-class upgrade to Hawaii from 10,000 to 30,000. Northwest has halted all free first-class tickets on domestic routes. Other carriers say they are keeping closer tabs to make sure freebies are not transferred to family members or friends.

The airlines say the frequent-flyer programs became so generous that even infrequent flyers were getting free trips and freebie passengers were filling up the planes. So many people qualified for free or upgraded service on United flights to Hawaii, for example, that paying customers were turned away, says Suzanne Weiss, manager of United's frequent-flyer program.

Airline Maxi-Savers Open The Door

The latest tactic in the airline price wars—deep discounts for a two-day advance purchase of tickets—will cost the airlines in the short-term. But over the long run, it could lead to a rich source of revenue. Reason: The tickets are not refundable.

The new fares—dubbed Maxi-Savers—are priced around 40% below the thirty-day advance purchase Super-Saver fares. They were initiated by Texas Air when it folded New York Air and People Express into Continental Airlines on February 1 and wanted to establish a presence in their markets. The other airlines quickly followed suit. "Continental opened the door, and everyone in the industry is secretly cheering," says Edward Starkman, airline analyst at PaineWebber Inc.

Indeed, the airlines are looking forward to the day when all discounted tickets will be nonrefundable. American Airlines plans to stop offering the two-day advance tickets on March 2 and sell its thirty-day advance tickets on a nonrefundable basis. The still unanswered question is how substantial a discount the carriers must offer to

ILLUSTRATIONS BY GARY HALLGREN

It's the closest you can get to having two business jets for the price of one.

The incomparable Astra.

You have the right to expect a great deal from a business jet. It should be able to handle all your travel needs, from a short hop to a 3,500-mile flight. It should be fast, economical, spacious, comfortably appointed and, above all, affordable.

Amazingly, there is only one midsize jet on the market that can do it all: Astra.

The newest and most technically advanced jet in its class, Astra can take you coast-to-coast or across the ocean at eight-tenths the speed of sound. Yet it has both the power and the handling qualities to permit landing and takeoff at smaller, more convenient airports.

Its large, elliptically shaped cabin provides an exclusive "oval office" with stretch-out seating for up to nine passengers, a well-stocked galley, and a true airline-style lavatory. The cockpit boasts state-of-the-art Collins avionics. And at any speed, the powerful twin Garrett turbofans can be heard as little more than a muted murmur.

Yet, for all its unmatched versatility, a new Astra is priced at less than $5 million! And that is a great deal.

If you'd like a demonstration, or more information, please call Gordon Carr, VP Sales, at (302) 322-7244. Or write him at Atlantic Aviation, P.O. Box 15000, Wilmington, DE 19850. And find out why Astra really is the closest thing to having two business jets for the price of one.

ATLANTIC AVIATION®

for the Financial Executives Institute, which endorsed the summary report on the grounds that some shareholders want more detail than others.

Directors: How Big A Stake?

What's the optimum stake directors should own in a public company? Less than 20% but more than 5%, according to a study by the National Bureau of Economic Research.

Companies that are more than 20% owned by directors are the worst performers in both profit growth and the ratio of market value to the replacement cost of physical assets, the study showed. Companies that are less than 5% director-owned do somewhat better, but their performance is still only average.

When directors have a big position, "control seems to override maximizing the value of the investment," says Princeton University's Andrei Shleifer, one of the study's authors. They are more liable to spend company funds on themselves for pricy private jets, meetings in exotic resorts.

By contrast, when directors don't own enough, they may not stand up to management for fear of losing their seats on the board. Companies in the middle range are the best performing, Schleifer speculates, because the directors "have a very real interest—their own investment—in monitoring management" and yet "they probably are not so very rich, so the stake is more important to them."

MONEY & MARKETS

Gerald Corrigan's Plan Starts Picking Up Steam

Financial services executives across the nation are carefully studying the sweeping restructuring of the industry being proposed by President E. Gerald Corrigan of the Federal Reserve Bank of New York. As they point out, Corrigan could be echoing the views of Federal Reserve Board Chairman Paul Volcker. "He is close to Volcker and they have been of one mind on a wide range of issues in the past," says partner John Danforth of Washington bank consulting firm Golemby Associates. "If the past is any indicator of the future, it is only reasonable to assume that Corrigan's views are similar to the chairman's on this subject."

The Corrigan plan would construct a definite framework for the financial services industry. The blurring of distinctions among banks, securities firms, insurance companies and investment banks over the past decade has been done in piecemeal fashion. And many of the myriad proposals for deregulating the industry have been fraught with self-interest, as the players have attempted to move into new areas themselves while keeping others out of their businesses.

E. Gerald Corrigan

WIDE WORLD

Corrigan envisions the establishment of three types of financial institutions: banks or thrift holding companies, financial holding companies and commercial companies. Everybody in the industry would be allowed to select which of the three types they want to be; they would then be subject to specific applicable regulations.

Among the key elements of the plan: Bank or thrift holding companies would be permitted to underwrite and trade corporate stocks and bonds; financial holding companies, such as securities firms and investment banks, would have access to short-term borrowing from the Fed; and both types of companies would be subject to federally mandated reserve requirements.

The big losers would be the slew of commerical companies—such as Sears, Roebuck, Ford Motor and American Can—that have aggressively entered the financial services arena. They would be barred from owning or controlling a bank or thrift, although Corrigan expects "a very long divestiture period."

Initially, at least, banking executives appear to be very receptive to the Corrigan restructuring. Chairman John Swearingen of Continental Illinois Corp., for one, calls it "a very positive move."

John Danforth believes that the banking industry will drop its previous proposals and rally around the Corrigan plan. "Of course, certain measures will be opposed," he says. "But I think this will be the platform from which everyone—including the securities firms—will have to operate when Congress looks at a total overhaul of financial services."

The Allure of Gold Mine Companies

Harried gold traders last month drove the price of the precious metal below the psychologically important level of $400 an ounce. Yet the tarnish in gold prices did nothing to dull the bright prospects that many analysts see for gold-mining companies. Says John Tumazos of Oppenheimer & Co.: "Gold-mining is one of the very few sectors in basic industry providing attractive investment opportunities."

Capable of low-cost, high-profit operations, some gold-mining companies boast net profit margins of 30% or more. Nor has the metal's lustreless price discouraged digging for more ore. In some Canadian fields, reports Chairman Douglas J. Bourne of Battle Mountain Gold Co., "it's standing room only."

The dip below $400 was "just one day's action," says Dennis Suskind, partner in charge of metals at J. Aron & Co. "There is no doubt that gold-mining is one of the very few profitable mining ventures around." Adds Bourne: "We can be profitable with gold at $235."

FREE INFORMATION BUSINESS MONTH

Literature on products advertised and featured in this issue is available free from the companies listed below. Just circle the numbers on the attached postcard that correspond with the products or companies you are interested in.

PRODUCTS & SERVICES

1 AGS Computers
2 Atlantic Aviation
3 Chevrolet Fleet Sales
4 Hitachi America Ltd.
5 Mitel
6 NCR Corporation
7 Oldsmobile Cutlass Ciera
8 Xerox Corporation

PLANT SITE

9 Delaware Development Office
10 Louisiana, State of
11 Michigan Department of Commerce
12 Missouri Division of Community & Economic Development
13 Netherlands Foreign Investment Agency
14 New Jersey Department of Commerce & Economic Development
15 Puerto Rico, Economic Council of
16 Southern Indiana Gas & Electric Co.

ANNUAL REPORTS

17 Leybold-Heraeus GmBh

BUSINESS MONTH

MARCH 1987

BUSINESS MONTH/ FREEFAX MAIL SYSTEM

Please send the information corresponding to the circled numbers below:

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30

TITLE (Please check)
A ☐ Chairman of the Board
B ☐ President
C ☐ Vice-President
D ☐ Treasurer/Secretary
E ☐ General Manager
F ☐ Division Manager
G ☐ Department Manager
H ☐ Management, other
J ☐ Controller
K ☐ Other:_____

Are you currently a Business Month subscriber? ☐ Yes ☐ No

Name_____Title_____

Company_____

Address_____

City_____State_____Zip_____

Telephone #_____

VOID AFTER 6/15/87

NO POSTAGE NECESSARY IF MAILED IN THE UNITED STATES

BUSINESS REPLY MAIL
FIRST CLASS PERMIT NO. 04087 NEW YORK, NY

POSTAGE WILL BE PAID BY ADDRESSEE

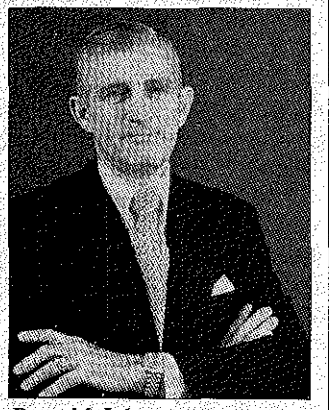
ATTN: EVELYN HURDY
BUSINESS MONTH
FREEFAX MAIL SYSTEM
875 THIRD AVENUE
NEW YORK, NY 10022

ADVERTISING

Troubles Not Over for JWT

The initial furor over the top-management shakeup at J. Walter Thompson Co. is subsiding, but the ad agency's problems certainly are not. Now that Donald Johnston has fired Chairman Joseph O'Donnell—after O'Donnell's attempted palace coup to assume control of the company failed—and taken the job back himself, JWT's financial problems loom larger than ever.

In his decade-long tenure at JWT, Johnston turned the once-dubbed "J. Walter Tombstone" into one of advertising's most creative agencies. But its costs mushroomed. In the wake of wholesale layoffs and other cost-cutting measures in the business, the JWT staff remained fat, and employee bonuses kept getting bigger. "Johnston's management style is to service clients and then they will take care of you with increased business," explains analyst Charles Crane of Prudential-Bache Securities. "So JWT has had a tradition of having a heavier staff than other agencies. But this doesn't work in a poor economic climate."



Donald Johnston

There also have been numerous problems with the company's international operations. Most of the high-priced foreign agencies Johnston bought are still struggling, and in 1985 JWT took a $2.8 million write-off when it divested its Paris-based EA-International Group.

JWT's earnings have been falling dramatically. After Johnston took back the reins in late January, he told security analysts he expected a $5 million loss in the 1986 fourth quarter and full-year earnings of 50 cents-to-70 cents a share, down from $2 in 1985.

Johnston unveiled a cost-cutting plan at the analysts' meeting. "The plan is a bit ambitious," says David Liebowitz of brokerage American Securities, "but there's a good chance they may be firmly in the black by the end of 1987." ■

COMPANIES

Apple Pulls Out the Stops In the Office Market

In the two years he has had a free hand in running Apple Computer Inc., Chairman John Sculley has been more successful than anyone expected in establishing a beachhead in the business market. His weapon: the remarkable graphics and easy-to-use software of the Macintosh personal computer. Macintosh sales doubled in 1986 and accounted for 7% of personal computer sales to business, according to research firm Dataquest.

Now Apple is trying to crack the corporate market wide open with a barrage of new products designed to make the Macintosh fit in among the menagerie of computer products that occupy the typical office. "Apple wants the Macintosh to be the desktop terminal for the IBM and Digital Equipment worlds," says CEO Andrew M. Seybold of the Seybold Group Inc. consulting and market research firm. "It is going to establish itself as the second standard."

Last month, Apple unveiled a software package that converts a Macintosh to a so-called file server—that is, a central repository of data on an Apple PC network—and a plug-in card for the IBM PC that allows it to hook up to the AppleShare network.

And it is reportedly planning an upgraded version of the Macintosh to make it substantially more flexible for business use. The new Mac will contain six-to-eight expansion slots for plug-in cards that add more functions, according to *Computer and Software News*, a trade publication.

To be sure, Apple faces a long, uphill battle against IBM in the business market. Its PC network is too slow, critics say; it needs to wean itself from retailers; and Big Blue is following fast on its heels with Mac-like graphics for its PCs. Nevertheless, the ingenious design of the Macintosh is expected to give it at least a year's lead over the competition.

Kaiser Files Chapter 11

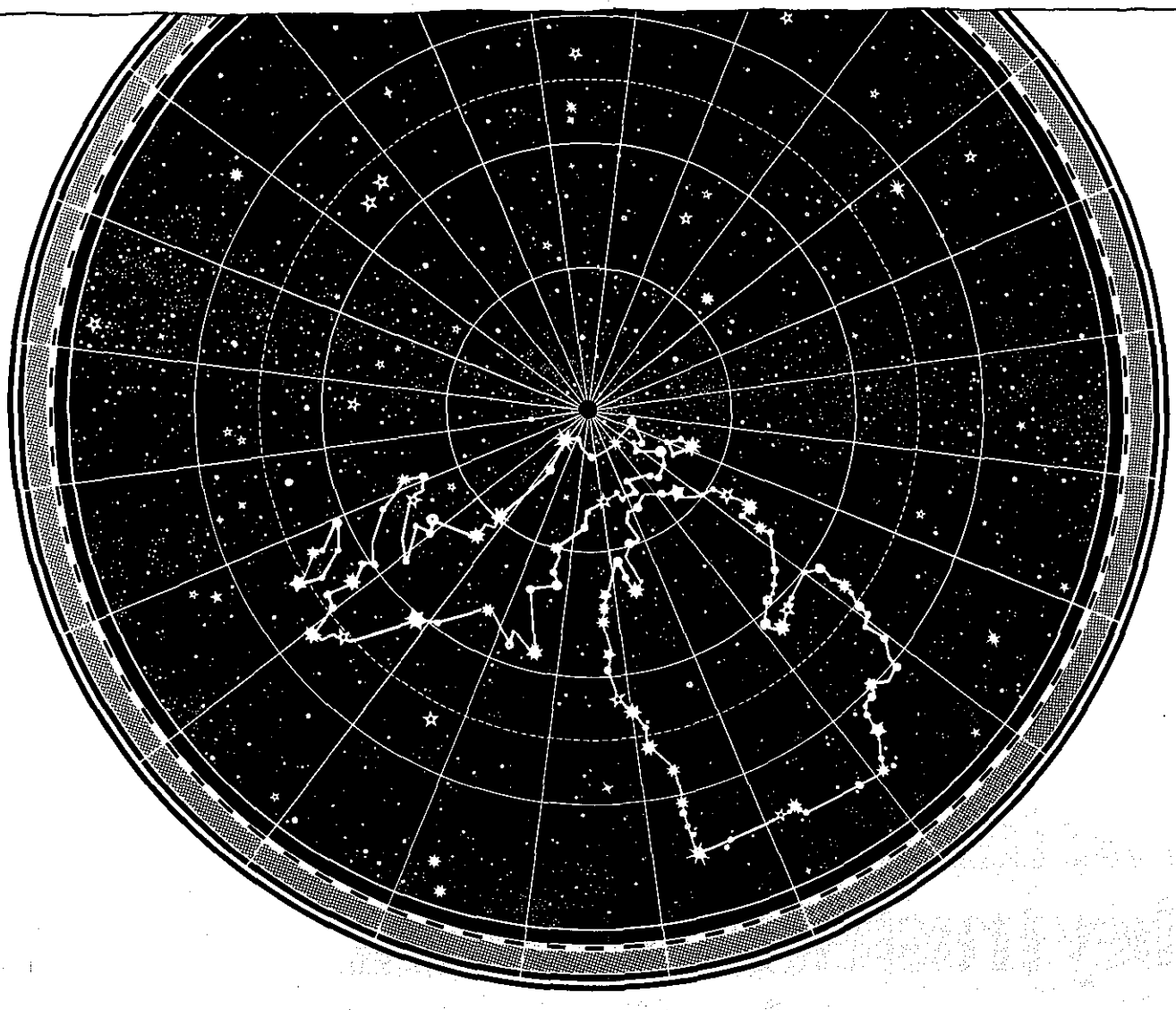
Kaiser Steel Corp. filed for Chapter 11 protection in bankruptcy court in Denver, in a last-ditch effort to gain time for its ambitious restructuring program. Chairman Bruce Hendry said: "We were fearful that if we didn't do it, someone else might do it for us."

The troubled company had been racked by feuding between Hendry and Monty Rial, whom he recently succeeded as chairman, over how the company should be restructured.

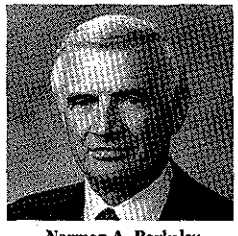
Hendry had proposed that Kaiser sell its remaining coal and steel operations and confine itself to real estate and hazardous waste. Rial opposed selling the coal business in this depressed market. But Hendry insisted Kaiser had to raise "lots of cash" to negotiate with its lenders and its retirees, who have claims against the company for about $240 million in unfunded pension liabilities.

Cutting Costs With H.O.T.

Dallas' Haggar Apparel wants to help U.S. retailers, apparel makers and textile firms hold the line against imports, which captured more than 40% of the domestic market last year. The company has introduced a computerized inventory control system called H.O.T., for Haggar Order Transmission, that cuts costs by allowing users to keep less inventory on hand and reduce restocking time sharply. *(continued)*



To reach for the stars, your business should be in a state that puts them within reach.



Norman A. Barkeley
Chairman, President
Lear Siegler, Inc.

In Michigan, business is reaching new heights, thanks to a business environment that is emerging as one of the nation's most progressive.

Here, advanced manufacturers such as Lear Siegler, Inc. are thriving. In Michigan, Lear Siegler has found the mix of ingredients it requires for its complex operations, including a major aerospace division. Norman A. Barkeley, Chairman and President of Lear Siegler, lends his endorsement: "For sophisticated new technologies, Michigan's environment is conducive to success. The R&D base, the well-trained workforce, the track record of innovation. It's all here."

Twenty percent of Lear Siegler's national workforce is located in Michigan. They operate 15 facilities across the state that are involved in the manufacture of everything from automotive seating to material handling, from avionics to furniture. They're here because of other manufacturers: the buyers and suppliers of the advanced technologies that give Lear Siegler a reason to be and a reason to be in Michigan.

Unquestionably, the presence of Lear Siegler and other state-of-the-art manufacturers in Michigan has pushed our state to the top in the world of advanced manufacturing. And that's not a bad place to be when you're reaching for the stars.

For more information write:
Doug Ross, Director
Michigan Department of Commerce
Lansing, MI 48909

150 YESM!CH!GAN™

Michigan business, the answer is yes.

Monterey, California. Jazz, golf, sun and seafood. It's paradise behind the scenes, too.

At the Monterey Sheraton, a member of the housekeeping staff punches in a code number to tell the front desk that the room is ready for the next guest.

A manager asks the property management system to present the daily long-distance records.

The concierge assures a large tour group that each of their names will be automatically listed with the hotel operator.

All over America, corporations trust the Hitachi DX Series for its reliability, expandability, smooth operation, and ability to be custom designed, including software, for each site.

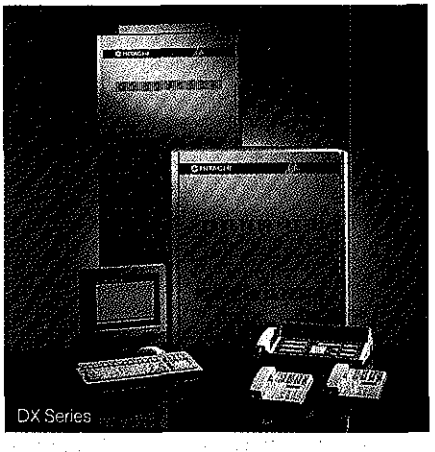
But, then, it makes a lot of sense for corporations to look at our telecommunications equipment, because so many rely on Hitachi America, Ltd. for a wide range of products: semiconductors, computers, and other sophisticated electronic and industrial equipment.

Whatever the product, our high technology is matched by an equal pride in our people. Our employees are dedicated to quality and to customer service, making Hitachi America a vital part of American industry, serving key sectors throughout the nation.

Hitachi America strives to create a climate that fosters a productive relationship. The result is a broad range of innovative products that contribute to higher productivity and a better quality of life. Our strong commitment to improving the way Americans work and live has been part of our history since 1959.

You can see the results in Monterey. Perhaps we can go to work for you too.

For further information on the DX Series, please contact: Telecommunications Division, 2990 Gateway Drive, Suite 1000, Norcross, GA 30071. 404/446-8820.



Hitachi America, Ltd.

HITACHI®

Power & Industrial Equipment • Industrial Components • Automotive Products • Telecommunications • Computer • Semiconductor & I. C.
Electron Tube • Digital Graphic/Precision Products • Procurement & Technical Services • Office Automation Systems

the best ways of tapping an overfunded pension fund. "Given the pace of change and the vagaries of the law, you just have to rely on your best guess sometimes," laments Jean-Paul Valles, CFO at Pfizer, Inc.

As the risks go up, so do the rewards for success. More of CFOs' total compensation comes not from fixed paychecks but from bonuses and incentives such as stock options.

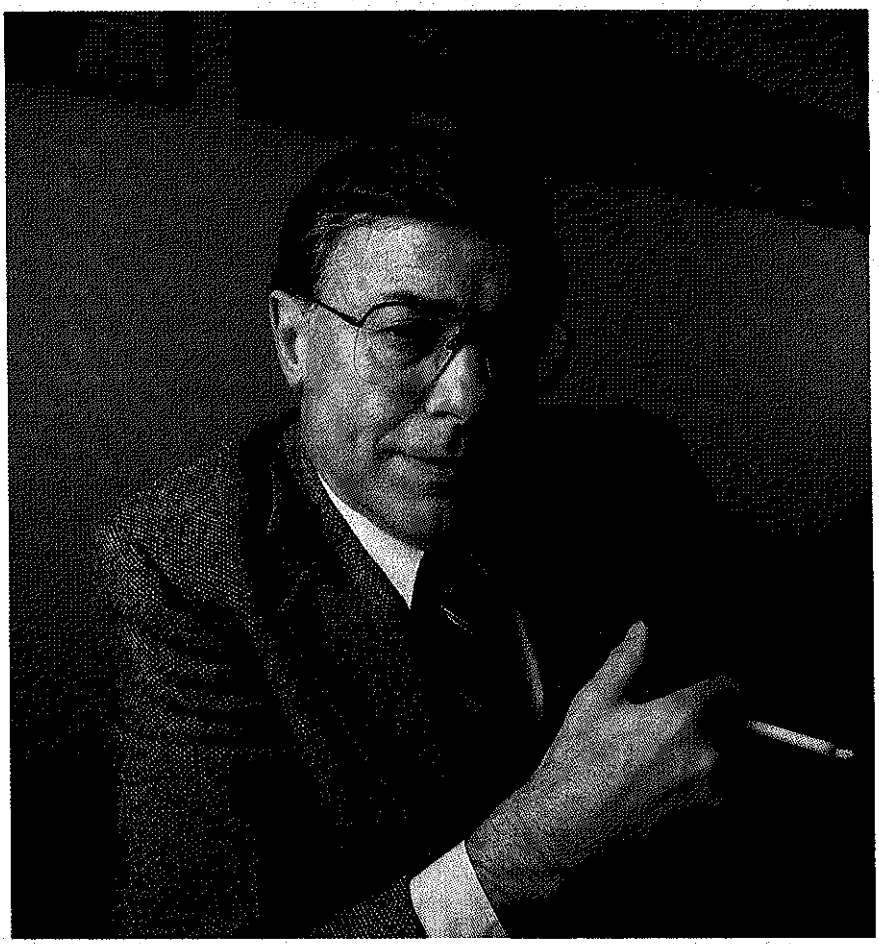
For example, at the big investment banks and the most diversified financial companies, CFOs' base salaries rose only 17.5% from 1984 to 1986, but their total compensation was up 43.4% because of a whopping 75% increase in bonuses and long-term incentives.

The picture was much different at industrial companies, which weren't making those big Wall Street profits. There, CFO total pay was virtually flat; decreases in bonuses canceled increases in base salary. "The bottom line is, there's a much higher return and also a much higher risk for CFOs," says Peter Egan, partner, Hewitt Associates, an Illinois-based compensation specialists' firm.

CFOs still don't make nearly as much as CEOs. Even in the big investment banks and financial companies, the average CFO total compensation last year was $474,500, to $1.5 million for CEOs. And 1984-86 CEO compensation in these firms rose faster—by 55.7% to 43.4% for CFOs—so the spread is widening even further.

In fact, some CFOs are deciding the only way to break through the CFO barrier is to break out of the CFO mold and become a CEO. Jon W. Rotenstreich, a former Salomon Brothers partner and IBM treasurer, traded it all in for the CEO job at much smaller Torchmark. Edward Hennessy Jr. moved up from CFO at United Technologies to CEO of Allied-Signal, Inc.

Still, most CFOs seem to be enjoying combat conditions. "The job has a breadth and scope that it didn't have before," says Arden B. Engebretsen, CFO of Hercules Inc. "It's more exciting. You're making things happen." Here are three who are making things happen.



Hans Storr of Philip Morris: A living legend in international finance

HOWARD CLARK JR. AMERICAN EXPRESS

You might call Howard Clark Jr. the very model of a modern CFO. He is a former investment banker who works for a former investment banker in a strongly financially oriented company. And he has all the technological tools a CFO could ask for.

High on the fifty-first floor of American Express' elegant new world headquarters, with Wall Street spread out below, Clark sits at the controls of $14.7 billion American Express, the financial services empire insiders call "the blue box." The four corners of that box are: a London-based bank (American Express Bank Ltd.), the third-largest U.S. investment bank in terms of capital (Shearson Lehman Brothers), a fast-growing Midwestern financial planning powerhouse (IDS Financial Services) and, of course, the American Express credit card and travelers check system with its international recognition.

When American Express Chairman James D. Robinson III recruited Clark in 1981, he was a managing director at Blythe Eastman Paine Webber. "I sometimes feel I'm still in the investment banking business," says Clark. "I just traded twenty clients for one very large, very active client."

Clark has been involved in evaluating no less than forty acquisitions and divestitures. If an acquisition doesn't fit, it is sold, à la Fireman's Fund. If a diamond in the rough is bought, like IDS, it must be integrated into the core businesses to maximize its strengths and protect its independence. And despite the fact that Shearson Lehman is part of the family, "we do it all ourselves," he says.

He also does his financial maneuvering himself. Clark oversees a huge investment portfolio of $20 billion, whose average maturity he has brought down from 25 years to under ten years. In 1986, he raised $3.3 billion in fixed-rate debt with one-third in foreign currency or interest rate swaps. One borrowing was swapped

PHOTOGRAPH BY RICHARD FLYNN

suing commercial paper to refinance part of the General Foods purchase. Indeed, he has built an operation that is as independent from Wall Street as possible. Storr set up Philip Morris Credit Corp. in 1982 as an in-house financing arm and is constantly adding to his international borrowing capability. "You can't be a chief financial officer without knowing international markets," he says.

CLAYTON STEPHENSON
UNION CARBIDE

J. Clayton Stephenson spent twenty-five years running various Union Carbide chemical operations before finding himself in a brutal takeover battle as the company's CFO. When GAF's Samuel J. Heyman started amassing Carbide's depressed stock in the wake of the 1984 Bhopal disaster and then bid to take it over, Stephenson masterminded the defense.

That defense gutted the company and burdened it with debt, but also rewarded shareholders handsomely. Carbide paid out $4.3 billion to them in a tender package and a special $33 dividend. "We said, 'If someone is going to get some money on this, we want it to be our shareholders, not his'," says Stephenson. The scorched-earth tactics boosted the stock price from $7 to $22 in twelve months. The bottom line: Sam Heyman went away.

The most important step was the first, Stephenson says: a strategy to get the stock price up, backed by the Carbide board and ready to go when the GAF bid hit the wires. Half measures wouldn't work, Stephenson told his board.

Carbide bit the bullet. Beginning in mid-1985, the company sold off its prized consumer products division, junked its five-year diversification plan and slashed 4,700 employees from its payroll. By 1986, it had shrunk from a $9.5 billion company to a $6.3 billion company. When GAF withdrew its $5 billion bid in January 1986, Carbide's equity was a quarter of its original size and it had doubled its debt with a flood of junk bonds.

The recapitalization plan that came next was equally grueling. "I sat down and had lunch with Pete Buchanan of First Boston one day in the fall of 1986," Stephenson recalls. "I said, 'This is what we are at the moment. I think there's a lot of investment banking opportunities in this. Why don't you guys come and talk to us?' "

First Boston CEO Buchanan not only came and talked, he and Stephenson worked out a $3 billion plan to refinance the junk debt that included selling Carbide's new headquarters in the bucolic Connecticut hills and borrowing $1 billion from First Boston itself. Carbide raised the rest by selling off more assets and issuing $585 million in common shares, its first stock offering since 1917.

Stephenson says his operating background was invaluable. He started as an accountant with Carbide fresh out of Yale with a degree in economics, but after seven years in finance, switched to the operating side until he was named CFO. "That experience in the operating division made the financial fall into perspective," he says.

Operational management also made Stephenson a no-nonsense manager and planner. Fighting a raider is not that much different from building a new plant, he says. If you're going to do it, do it. "Don't peck away," he says. "Bang, get it done. None of it would have worked if everything hadn't worked. And that kind of planning is the contribution that a guy in this role makes."

Stephenson gives plenty of credit to his investment bankers, First Boston and Morgan Stanley & Co. "We learned more corporate finance in twelve months than most people learn in a career," he says. His advice: "Really know your bankers. Work at the task of visiting with them and knowing them at all levels. Then when you've got a problem like this, you're starting from a knowledge base."

Last December, after the dust settled, Stephenson was rewarded by being appointed vice chairman as well as CFO and is now considered Number Two in line for the presidency. A robust man with a hearty voice, he offers no excuses for Carbide's failure to take its draconian steps until the GAF wolf was at the door. Why didn't the company get its stock price up sooner? "When did I stop beating my wife?" he answers with a smile. "Yes, we should have done this in 1981. The fact is we didn't. I could be very bitter, very unhappy. I'm not. It's been a very therapeutic experience." ■

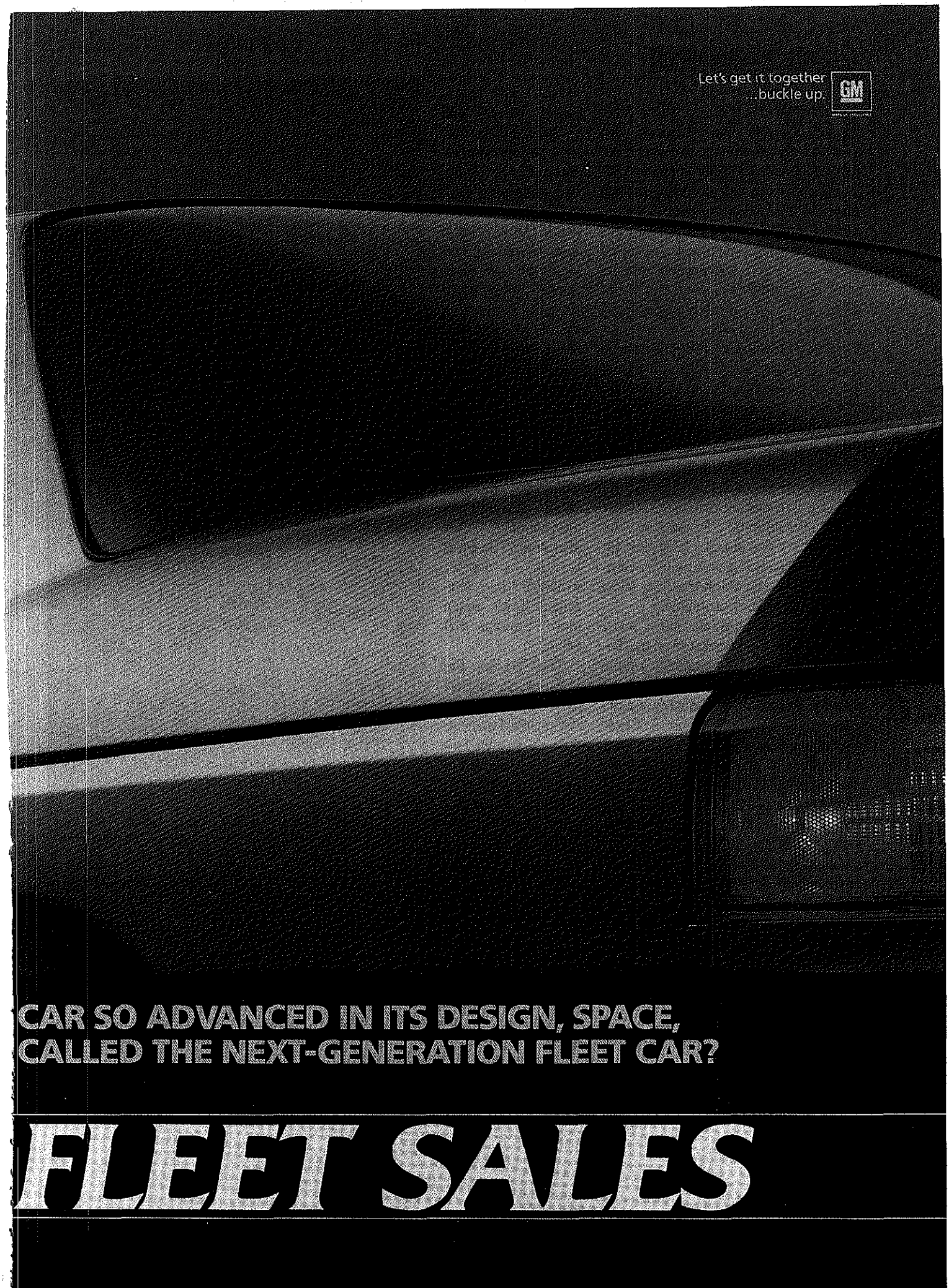
WHAT U.S. STOCKS ARE THE JAPANESE BUYING?

The Japanese are funneling billions into the U.S. stock market. What do they like?

by David Kiley

Japanese money is pouring into the U.S. stock market at a record rate—$17 billion in the first nine months of last year alone, perhaps twice that this year. What are the Japanese buying? Judging from volume in the 32 U.S. stocks now listed on the Tokyo Stock Exchange, Japanese investors like the icons of America.

"Japanese buy blue-chip stocks, especially ones with tradition, because they believe they are buying into American power," says Motoi Okada, executive vice president of Daiwa Securities America Inc. The heaviest volume on the Tokyo Exchange in January, for example, was in American Express, Dow Chemical, Disney, Merrill


Let's get it together
...buckle up.
GM
CAR SO ADVANCED IN ITS DESIGN, SPACE,
CALLED THE NEXT-GENERATION FLEET CAR?
FLEET SALES

XEROX

A Xerox Electronic Publishing System turns turnaround time into no time.

You've accomplished the impossible. You were given 11 documents to publish in seven days. And now that you've got them done, you're told one needs a minor change, three need small changes and seven need major changes. But, instead of panicking, you calmly collect your thoughts and sit down at the terminal of your Xerox XPS 700 Series Electronic Publishing System. The system that's sophisticated enough to let you turn out document after document with practically no turnaround time.

But a Xerox Electronic Publishing System can do more than just make it possible to meet seemingly impossible deadlines. It can make your business more competitive. For instance, let's say you're bidding on a big project. And there's a last-minute change in specs. That change may delay your competition's bid as they wait for new proposals, contracts, manuals and documentation to be printed. With a Xerox Electronic Publishing System, jobs that used to take days take hours. And changes that took hours now take only a few minutes.

In practically no time, a Xerox Electronic Publishing System can pay for itself. It'll pay for itself by saving you time and overtime charges. And because it uses a powerful and proven integrated composition software package, it's easy to use. Which means you won't have to go to great expense or time to train someone to use it.

If you'd like to learn more about electronic publishing, take the time to speak to a Team Xerox member. Send in the coupon below or call Team Xerox at 1-800-TEAM-XRX. We'll do more than just offer you the widest selection of electronic publishing equipment available. We'll offer you the resources of Team Xerox. Experts who'll give you the advice, service and support you need to set up your system and keep it running. So that your system will always be able to turn your turnaround time into no time.

TeamXerox

Xerox brings out the genius in you.

Xerox Corporation, P.O. Box 24, Rochester, NY 14692.

☐ Please have a sales representative contact me.

☐ Please send information on Xerox Electronic Publishing Systems.

NAME (Please Print)

COMPANY TITLE

ADDRESS

CITY STATE ZIP

PHONE

Or, if you can't wait, call
1-800-TEAM-XRX, ext. 186B
186B (1-800-832-6979, 186B).

004-3-87

for their goods. Despite their creative flair, the founding families were ultra-conservative managers and parsimonious when it came to putting money into expansion.

As recently as a decade ago, for example, Louis Vuitton had only two retail outlets, in Paris and Nice. And vintner Moët-Hennessy did not even have a Paris office until 1970. Says Clement Freud, the British parliamentarian, gourmet and self-appointed arbiter of good taste: "French elegance may have been in demand the world over, but it was rarely on sale far beyond the confines of the eighth and ninth arrondissements [where Paris' luxury retailers are centered]."

In the past decade, though, economic necessity has spawned a revolution among the French luxury firms. Bursting onto the international scene with a flamboyance that would have shocked their founders, they have been hawking their well-known brands around the world, setting up manufacturing operations abroad and diversifying into a variety of new businesses.

Typical of their expansionist fervor: Moët-Hennessy is now a leading rose producer in the U.S.; Louis Vuitton has set up an American manufacturing operation; Moët and rival champagne makers Piper Heidsieck and Roederer own wineries in California; and fashion designer Pierre Cardin has become a merchandising powerhouse with his name imprinted on everything from food products and furniture to skis and tableware.

(Cardin has even set up a branch of Maxim's, his Belle Epoque restaurant, in Beijing and is now planning a 300,000-square-foot superstore in Moscow. Paris gossip has it that Raisa Gorbachev, the fashion-conscious wife of the Soviet leader, startled Cardin on her recent visit to his Paris studio by asking—presumably in consideration of the girth of potential Russian customers—"How much do women have to weigh to wear your clothes?")

The economic factors that spawned this new French revolution—growing competition in the rich but increasingly volatile French market and the need to broaden earnings through geographic and product diversification—had been evident to industry-watchers for decades. However, it took a new group of professional managers in the 1970s to get the ball rolling. It was outsiders such as Moët Chairman Alain Chevalier and Vuitton Chairman Henri Racamier, both from the steel industry, who persuaded reluctant boards of directors to cough up capital for expansion and new ventures.

As the earnings of these early adventurers grew, dozens of other companies were persuaded to follow suit. The 1981 Socialist victory in France, observers say, escalated the trend. "When Francois Mitterrand arrived in the presidential palace, I knew we had to look abroad for growth," comments a senior board

1985. But it broke even last year and is expected to turn in healthy profits this year. Insists Chevalier: "Roses are just another product. If you can ensure top quality, you can market them just like champagne."

At Christian Dior, Chevalier has poured big money into developing and promoting new products. Last year, he shelled out $10 million to launch its new fragrance, Poison, in the U.S.; sales there have since passed the $50 million mark. He spent millions more promoting its Capture anti-aging skin cream in Japan, where it made a big splash, and it is now introducing Capture in the U.S.

To manage Moët's increasingly broad-based empire, Chevalier has set up tough financial controls within the company and tightened control of distribution abroad by buying up Moët's distributors in the U.S., Germany and Japan. He also acquired the Laboratoires Roc cosmetics group, which boasts a strong international distribution network through drugstores and pharmacies.

Chevalier plans further diversification moves but is not ready to discuss anything definite. Whatever direction Moët-Hennessy takes, he believes, its success will depend not on the luster of its name but on the quality of its products. "Prestige does not count for much in new or foreign markets unless it is backed up by quality," he says.

A MONOGRAM KNOWN AROUND THE WORLD

Ten years ago, Louis Vuitton was a quiet, family-owned company with one factory, two retail outlets, seventy employees and sales of $17.5 million. Today, the firm's distinctively monogrammed luggage, handbags and other leather goods are sold in eighty stores around the world, bringing in sales of $200 million; its employment roster has grown to 1,800; and its stock is traded on the Paris Bourse and over-the-counter in New York. "A century and a half after the company was founded, it is finally a rising star of international retailing," says Paris broker Bruno Pierard.

It was French Empress Eugénie who first discovered Louis Vuitton's talents. A penniless sixteen-year-old from the provinces, Vuitton arrived in Paris in 1837, where he was apprenticed to a trunkmaker. He also entered the royal household as packer of the Empress' clothes, and her crinolines were said to emerge without a crease from the cases in which he folded them. Striking out on his own, Vuitton opened a factory in 1854 to make a new style of elegant, canvas-covered trunk that became immensely popular. The now familiar LV-monogram design was introduced by Louis' son George in 1896 to confound counterfeiters—a problem for Vuitton even then.

The architect of Vuitton's current growth is 73-year-old Henri Racamier, a longtime steel industry executive. Married to one of the Vuitton heiresses, he was called in by the family to take over the company as chairman in 1977, at an age when most men are getting ready to retire.

At the time, Vuitton was primarily a wholesale operation selling to leading specialty stores. Although it was profitable, Racamier concluded that it could make a lot more money in the retail end of the market, where profit margins on luxury goods tend to be around 50%, compared with just 5% in wholesaling. "And being boss at the retail end is the best way to maintain your public image," he points out.

Rather than build stores from scratch, Racamier decided it would be easier and less expensive to set up leased boutiques in upmarket department stores. The first boutique was opened in Japan, where consumer demand was so great that sales grew sixfold in three years.

Racamier opened more boutiques in major European and Japanese cities. But he hit a snag in the U.S. due to existing Vuitton wholesale arrangements and the opposition of many American retailers to leased departments in their stores. As a result, Vuitton opened a stand-alone retail store in Manhattan in 1981; it now has 23 U.S. outlets, including several leased boutiques, in major cities across the country.

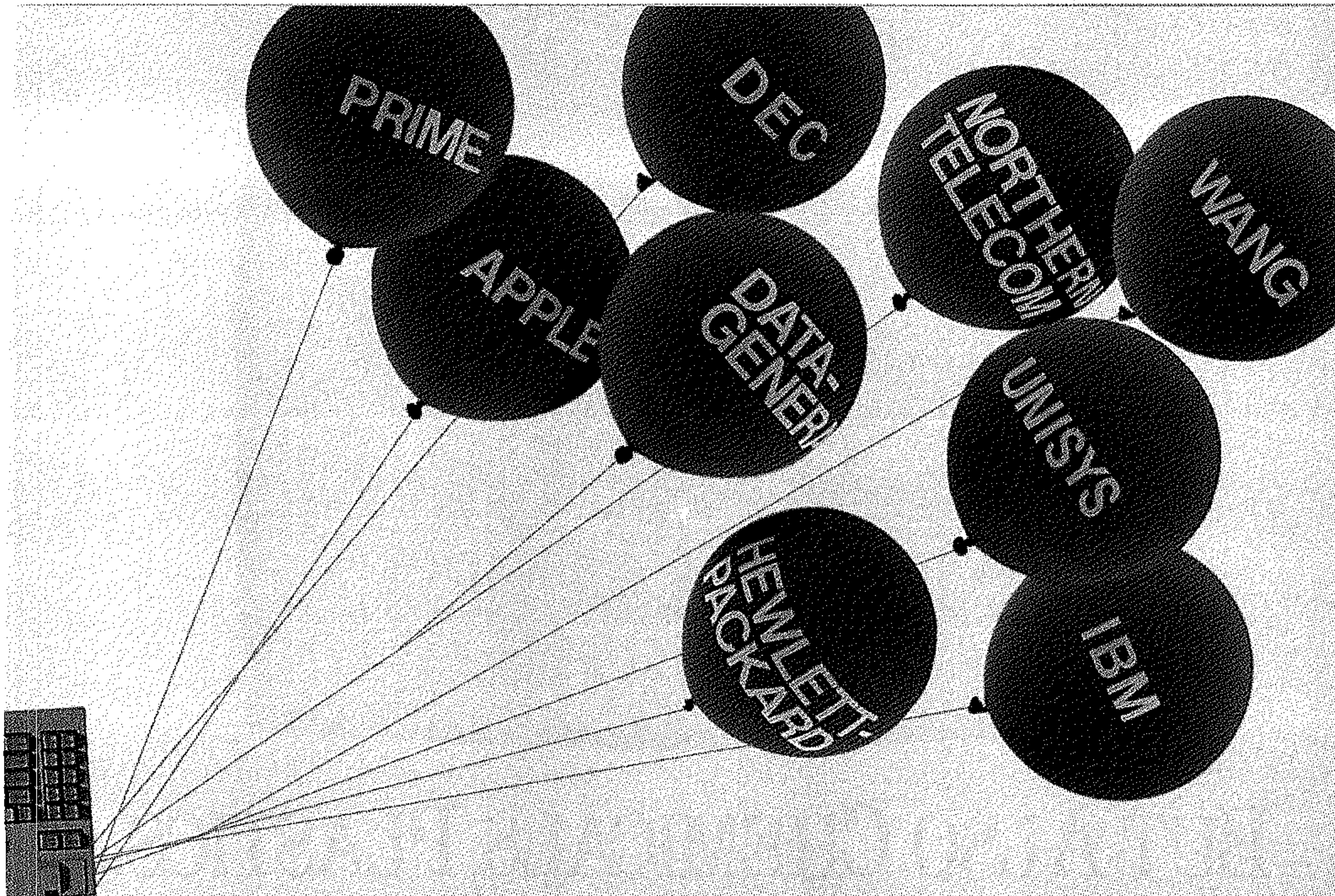
To keep up with surging international demand, Racamier has set up six more manufacturing operations in France, as well as one in California called the French Company. Vuitton has also brought out a new high-priced line of leather goods under the Challenge label, which does not carry the familiar LV monogram.

To broaden Vuitton's product base and enhance its international stature, Racamier has begun diversifying. Late last year, the company paid $650 million for Veuve Clicquot, France's fourth-largest champagne producer, which also owns perfume maker Givenchy. As Racamier says, "The public expects a prestige house to have activities in champagne and perfume."

Houël, Moët-Hennessy's finance director, insist they will not move downmarket. "To keep earnings fizzing, it is essential to operate under the panoply of prestige," Houël says. "The secret of success is to maintain the product's quality and to make it accessible to a wider spread of customers, rather than to cater to a larger, less sophisticated clientele."

At any rate, analysts point out, the size of the luxury market continues to outpace economic growth in all the industrialized countries. "This is a market that is nowhere near saturation," says analyst Simon Aldwych of London securities firm Savory Milln. "It is capable of sustained growth." ■

PHOTOGRAPH BY PERRY ALAN WERNER



meridian SL-1

NETWORKING

WHY CAN'T AMERICA COMPETE?

Americans pride themselves on their do-or-die spirit. Believing we are the best, whether in the sports arena, in battle or in business, we are always confident that if we lose one round, we will come back in the next. But in the economic competition in which the U.S. is now engaged, we are just beginning to perceive that regaining preeminence in world markets is not the same as winning the America's Cup or putting a man on the moon.

It's a new economic world out there—a complex global marketplace in which U.S. industry is having a tough time competing, much less winning. Many of our strongest and most efficient companies have been crippled in this struggle by unforeseen shifts in the world economy.

They were hurt by sky-high oil prices in the 1970s and then hit again by an overpriced dollar during the Reagan Administration's first four years. They were forced to stand by helplessly while foreign governments subsidized their export industries and threw up insuperable barriers to their domestic markets to the detriment of U.S. exporters. More recently, the shrinking oil revenues and swelling debts of Third World countries have wiped out whole markets for our manufactured products, and bumper crops worldwide have shrunk the demand for our bountiful harvests.

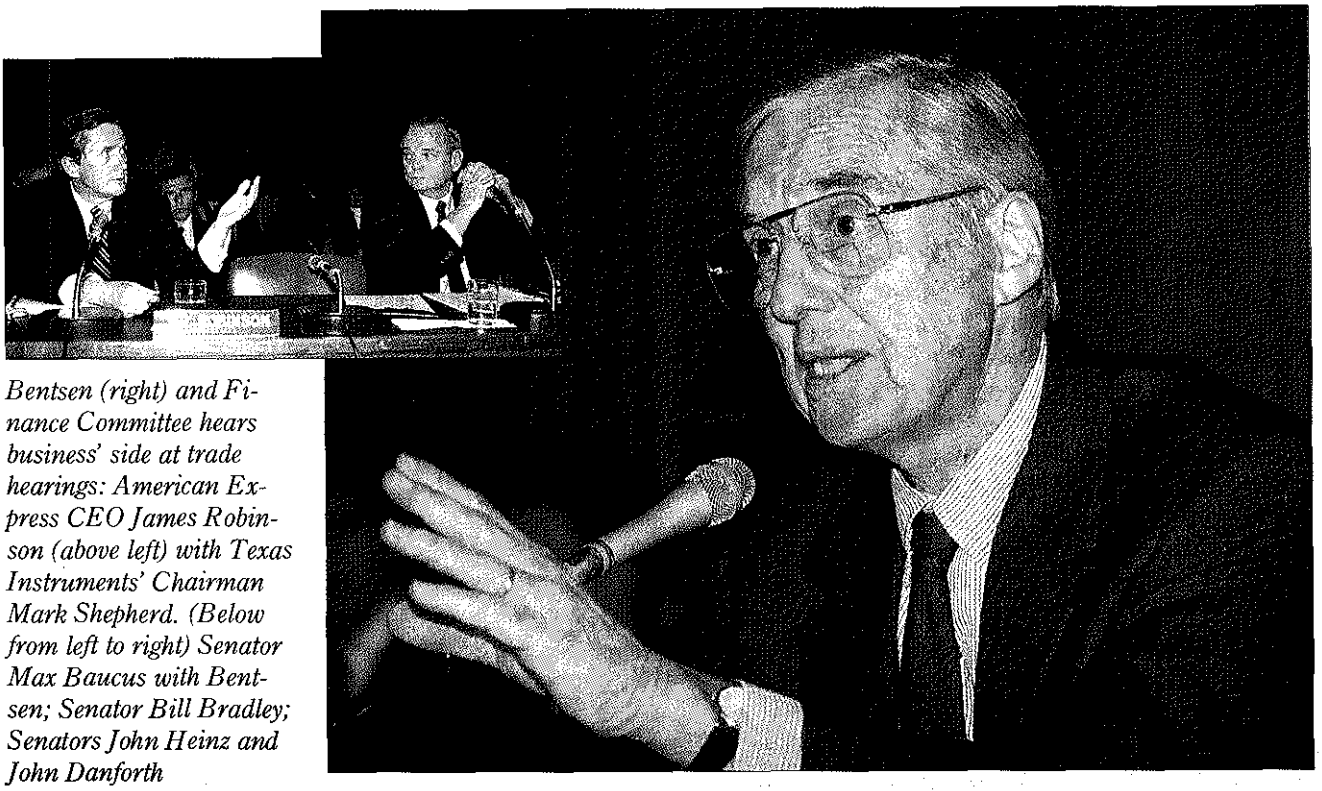
ILLUSTRATIONS BY ANTHONY RUSSO

The electorate has steadfastly refused to pay higher taxes or take less government largesse to reduce the burgeoning budget deficit that makes U.S. interest rates higher than those of Japan and Germany. The resulting higher costs of capital to U.S. industry and financial institutions has injured our price competitiveness.

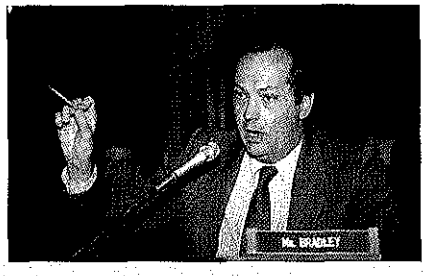
Industry itself has been slow taking action to overcome its growing weakness in the international arena. After years of neglecting product quality and hiking costs with fat payrolls and perks, only in the past five years or so has it begun to clean house and invest in the technology needed to produce better products and improve efficiency and labor productivity.

Now, suddenly, "competitiveness" is the buzzword in Congress. Under this new rubric, legislators are considering a host of programs, some new, some old. They hope to enact trade measures to slow the import invasion and step up exports, to fund research in advanced technology and to devise programs for educating the young and retraining older, laid-off workers.

The following five-part special report examines the complexities of the competitiveness issue for the U.S. and attempts to throw some light on the critical areas under debate. The new trade proposals of Chairman Lloyd Bentsen of the Senate Finance Committee are analyzed in a profile of the Texas Democrat; our Presidents' Panel of 200 top CEOs discusses the role that government ought to play in helping industry compete; and an examination of the restructuring in the machine-tool industry pinpoints the results of recent industry efforts to reposition itself with government help. An assessment of MCC, the cooperative research venture, underscores U.S. industry's shortcomings in joint technology research. And the lessons of recent government-industry worker retraining efforts are reviewed.



Bentsen (right) and Finance Committee hears business' side at trade hearings: American Express CEO James Robinson (above left) with Texas Instruments' Chairman Mark Shepherd. (Below from left to right) Senator Max Baucus with Bentsen; Senator Bill Bradley; Senators John Heinz and John Danforth



determined to go far beyond trade to fashion a competitiveness policy that includes everything from education and macroeconomic policy to retraining displaced workers and easing Pentagon-imposed curbs on high-tech exports. This is putting intense pressure on the White House to come up with a comprehensive package. But Bentsen will keep the focus on trade. "The Administration is likely to send a competitiveness bill," he says. "We'll send a trade and competitiveness bill back."

Within days after November's election, in which the Democrats' recapture of the Senate assured Bentsen of the Finance Committee chairmanship, his staff began a dialogue on trade with aides of Senators of both parties. Determined to craft a measure that will become law rather than veto-bait, Bentsen worked closely with Republicans from the first, particularly Missouri's influential John Danforth.

The canny Texan's strategy is to line up GOP support for his measure before the White House comes up with a bill. As Bentsen lines up his ducks, the House is likely to pass a competitive package that is sure to be too costly for the White House or too protectionist. Still, it could attract a good deal of Republican support. One-third of the House Republicans voted for last year's omnibus trade measure, and Speaker Jim Wright has signalled his desire for GOP input.

Bentsen will hold back until the House passes a bill, which isn't likely until early May. He then hopes to get a measure to the Senate floor by July. That allows plenty of time for bargaining, and former committee Chairman Robert Packwood says, "It could be more difficult writing a trade bill than passing tax reform."

The difficulty: Many Senators have constituent industries to protect. Once industries start working individual preferences into the bill a free-for-all will erupt. If Bentsen can't keep such preferences out, he will then push for a bill that mandates retaliation against nations that discriminate against U.S. telecommunications exports. "We may end up with that," Bentsen says. "But I hope not. And I will do my damndest to see that we do not throw up barriers, that we do things that promote more open trade."

Tall and lean, the 65-year-old Bentsen looks more like the corporate executive he once was than a politician.

PHOTOGRAPHS BY BRAD MARKEL/GAMMA LIASON

FROM PAN AM. SHOULD.

To begin with, our maintenance staff has been diligently scrubbing and polishing our entire fleet of planes; redecorating our Clipper® and First Class with new upholstery and carpeting.

Our Engineers have installed new electronic headsets and are working on adding bigger, roomier storage space, new lighting, and new video equipment.

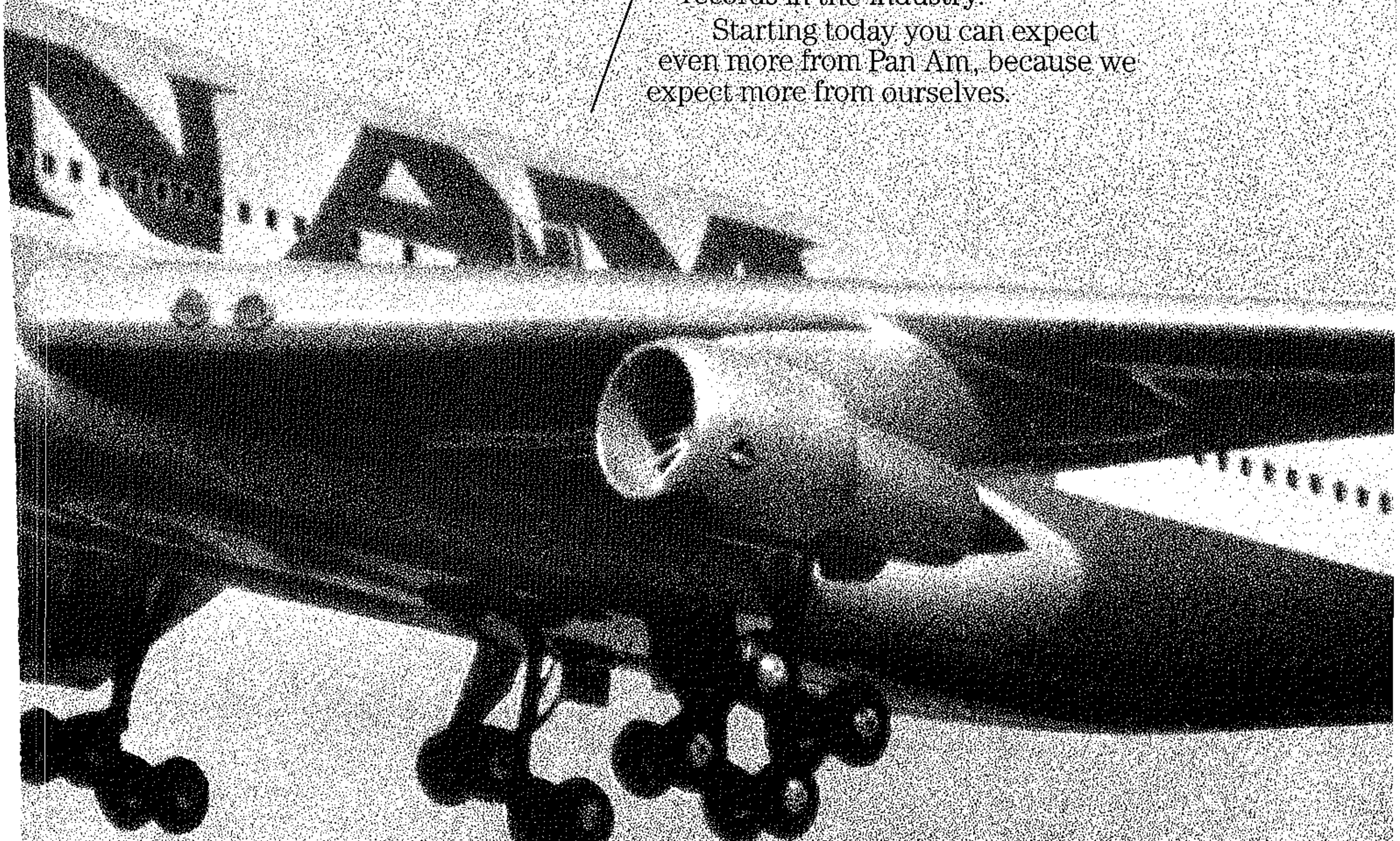
We're introducing an all new reservations system which will mean faster ticketing, and shorter lines at the airport.

And, once you're comfortably on board, we're working harder than ever to get you down the runway

and to your destination on time.

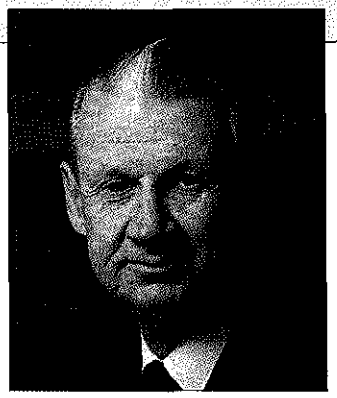
Currently Pan Am is providing one of the most impressive on-time performance records in the industry.

Starting today you can expect even more from Pan Am, because we expect more from ourselves.



FROM PAN AM℠

PAN AM



Chief Executive Hayes Watkins of CSX: "The key issue is [foreign] government-approved 'dumping' "

credited 'industrial policy' and 'national economic planning' schemes from the Seventies," contends Chairman Richard M. Morrow of Amoco Corp. "We do not need some grandiose-sounding policy with attached bureaucracy."

The CEOs favor retaliation against nations that discriminate against U.S. goods. "Legislation should be designed to open foreign markets to our products," declares Chairman Donald D. Lennox of Navistar International Corp. They also demand action against governments that subsidize exports so that their companies can sell overseas below cost. "The key issue is government-approved 'dumping,' " says CSX Corp. Chairman Hays T. Watkins.

Washington must get tough, say the CEOs, but this is not a call for protectionism. The panel is against raising either quotas or tariffs. "Quotas are not the solution," says Chairman Robert Stockham of Stockham Valves and Fittings Corp. Adds Federal Mogul's Russell: "Tariffs raise the cost to the consumer and do not force American business to drive costs down."

The White House's successful drive to force the dollar down is welcomed by the panelists. But they point out that the failure of the trade deficit to respond thus far is a clear indication that foreign governments are not permitting the free market to work. Many nations are using subterfuges to undercut more attractively priced U.S. products. CSX' Watkins contends that the lower dollar will not bring enough improvement in the deficit because "some foreign governments have decided their subsidized support is needed to penetrate the U.S. market, and justify that as national policy."

Others point out that a drop in the dollar against the yen and the deutschemark solves only part of the problem. Chairman Robert Anderson of Rockwell International Corp. cites the "lack of movement of many key currencies, including those of Canada, Brazil, Korea, and Taiwan."

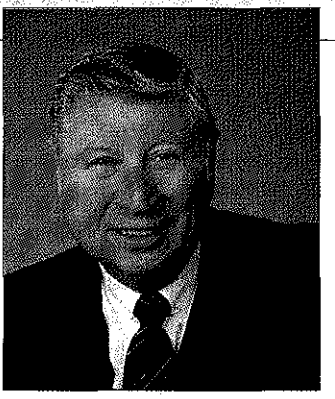
The Administration's policies have hampered industry's ability to compete, say the CEOs, citing the killing of such investment incentives as accelerated depreciation and the investment credit. They also note that programs that aid innovation have been cut back. Says Chairman Ronald Cape of biotechnology pioneer Cetus Corp. "Especially in high tech, where innovativeness is key, money for basic research and education is being reduced and tax incentives eliminated."

Chairman John Bierwirth of Grumman Corp. would reduce the budget deficit and simultaneously cut exporters' costs by instituting a European-style Value Added Tax. "VAT, which European companies get back when they export, is just great," he contends. "Reduce corporate taxes, put in a VAT, that would help exporters."

The businessmen favor the Administration's proposal to ease up on antitrust to allow companies to combine to meet foreign competition. But they are sharply divided on whether mergers and joint ventures will cut the trade deficit. Still, many maintain that antitrust relaxation would help in competing with nations that are not concerned about corporate combinations. It "would allow common manufacturing of low-volume nonprofitable products," says Navistar's Lennox. "It would also allow joint venture arrangements."

Congressional proposals to give companies tax credits to retrain laid-off workers have little support among the CEOs. "Vocational institutes should be used, not companies," says one panelist. The executives also don't care for the idea, which is also popular on Capitol Hill, of linking wages to profits. CSX' Watkins calls it "just more governmentally-imposed overhead to build bureaucracy."

One action the government could take, says the panel, is to curb takeovers. Federal-Mogul's Russell would "require shareholders—and only shareholders who own the stock for more than six months—to approve all actions." One CEO, obviously anxious to stop the takeover game, suggests the ultimate sanction: "Tax profits from takeover speculation 100%."



Federal-Mogul Corp. Chairman T.F. Russell: "Legislation will not correct the situation. It will require additional taxes"

slimmed down, merged, restructured, discarded unpromising businesses, adopted new marketing strategies and sought out new partners. Says Joe Franklin, administrative director of the National Machine Tool Builders' Association, "We've seen in this industry a significant case of structural change."

Large American manufacturers began changing their product lines to recapture the mid-tech market. They started promoting individual machines designed to be integrated into systems later, if the need develops. "We have moved down in the market to pick up the smaller customer," confesses William Fife, president of Cross & Trecker Corp.'s Kearney & Trecker unit. "We're trying to go back to the fifty-employee, mom-and-pop machine shop and sell them a plain vanilla machine."

Nevertheless, the relatively well-heeled U.S. majors still labor under marketing disadvantages. For one, there are large inventories of foreign machines overhanging the market. For another, some U.S. companies lack distribution networks to sell smaller products. For example, Kearney & Trecker, which uses a direct sales force for its customized manufacturing systems, has few ties to the dealers who sell standardized machines.

Moreover, there isn't much demand for new machine tools. With only 79% of America's manufacturing capacity in use, laments Harry A. Hall, senior vice president of Giddings & Lewis Machine Tool Co., "there's not a big market left for U.S. builders to fill."

In the short term, the VRAs will enable the large companies to maintain their current operations in the U.S. But they are already casting about for foreign production sites for the day when the VRAs come off. Cross & Trecker sees its new licensee in India as a potential supplier for the U.S. market. Cincinnati Milacron is eyeing Southeast Asia. Adds Gidding & Lewis' Hall, "You've got to be vertically integrated on a global scale now."

No matter what the exchange rate, few people expect that the assembly of standardized machine tools will remain in the U.S. What will remain is the manufacture of complex systems.

By the end of the decade, observers contend that the industry will be dominated by a relative handful of large companies: Cross & Trecker, now the country's largest tool builder; Cincinnati Milacron Inc.; Giddings & Lewis, a unit of AMCA International Ltd; privately-held Ingersoll Milling Machine Co.; and three or four others.

The VRAs are unlikely to reverse the competitive disadvantages of the smaller firms. As the rate of technical innovation accelerates, the day of the independent local tool builder is rapidly fading. The important differences between machines nowadays lie in the computer software that runs them, not in their physical design. Predicts Cross & Trecker CEO Richard T. Lindgren: "A company that wasn't strong enough to make it before the VRAs is not going to be strong enough to make it after the VRAs."

Two federal programs are designed to help the smaller firms compete. The Administration pledged $15 million for a National Center for Manufacturing Sciences to do cooperative industry research. And the National Bureau of Standards is working on standardizing communications protocols, so a manufacturer could integrate a machine

WHO'S MAKING MACHINE TOOLS?

Here are the worldwide sales of the largest companies with substantial machine tool manufacturing in the United States.

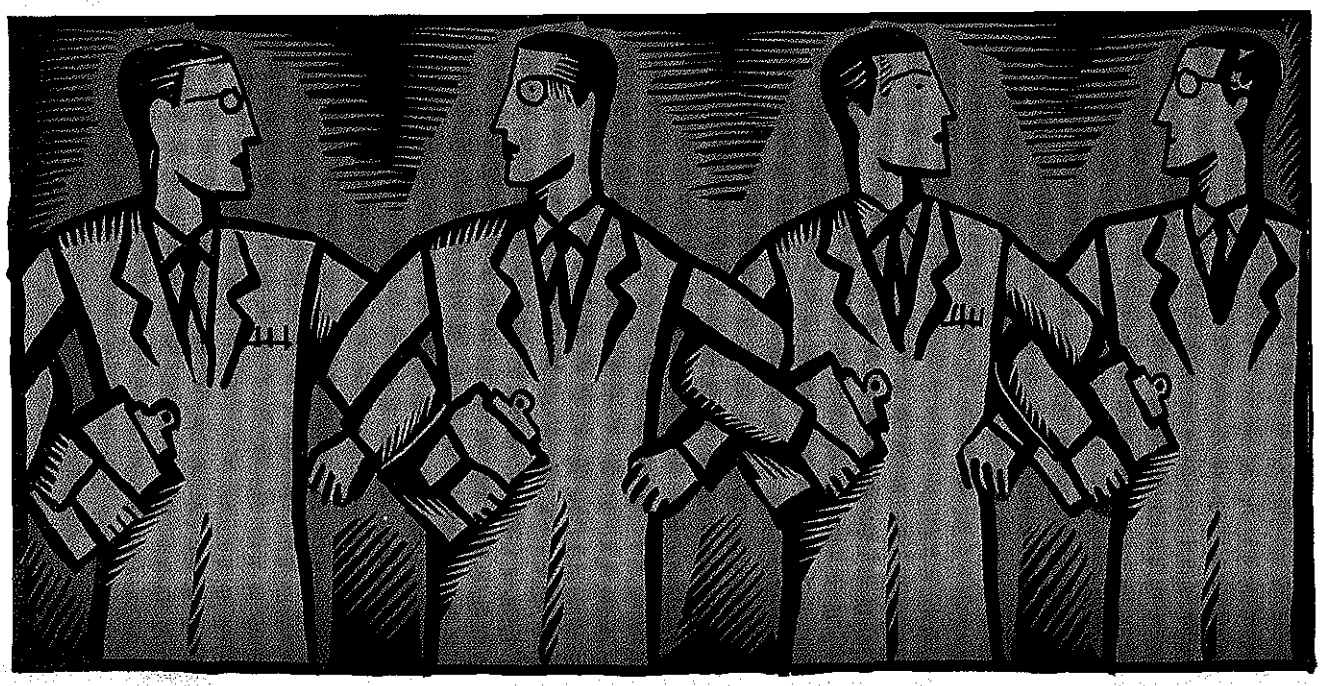
Company	1985 Sales (millions)
Cross & Trecker	$423.3
Cincinnati Milacron	325.8
Yamazaki Machinery Works	275.0
Lamb Technicon	225.0
AMCA	180.0
Oerlikon Buerhle	170.0
Ingersoll Milling Machine	165.0
Litton Industries	145.0
Gleason Works	137.7
Esterline	135.9

Source: American Machinist

MCC: The Dilemma Of Joint Research

Is cooperative innovation possible in a country where corporate secrecy is a way of life?

by Fred V. Guterl



Microelectronics and Computer Technology Corp. (MCC) exudes high-tech confidence. Its shiny new building on the outskirts of Austin, Texas, offers hundreds of the nation's brightest scientists and engineers a comfortable, elegant environment in which to work at the vanguard of corporate research. The laboratories are filled with the most advanced equipment, and all offices come equipped with powerful, expensive computer workstations. The building itself sits at the center of 200 empty acres, as though the planners expect this experiment in Japanese-style cooperative research to spin off high-tech commerce in all directions at once.

Set up four years ago, MCC is the unique research consortium jointly owned and managed by some of the country's leading high-tech companies. Its twenty members (or shareholders) are a diverse group that includes the likes of Digital Equipment, Boeing, Martin Marietta, Eastman Kodak, Motorola, National Semiconductor and Bell Communications Research *(sidebar, page 51)*.

Defying the skeptics, MCC seems to have done impressively well so far. Its membership has doubled, and its budget has grown to $75 million this year. More important, MCC can already boast considerable technological advances. Concentrating on applied research only, it has developed new computer languages, computer-aided design software and a method of packaging semiconductor chips.

But as it begins to turn out this usable technology, MCC is running up against some formidable obstacles. The fundamental problem: Transferring technology to member companies is turning out to be far more difficult than planners had envisioned. S

CONFLICT AT BELLCORE

American industry has come to depend increasingly on outside consortia for advanced research, and dozens of new ventures have received corporate funding in recent years. Most of the groups conduct basic scientific research through university affiliation. Some, such as the Center for Integrated Systems at Stanford, are run by universities. Others distribute academic research grants to the schools. The Semiconductor Research Corp., for example, currently has around $15 million invested in projects at a dozen academic research centers.

The one consortium that is similar to MCC is Bell Communications Research. Known as Bellcore, it was formed in 1984 by the seven Bell telephone companies after Bell Telephone Laboratories became the private research lab of AT&T.

Like MCC, Bellcore is involved in applied research programs for its members. Also like MCC, it must juggle the interests of its members. And now that the telephone companies are diversifying into competitive markets, the consortium is running into the same problems that plague MCC: Members are less willing to share technology with each other or to rely on Bellcore's research.

Bellcore does some contract work for the individual operating companies on a proprietary basis. But its applied research is paid for and shared equally by all the members. Now, though, U.S. West is seeking a change in the consortium's structure that would give it access to research that is kept secret from other members. Moreover, according to company spokesman Don Johnson, U.S. West recently gave Bellcore the mandatory three-year advance notice that it might pull out of the consortium. "We want to be able to have some research done just for us," Johnson says.

Indeed, U.S. West and Nynex have both begun ambitious internal programs to build and staff their own research centers. Nynex has built five labs and plans to quadruple its research staff to 400 by 1990. "There is work we can do to give us a leg up on the competition that is not done at Bellcore," says Dennis M. Mardon, director of strategic technology planning at Nynex.

As a result, the telephone companies are beginning to look less and less to Bellcore for technology applications and use it more for generic research. The consortium is even finding it difficult to get the members to agree on the move toward so-called open network architecture—a set of technical standards for connecting the nation's telephone network. "Each of the seven companies has a different view of its business direction," points out Bellcore Executive Vice President Irwin Dorros, "and that influences the technical solutions." —F.V.G.

In most cases, Inman points out, resistance to new technology comes from the operating levels of the member companies rather than upper management. When a new technology is adopted, years and years of research on an old technology often must be abandoned. "The engineers who do the actual product design and manufacturing find it painful to change the way they do things," he says.

An even bigger gap between the cultures of MCC and some of its members is created by the fact that many of MCC's research methods are too esoteric for the practical world of corporate product development. Much of its computer-aided design software, for instance, is written in LISP, a language common in university research but foreign to most company labs.

To make it easier for company researchers to understand the potential applications of its technology, MCC is encouraging members to develop so-called "shadow research" that duplicates the consortium's work and thus allows them to keep up with it. But such research requires substantial additional investment for member companies. Digital Equipment Corp. spends 50% above its investment in MCC studying ways to use the consortium's technology, according to Thomas F. Gannon, Digital's representative on MCC's technical advisory board. And only Digital, NCR, 3M and perhaps a few other shareholders take such an active role.

Some of the biggest technology companies—including IBM, AT&T, Xerox, Intel and Texas Instruments—have not joined MCC, and several members have left. However, two new companies, Hewlett-Packard and Westinghouse Electric, recently joined to fill the gap. And most of the consortium's shareholders have remained supportive.

If that support continues and the problems can be worked out, the MCC experiment might yet turn out to be feasible. But Inman believes that member companies must come up with ways of circumventing the layers of bureaucracy that separate the research lab from the product lab. Among his suggestions: forming quasi-independent organizations for product development and marketing or even seeking outside financing for spinoff ventures to handle the job. "It isn't expensive," he says. "What is needed is a sense of urgency."

A lot of people are rooting for MCC's success. Comments Gordon Bell, the prominent computer inventor who is now assistant director of the National Science Foundation: "MCC is a brand-new model, and I just hope to God it works." ■

Two solid foundations, actually.

The Financial Tower Branch Automation System. And NCR.

The Financial Tower™ System is the first branch automation system designed to protect your institution against obsolescence.

We call it an open platform because it's built around open, industry-standard architecture, so it will accept a wide range of peripherals, software, and expansion options.

From a wide range of suppliers.

You can reconfigure your system to meet your changing requirements. Expand hardware and software without waiting for your vendor to get around to offering upgrades. And avoid dependence on any one automation supplier.

Now and in the future.

Avoiding dependence doesn't mean you shouldn't look for a vendor you can count on, though.

Which is why you should consider NCR carefully.

You can count on us to understand your needs and to respond with well-thought-out solutions. After all, we're no strangers to the financial marketplace.

We're the world's largest supplier of both ATMs and proof machines, and a major supplier of teller terminals as well.

Now we're determined to be the dominant supplier in the branch automation market, by offering the best product at a competitive price.

But simply providing a superior product is not enough. We're also committed to first quality support and service. And we have the people to back it up. Over 10,000 customer support personnel dedicated to customer satisfaction.

These commitments come from a successful and stable company. That means we're a partner your organization can rely on for years to come.

For complete information on the Financial Tower System, phone 1-800-CALL NCR for the name and number of the NCR representative nearest you.

It could be the foundation of a profitable new relationship for both of us.

NCR

THE FINANCIAL TOWER SYSTEM
THE OPEN PLATFORM FOR BRANCH AUTOMATION.

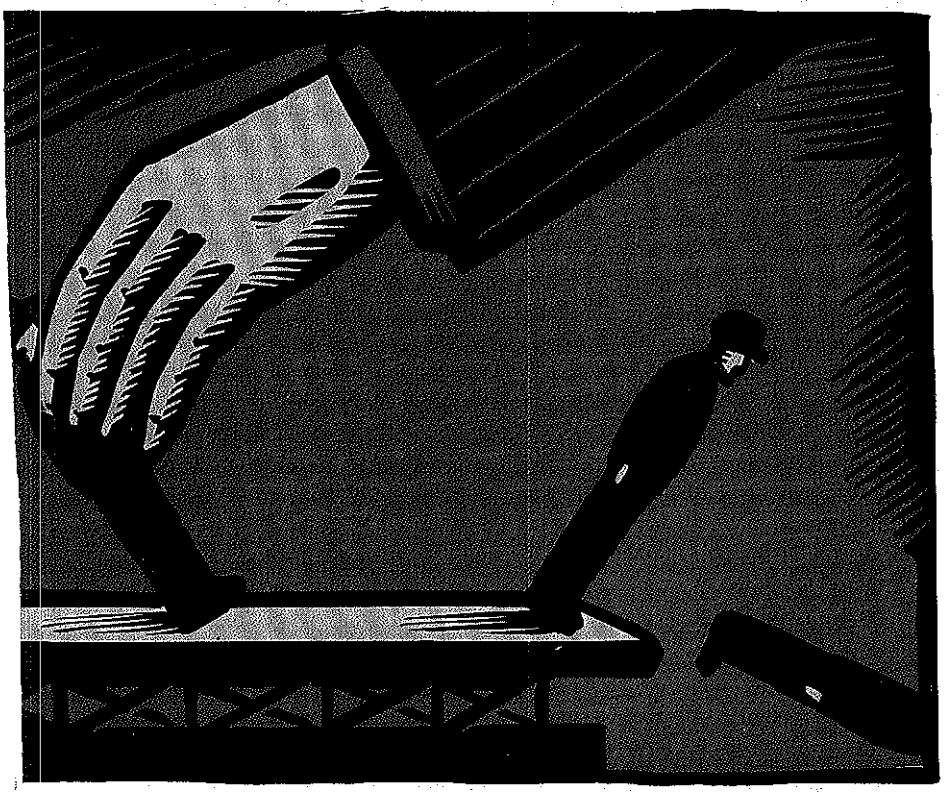
FINANCIAL SYSTEMS DIVISION, USG-2, Dayton, OH 45479. 1-800-CALL NCR

Work in America Institute.

Successful reemployment and retraining programs, like happy families, all look alike. The DOL study found these common elements:

☐ Advance notice of layoffs; at least six months. B&W gave workers one-year's notice. The DOL found scant evidence of disruptions, theft, customer flight or plummeting productivity after notification.

☐ A concerted effort to get workers to participate, particularly older, less educated workers who refuse to accept help. It's rare to get more than 80% of the idled workers to go for retraining or job counseling; 60% is a common figure. Ken Ross, AT&T's director of retraining, says, "It's a psychological problem to get folks to take charge of their career. It helps to have good union leadership. But they really have to feel the pain of insecurity."



☐ Counseling to help the manufacturing blue-collar elite realize that they are not going to find another job paying $13 or $15 an hour, but half that.

☐ A joint management-labor committee to oversee outplacement; management works most effectively in finding jobs and providing guidance, unions in securing worker participation.

☐ Companies assess the local job market and train workers accordingly.

☐ Companies provide workers with professional assessment of their skills and advice on job search techniques.

☐ Reemployment centers stay open after the plant shuts down.

As elaborate and expensive as an outplacement campaign sounds, it pays off. Laying off workers costs both employers and the economy a bundle. The Work in America Institute estimates that employers spend $8,900 to dismiss a semiskilled worker. The costs to government are even greater. The Midwest Center for Labor Research estimates that dismissing a worker earning $10 per hour costs the state and federal governments $19,000 over a two-year period in lost income and sales taxes and increased welfare benefits.

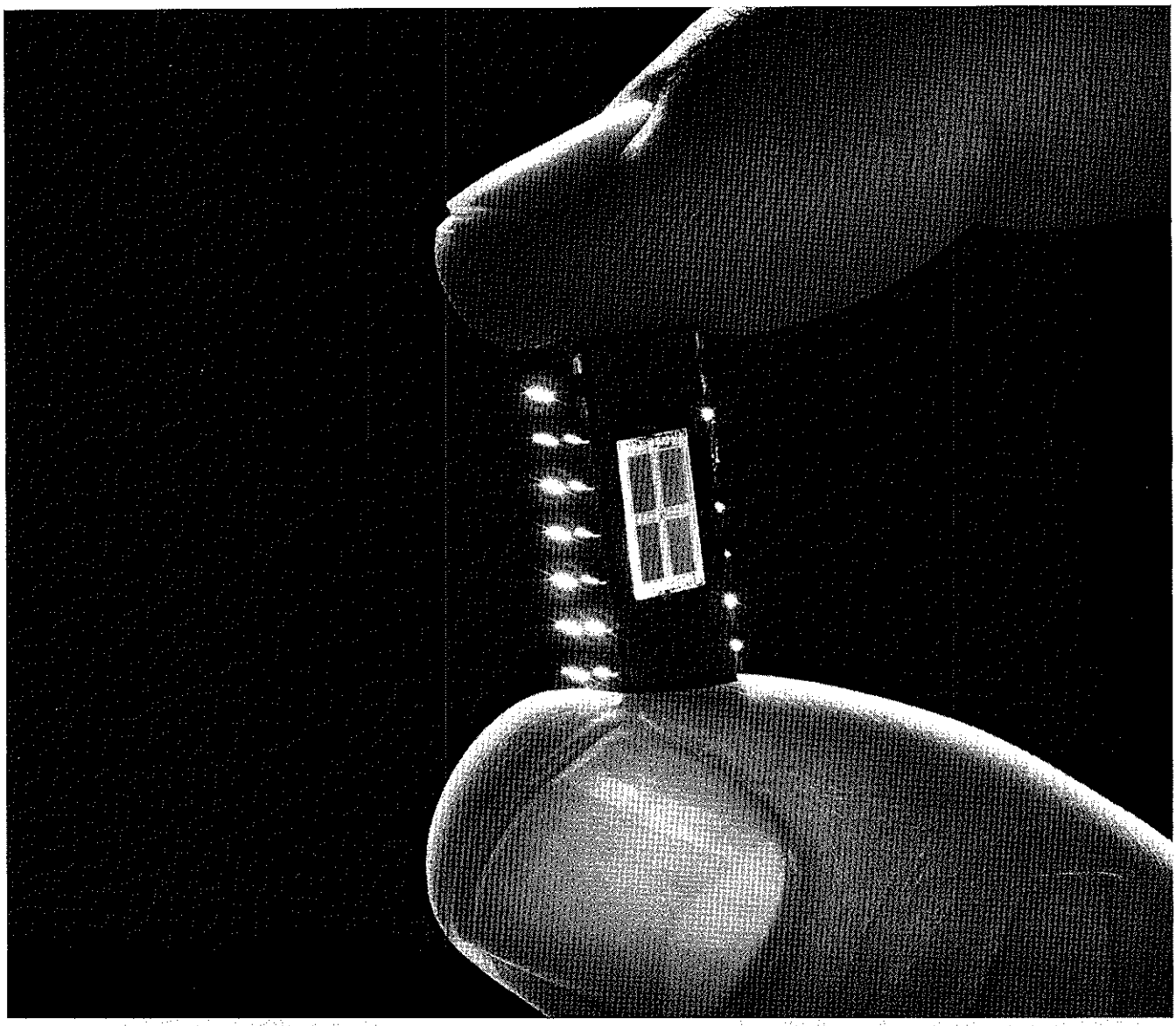
But government programs, which spewed out monumental sums on training programs, helped find jobs for only a minute fraction of laid-off workers. According to the General Accounting Office, at most 8% of the displaced workers found jobs through the Title III of the Job Training Partnership Act and the Trade Adjustment Assistance Act. JTPA placed 69% of the people it served in 1985, but that was only 178,000 out of the 2 million or more laid-off workers.

Employers' programs typically fall short of providing sufficient help, especially for those who may need it most. The GAO found that more than half of the company programs offered severance pay and a third placement assistance, but only 3% offered occupational training, and 36% did nothing.

Moreover, if the object of training is to maintain income for manufacturing workers, the price tag will be prohibitive. Economist Lou Jacobson of the Upjohn Institute estimates that it costs $10,000 in training to raise income by $1,000. Most workers knowing that they probably will fail to match their last wages, get discouraged from retraining and job seeking and wait until their benefits run out. When they finally go job hunting, they have no time to mount a coherent campaign.

Successful company programs nip this cycle of depression in the bud. Ten months before Stroh Brewery Co. closed its Detroit brewery in 1985, idling 875 hourly workers, the company opened up a job club with phone banks and resumé preparation help. It also canvassed prospective employers and gave tips on local job possibilities. Jack Barthwell, Stroh's director of industry affairs, says, "We let them have all the long-distance calls they needed. We decided if they needed to call relatives and friends, it was part of the adjustment process. And they might find a job that way." The results were amazing: 98% of the workers got jobs.

Because of the critical role union leaders play in encouraging participation, GE had to create a worker's organization when it shut down its nonunion microwave oven operation in Columbia, Maryland, in 1985. GE asked each section of the plant to nominate representatives to design the program and communicate it to their colleagues. With their help, GE set up a soup-to-



Why AT&T has it Made in Missouri.

Missouri's business environment is ideal for high-tech industries. So ideal, in fact, that we outproduce the Silicon Valley in microchip innovations.

That's why so many leading names in communications/electronics—AT&T, Bendix, McDonnell Douglas, 3M, Emerson Electric and others—have it made in Missouri.

Our advantages include America's most favorable business taxes. Low production costs. A wealth of skilled labor. Bright young engineering, science and math graduates. Superb public facilities equipped for cutting-edge R&D. A central location. Excellent transportation links. A low cost of living. And more.

All in a state fun enough to make tourism our second largest industry.

To find out how **your** business can have it made in Missouri, clip the coupon. Or simply reach out, collect: (314) 751-4539.

DBM387

☐ TELL ME MORE ABOUT HOW TO HAVE IT MADE IN MISSOURI.

☐ CALL ME ABOUT YOUR FREE PLANNING ANALYSIS FOR BUSINESS RELOCATION OR EXPANSION.

The Missouri Advantage™

NAME _____

TITLE _____

COMPANY _____

ADDRESS _____ PHONE _____

CITY _____ STATE _____ ZIP _____

Mail to: MADE IN MISSOURI,™ P. O. BOX 118
Jefferson City, MO 65102

reers of young, fast-track managers after they leave, keeping them in mind for future executive positions. That has long been the practice at General Electric Co., for one. Both Robert Wright, who was named president of RCA after GE acquired it last year, and Fred W. Garry, vice president of corporate engineering and manufacturing, are boomerang executives who had left GE earlier in their careers. "We're always sorry to lose good people," explains a GE official, "so we keep an eye on them and from time to time make a point of asking them back."

Lawrence ("Mac") Ausbon had a similar experience. In 1976, he had left his job as national sales manager for Virco Manufacturing's Pride-Trimble division, which makes children's furniture, and spent most of the following nine years at competitor Strolee of California Inc., where he rose to the position of executive vice president. In April 1985, President Robert Virtue of Virco invited him back as president of Pride-Trimble. "He knew me and my record from our long acquaintance," Ausbon says, "and that clearly gave me a leg up on the job."

W. Douglas Leys has returned twice to his old company, Mica Corp., a producer of laminates for circuit boards. A highly respected engineer, Leys first left Mica in 1982 after a ten-year stint, during which time he rose to the position of plant manager. Leys says he resigned because the company's fortunes were tumbling and he feared for his job. Two years later, the company was doing well again and asked him back as engineering manager at a much higher salary.

A year or so later, Leys decided he wanted to run his own show and left Mica to help start up a technical testing company. The infant firm flopped within six months, and Mica welcomed him back to the same job last year. "They showed a lot of patience and understanding," Leys says. "But now that I have gotten that fling out of my system, I plan to be here for a long time."

As the above experiences indicate, many executives have found the boomerang route a good way to move up the corporate ladder. Returning managers can expect the faith shown in them by their employers to be transformed into increasingly higher levels of responsibility, notes New York recruiter William Battalia—unless, of course, they foul up.

With this in mind, the boomerang executives and recruiters interviewed by BUSINESS MONTH offer a few tips to help pave the way back. At the top of the list: When leaving a company, always do so under the most amicable circumstances. To grin and bear it can be very difficult, of course, especially if the motive for quitting stems from conflicts with superiors.

Manager Brad Townsend, for one, attributes his invitation to return to his old company largely to the calm and cool manner in which he had left. A district sales manager for Fender Musical Instruments Co., Townsend had walked out in 1980 angry and frustrated over the company's handling of its sales operation. "I didn't read them the riot act, although I felt that I should," he says. "I just typed out a one-sentence letter of resignation and politely went my way." Townsend returned to Fender as a district sales manager with bigger responsibilities and a richer compensation package and has since been elevated to credit manager.

Keeping in touch with the old company also pays off. Even when an executive has no intention of going back, maintaining contact with former colleagues is a practical way of keeping abreast of industry developments and making sure he is not forgotten. "Savvy executives never burn their bridges," Gervas says. "They know that networking is a smart way to help build a career."

Finally, experienced boomerang executives point out, company managers often feel unjustly passed over when an outsider is brought in to fill a slot, even if he is an alumnus. Minimizing that resentment is important for a smooth transition back. Mac Ausbon says it helped his cause that most of Pride-Trimble's division managers still knew him, and he was able to reassure them through private conversations that their jobs were not threatened. "The key is to allay their fears quickly," he says. ■

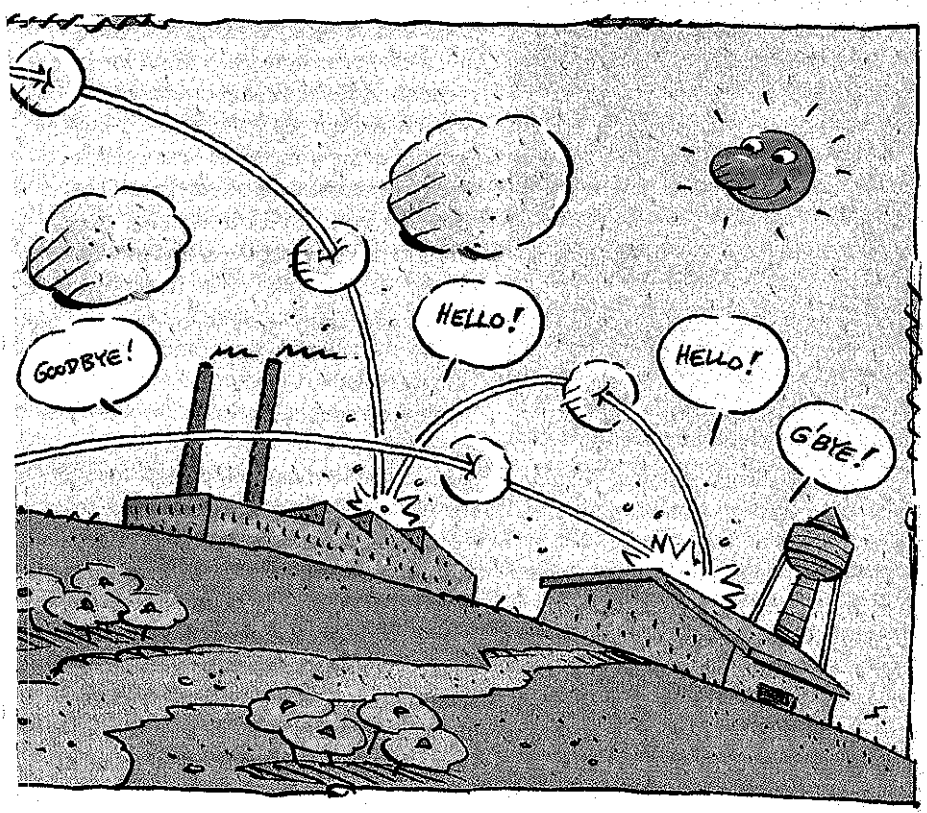


ILLUSTRATION BY ELWOOD SMITH

cheaper to farm out the marketing function to MCA than to do it in-house.

After growing internally for a long time, about two years ago MCA went on an acquisitions spree to build its marketing supermarket. MCA bought itself an instant reputation for creativity in advertising by snaring hot ad agency Ally & Gargano for $26.6 million last year. MCA combined Ally with its existing agency MCA Advertising, which lacked the creative panache to bring in new clients. A&G's roster of service industry clients, including Federal Express and Dunkin Donuts, was a good fit with MCA's packaged goods accounts such as Heinz, Lipton and Ralston Purina, but it has not yet paid off in new business. The new agency bills about $300 million for a stable of 22 clients, which makes it about thirtieth in the nation.

Similarly, MCA expanded its presence in sales promotion, a $99 billion business that is currently 65% of the marketing budget versus 35% for advertising, according to *Marketing Communications* magazine. Acknowledging its weakness in in-store merchandising, it acquired Chicago-based agency Lee Hill, Inc. With this addition, it now covers the whole gamut of trade and consumer promotion. It also hired one of the best known direct marketers in the business, Ray Dempsey, from industry leader Wunderman, Ricotta & Klein, Inc. to set up a direct response group.

To capitalize on their clients' enthusiasm for advertiser-sponsored special interest magazines, MCA launched its own publishing group last year. It hired husband and wife team Jack and Mary Lou Decker to form Target Market Publications, which will be distributed through retail outlets that sell the advertiser's products. The first launch will be announced in the next few weeks.

But McManus is unwilling to sacrifice profitability to be all things to all customers. Consequently, he sold MCA's coupon insert business even though it had been one of its most profitable operations. MCA entered the coupon business in Sunday newspapers in the early 1970s and soon snared 20% of the market. But in the early 1980s, a price war broke out and prospects for profits plunged. MCA sold the business to Vlassis Inserts, the industry leader, for a reportedly hefty profit.

Even more unusual than the broad array of services that MCA offers is its entrepreneurial spirit. Unlike the stultifying inbred corporate culture of the typical packaged goods marketing department, MCA fosters risk taking. For example, McManus believes most big companies mistakenly instill a fear of failure in their employees. So he set aside 15% of gross profits to enable MCA executives to toy with new ventures. That's how come the marketing giant owns a regional airline, a chain of seventeen upscale eateries, a real-estate management and development company, a venture capital firm and an educational software group.

These ventures compel MCA consultants to learn by doing, which distinguishes them from other consultants. And they do very well, thank you. MCA's regional airline, Business Express, was an overnight success. In 1984, it acquired a $2 million airline, when MCA executives noted it was easy to fly from neighboring Bridgeport to Miami or San Francisco, but hard to get to Washington, Philadelphia or Baltimore. Business Express is now a $50 million carrier servicing twenty cities. And it has never cut prices. "All we did was focus on service," says McManus.

The MCA staff combines heavy corporate experience with a laid-back culture. The casual tone is set by McManus, an affable gray-haired man who rarely wears ties and is featured in

Dressed for the day at Marketing Corp. of America: Chairman James McManus (left), and President Robert Kamarschen (right)

PHOTOGRAPHS BY BILL BERNSTEIN

Kroger flowers: "Everbody and his uncle wants to sell to the supermarkets"

now has flowers in 750 of its 1,200 stores and expects to gross $100 million from them this year, says Marnette Perry, manager of floral merchandising, procurement and distribution. Safeway sells flowers in "virtually all" of its 2,173 stores.

In a business as tight-mouthed as a Venus's flytrap, however, Safeway won't divulge sales figures. But Felicia del Campo, corporate public affairs manager, states categorically: "We sell more flowers than any other retailer in the world."

Because the supermarkets concentrate on commodity blooms such as roses, carnations, tulips and daffodils, flowers are logistically a natural extension of the produce business: a perishable product, usually purchased regionally, and benefitting from economies of scale and mass buying.

That mass buying is in turn good for the wholesale flower business. Nurseryman Yoshimi Shibata of Mt. Eden, California, the second of three generations in his family's 77-year-old nursery, remembers when people referred to "my florist" like a doctor or lawyer. Now, Shibata says, "everybody and his uncle wants to sell to the supermarkets." The Mt. Eden nursery's clientele extends from Safeway, Kroger and Alpha Beta Stores in California to Butt Stores in Texas.

Shibata says the supermarkets' volume buying has not degraded quality. 'They're very finicky about quality and very fussy that flowers should be long-lasting," he says. Adds Don Dobecki, Melridge national sales coordinator, "The perception that a supermarket flower is necessarily a poor flower is entirely false. Chain buyers do not look for cheap prices; they look for large supplies of good flowers."

In fact, to sell supermarkets the growers have had to devise some new techniques. Borrowing a trick from produce processors, flower growers are extending flower life (to around fifteen days for some varieties) by "precooling" them to 36° before shipment.

The growing supermarket demand has also further stimulated imports. Most of the flowers sold in the U.S. now are no longer grown here. Imports from such countries as Holland, Mexico, Colombia and Israel reportedly now represent 70% of domestic sales. Last year, the newly formed Floral Trade Council, a U.S. growers' group, filed anti-dumping complaints with the Federal Trade Commission. Carnations flown from Colombia, said the council, are being sold in Florida for less than it costs to transport them from Michigan, a major U.S. producing area.

But retailers and other industry groups don't want protection. Take, for example, the 77-year-old Florists' Transworld Delivery Association, the country's largest small business co-op, which handles flowers by wire for 23,000 members. It's "nonsense" to say that imports are ruining the flower business, says William Maas, FTD executive vice president. "Without imports, the market could not be supplied," he says.

The fact is, U.S. production is steadily falling, and for reasons other than foreign competition. "Flowers used to be grown commercially in the suburbs of cities where they were sold," explains Archie J. Clapp, executive vice president of the Wholesale Florists of America. "But soaring land prices, energy costs and restrictions on pesticides have dried up many of our biggest flower fields."

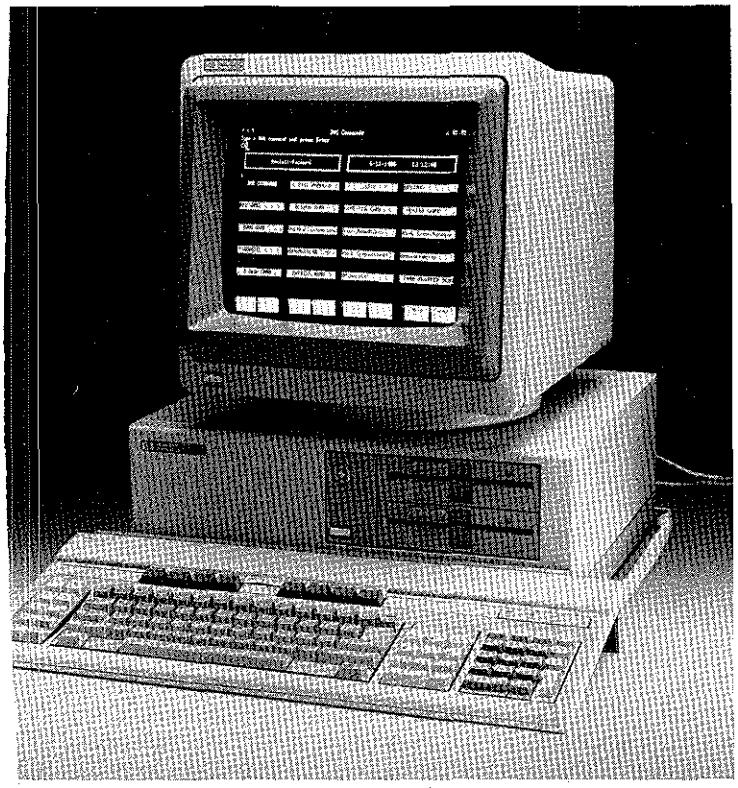
All told, FTD executed a record 21.7 million telephone orders last year for $600 million worth of flowers. Hence, Bill Maas doesn't see the supermarkets as any greater threat than the foreigners. His members will still command their traditional markets, he says, and they know a lot more about flowers than do supermarket clerks. "For putting a bunch of posies on the table, they're fine," Maas says. "But the expertise you find in supermarkets is very spotty."

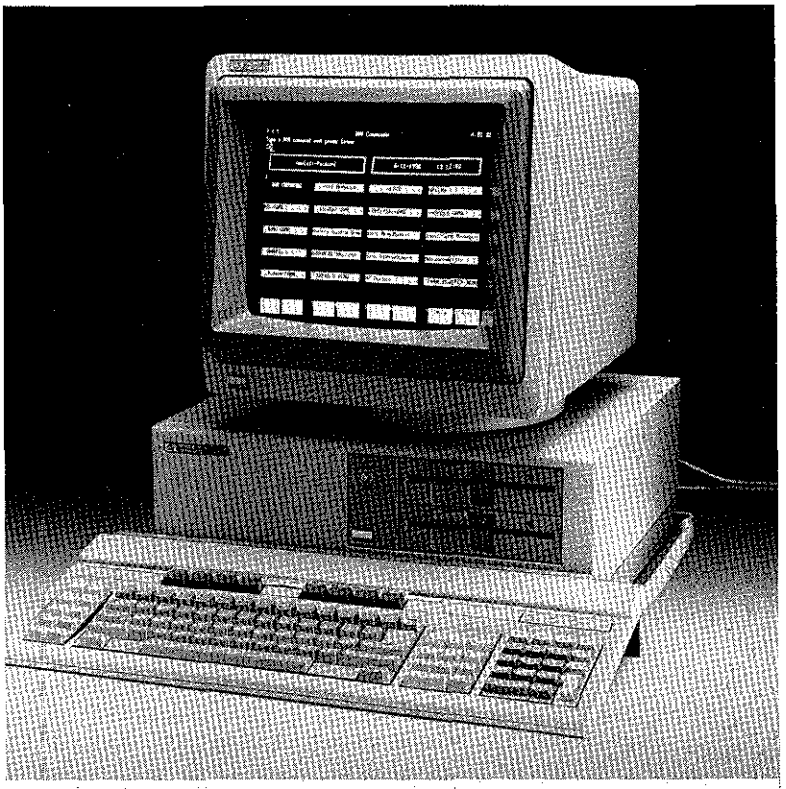
If that is so, entrepreneur John Felly, a Madison, Wisconsin, wholesale florist, wants to do something about it. Felly's company, Bouquet Connection, is a kind of floral rack jobber for supermarkets. It will deliver, arrange and even price a store's flower inventory twice weekly.

Started only last fall, Bouquet Connection has been growing like, well, a weed. It will probably gross about $1.5 million this year, Felly says, and now serves more than one hundred Wisconsin supermarkets.

"We're making it easy for shoppers to pick up a bunch," says James G. Marshall III, Felly's vice president, "not just for the dining room table, but for the kitchen—and why not the bath?" Why not, indeed? One of Bouquet Connection's newest clients on Madison's Grand Canyon Drive is the Mermaid Car Wash. ■

WHAT MAKES ONE MORE COMPATIBLE THAN THE OTHER?





FEDERAL TAX CREDITS.
LOCAL TAX INCENTIVES.
NO DUTIES.
NO QUOTAS.
LOW LABOR COSTS.

Hewlett-Packard computed the difference. And found the Commonwealth very compatible indeed. That's why some of the high-volume accessories for their new Vectra PC are made in Puerto Rico, and stamped Made in the United States.

Which means Hewlett-Packard didn't have to compromise their product-quality reputation one bit, while getting such friendly input as a substantial U.S. federal tax credit. Duty-free access to the U.S. market. An average electronic-industry labor cost of $4.05 per hour less than that on the U.S. mainland. Fast shipping and flights to the States. Factory space starting at $1.25/sq. ft./yr.

And most important of all to productivity- and quality-conscious companies like Hewlett-Packard, Puerto Rico has a highly skilled hi-tech labor and management force that interfaces with such names as Digital Equipment, Wang, Lotus, and a whole island of U.S. and international manufacturers of everything from designer clothes to pacemakers.

For all the current details, without obligation, mail in the coupon or call Maria Lopez today in New York at 212-245-1200, Ext. 230.

Yes, I want to know more. Please send my *Climate is Right* information immediately.

NAME_____

TITLE_____

COMPANY_____

ADDRESS_____

CITY_____ STATE_____ ZIP_____

TELEPHONE ( )_____

PRODUCT or SERVICE_____

☐ Current expansion project ☐ Future expansion planning DBM-03

Mail to: COMMONWEALTH OF PUERTO RICO
Economic Development Administration
1290 Avenue of the Americas
New York, N.Y. 10104-0092

Or call
Maria Lopez
212-245-1200
Ext. 230

PUERTO RICO

The climate is right.

FREE INFORMATION BUSINESS MONTH EXECUTIVE BUSINESS EQUIPMENT PLANNER

The Business Equipment & Systems Planner has been developed to help BUSINESS MONTH management readers become better acquainted with the products and services supplied by leading manufacturers in the office automation field. To receive detailed information on the equipment and services described on this page circle the numbers on the return card that correspond with the listings below. The manufacturer will send you the information directly.

AGS INFORMATION SERVICES, INC.
AGS Information Services, Inc. provides consulting support from coding of programs to senior management consulting, including feasibility studies, analysis, design, implementations, maintenance, conversions, training, documentation and knowledge engineering 90

MITEL
The SX200 Digital PABX family is ideal for businesses with 40 to 400 lines. Its digital switching foundation opens up the next decade of voice and data communications for your business 91

NETHERLANDS FOREIGN INVESTMENT AGENCY
Why have so many U.S. high-tech companies flocked to the Netherlands? Holland's central location, its advanced technological base and the high quality of the Dutch workforce are among the many reasons 92

PUERTO RICO, ECONOMIC COUNCIL OF
For information concerning tax exemption incentives, availability of competitive industrial space, skilled labor and other profit making inducements offered by Puerto Rico, circle reader service number 93

XEROX CORPORATION
For more information on Xerox electronic Publishing Systems Circle # 94

MARCH 1987

BUSINESS MONTH/ BUSINESS EQUIPMENT PLANNER

Please send the information corresponding to the circled numbers below:

90	91	92	93	94	95	96	97	98	99
100	101	102	103	104	105	106	107	108	109
110	111	112	113	114	115	116	117	118	119
120	121	122	123	124	125	126	127	128	129
130	131	132	133	134	135	136	137	138	139
140									

Are you currently a BUSINESS MONTH subscriber? ☐ Yes ☐ No

TITLE (Please check)
A ☐ Chairman of the Board
B ☐ President
C ☐ Vice-President
D ☐ Treasurer/Secretary
E ☐ General Manager
F ☐ Division Manager
G ☐ Department Manager
H ☐ Management, other
J ☐ Controller
K ☐ Other:_____

Name_____ Title_____

Company_____

Address_____

City_____ State_____ Zip_____

Telephone #_____

CARD VOID AFTER 6/15/87

NO POSTAGE NECESSARY IF MAILED IN THE UNITED STATES

BUSINESS REPLY MAIL
FIRST CLASS PERMIT NO. 04087 NEW YORK, NY

POSTAGE WILL BE PAID BY ADDRESSEE

ATTN: EVELYN HURDY
BUSINESS MONTH
BUSINESS EQUIPMENT PLANNER
875 THIRD AVENUE
NEW YORK, NY 10022

data input or access. Commodore Computer Systems has introduced two low-cost, fully configured IBM PC-compatible desk top computers.

And, Tandy Corporation/Radio Shack has introduced an enhanced version of its economy priced IBM PC-compatible *Model 1000EX* personal computer. It runs 50% faster than the comparable IBM system and includes a new graphics-oriented software product that integrates word processing, electronic filing, a spreadsheet, personal calendar maintenance and data communications capabilities.

Reflecting the trend to merge the capabilities of electronic typewriters with those of personal computers, Minolta has introduced several advanced versions of electronic typewriters, including the *EW 251F* which provides a diskette drive and can be connected to a personal computer.

Minolta also has enhanced the performance of its *Office System/PCW-1* with five new software packages, a data communications link and a 20 MGByte hard disk drive. The *PCW-1* can communicate with other personal computers, act as a telex machine with automatic answerback and support an electronic bulletin board.

Xerox also has added communications capabilities to its electronic typewriter. The *Memorywriter 645E* can be plugged directly into any Ethernet-compatible local area communications network.

Portable PCs Multiplying

Lap top personal computers are available from at least a dozen manufacturers. Wang Laboratories and Apple Computer are among the latest entrants.

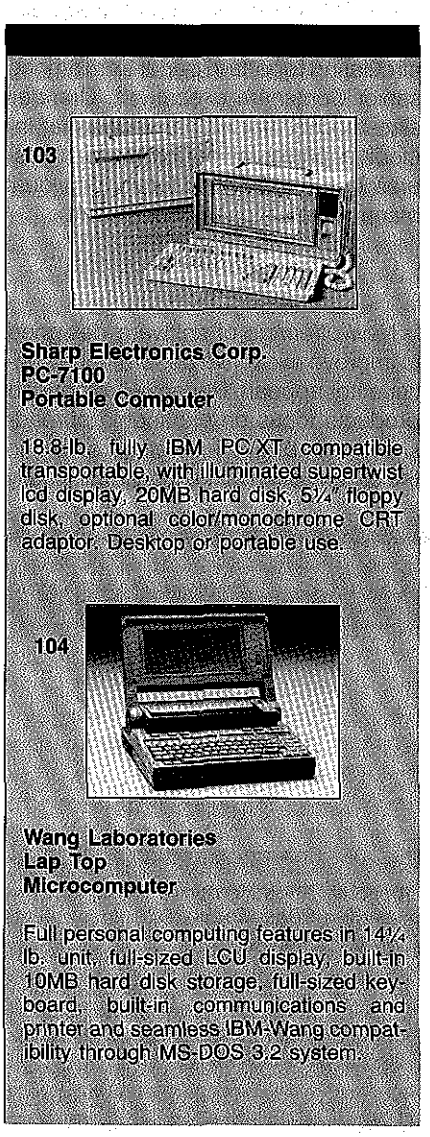
NEC Home Electronics Computer Products has introduced three new lap top computer models. Among them are its *Multispeed* unit, supplied with five built-in software products, including the unique *Outliner* program that aids in organizing material to be elaborated on with word processing software.

Tandy Corporation/Radio Shack has introduced its *Model 600* which expands upon the features provided in its widely used Models 100 and 200 lap tops. It provides data communications capabilities and includes built-in software for improved word processing and personal calendar maintenance.

The new version of Hewlett-Packard's IBM PC-compatible *Portable Plus* lap top based computing system uses software in plug-in cartridges and incorporates an auxiliary disk drive and ink jet printer in less than 19 pounds.

IBM's 13-pound *PC Convertible* personal computer functions as both a lap top and a desk top system. A dot matrix printer can be attached directly to the convertible. A modem permits it to communicate with other IBM PC-compatible personal computers. Removal of its liquid crystal display permits use with a standard IBM PC display unit.

Citicorp [Bank's] Global Trade Services Division executives use lap top computers in their worldwide activities. IRS plans to have 18,000 Zenith Data Systems lap top computers in the hands of field auditors by 1988. The U.S. Postal Service plans to begin using lap top computers to collect data on local postal facility mail handling performance. And, Cigna Insurance has joined those corporations in its industry that are placing lap top computers in the hands of field salespersons.



Charles Feld, Frito-Lay management services V.P., already has placed 200 Fujitsu handheld computers in service and expects by the end of next year to have the entire Frito-Lay national sales force using them to collect and communicate customer data.

The immediate goal is to reduce the sales force's data collection workload and to improve the quality of the information available to Frito-Lay marketing and production executives. However, long-range plans call for restructuring production and distribution system around this data handling process.

Comparable handheld computers weighing slightly more than three pounds each are available from National Datacomputer, Melard Technologies and Text Lite Communications. The latter's *PX 1000* unit can handle word processing chores and also can be used in an electronic mail system. Panasonic Industrial Co. has introduced an enhanced IBM-compatible version of its *Personal Partner Model FH2000* handheld computer. It can support a separate printer and access data from databases at remote locations.

"Executive" Software

The new class of EIS software has evolved from the more familiar decision support programs already used for some years with personal computers. They, in turn, draw upon the capabilities of a variety of specialized data acquisition programs, including spreadsheets and database management systems. Some EIS offerings also draw upon data analysis, forecasting and planning features of expert systems.

Representative of a new type of executive-oriented expert system creation tools is *1st Class*, available in Version 3 from Programs in Motion. It integrates spreadsheet and database content with graphic data display capabilities and is used to create systems that aid in purchasing decisions, credit approvals, analysis of customer service performance and operational and insurance risk analysis. Other expert system development tools now available include Texas Instruments' *Personal*

organizing the individual's daily work. Representative of these are *Metro* by Lotus Development, *KeyNotes* by Digital Learning Systems, *FIRST AVENUE* by Canal Systems, and *WordPerfect Library*. They can operate while the personal computer user is doing other work. They provide such things as a stop-watch timer, a calculator, appointment tracking, personal address and telephone number list maintenance and personal memo and file creation.

Rapidwriter by Quixote combines software and a modified IBM personal computer keyboard to permit single keystroke entry of frequently used words and standard paragraphs.

Local Area Networks

Successful use of these improved personal computing resources, in general, and EIS capabilities, in particular, relies in some measure upon a senior executive's ability to share data resources and the analyses made of them. This, in turn, requires the existence of an effective local area network (LAN) communication system tying corporate data sharers together.

Efficient LAN operation is becoming critical to realizing office automation benefits. LAN performance is increasing rapidly. The improvements are accompanied by significant cuts in LAN-associated costs. For instance, the investment associated with connecting a personal computer to a LAN is expected to drop by close to 55% this year. Industry experts expect this connection capability to become a standard personal computer feature by the end of the decade.

A LAN permits connection of a wide variety of document printers, scanners, facsimile devices, data entry terminals and voice communications devices, as well as personal computers, to main frame computers and high density data storage devices. While there are differing approaches to connecting LAN users to each other, network development tends to focus on easing the ability of all involved to share messages, data, software and workload.

Performance recently has been upgraded for, among others, IBM's *Distributed Office System* (DISOSS), Codex Corp.'s *4000* series system, Digital Equipment's *DECNet* and *ALL-IN-1*, Digital Communications Associates *IRMALAN*, NCR's *WorkSaver* system, and also Honeywell's *Office Net-Work Exchange (ONE) Architecture*.

Honeywell's *ONEPLUS* enhancement of its LAN offering reflects a growing interest in enabling members of corporate staff groups to share their own data through a subset of a larger LAN. This concept is called departmental computing and is the basis for several special new products from IBM, NCR and Digital Equipment.

ONEPLUS also supports departmental computing. In addition, it permits users of different personal computer varieties to communicate data between themselves through a common LAN facility.

More limited personal computer intercommunication oriented LAN products are Tandy/Radio Shack's *Vianet, TOPS* (Transcendental Operating System) available from Centram, and Digital Equipment's *WPS-PLUS*. *TOPS* facilitates communication between IBM personal computers and Apple *Macintoshes* and *Laserwriters*. *WPS-PLUS* permits a variety of Digital Equipment workstations and personal computers to communicate and share document preparation with the entire line of IBM personal computers.

Continued refinement of LAN technology has led to the development of both personal computers and software designed especially for use in that environment. Examples of the latter are the IBM *Business Adviser* and Computer Associates *Easy Business* series of accounting software products and the LAN multiuser version of Release 3.0 of Innovative Software's *Smart Software System*. All three items permit files and application programs to share data. In the case of *Smart* and *Easy Business*, this means that work in progress can be transferred directly, when necessary, between its word processing, spreadsheet, data manager and graphics offerings.

Both multiuser and so-called diskless personal computers designed for use in a LAN environment recently have been introduced. Representative of the former are the Harris Lanier Business Systems' *Concept 4300* and *Concept 6300*, Epson America's *Equity III*, Honeywell's *XPS-100* series and *DPS 6 PLUS Model 410*, Digital Equipment's *VAXcluster* systems, and the L/F Technologies *Cubix* offerings. These products can support anywhere from three to 18 users.

Diskless personal computers, such as Lancore Technologies' *Worknode* and Harris Lanier Business Systems' *Concept 2100*, are designed to provide significant data handling resources without requiring onsite file maintenance. They are significantly less expensive than conventional desk top computers and reduce the likelihood of sensitive information being compromised.

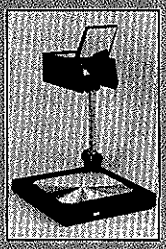
Electronic Mail

One of the basic LAN activities—and a key element in office automation—is the exchange of text messages between participants in the network. The process used is known as electronic mail. Such systems are not interactive, but do permit essentially instantaneous transmission of messages, typically brief and time sensitive, between indi-

Office Equipment

Circle number on reply card for more information

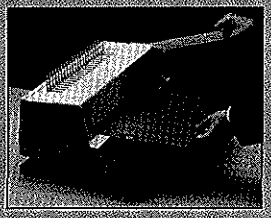
108



Da-Lite Screen Co.
Da-Lite/Beseler Pet 100
Audio-Visual Equipment

Lightweight, compact overhead projector. Ideal for traveling presentor. Simple to carry and easy to set-up. Comes with carrying case, weighs 13½ lbs.

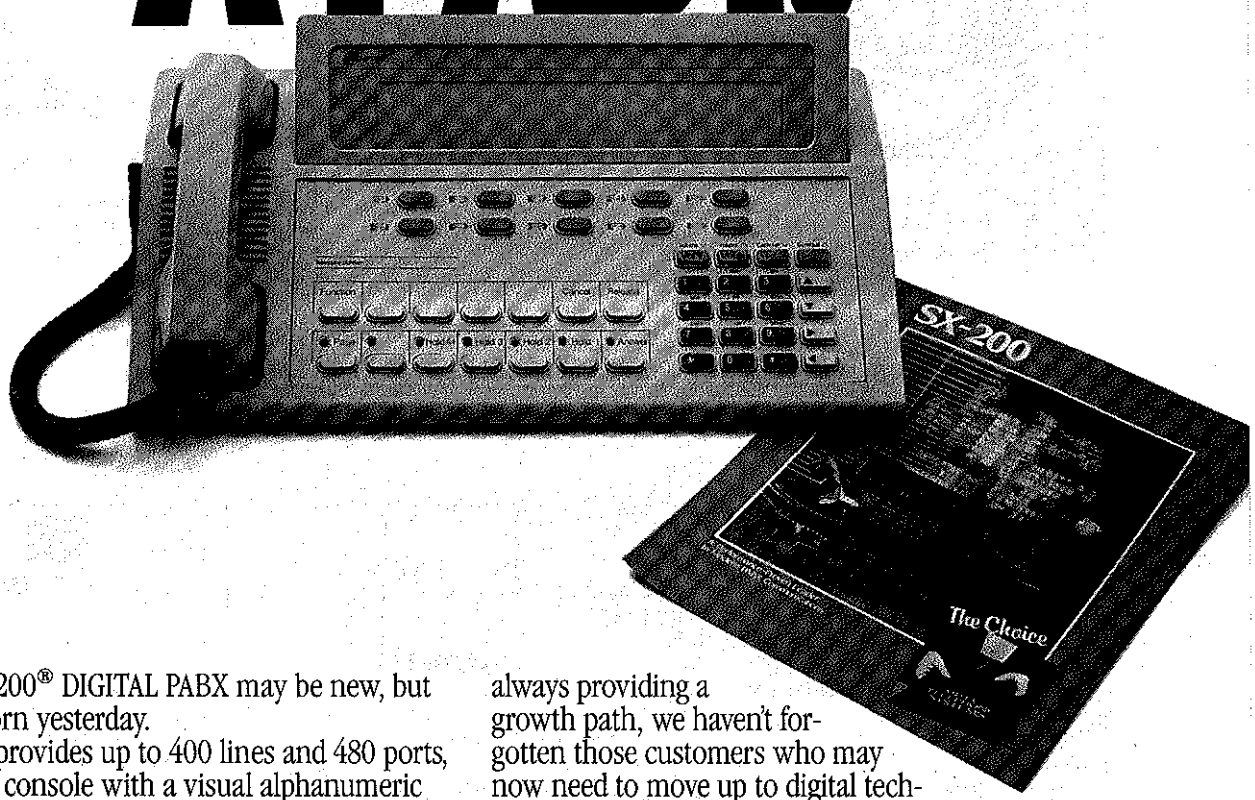
109



GBC (General Binding Corp.)
Image-Maker 2000
Plastic Binding System

Complete desktop punching-binding system quickly converts loose papers into reports, catalogs, handbooks, etc. Patented, user-friendly features easily bind documents up to 12" long. Up to 15 sheets can be punched simultaneously. Binds books up to 2" thick (425 sheets).

THE FIRST DIGITAL PABX WITH A PAST.



Our SX-200® DIGITAL PABX may be new, but it wasn't born yesterday.

True, it provides up to 400 lines and 480 ports, and even a console with a visual alphanumeric display.

But its lineage comes straight from our proven analog SX-200 PABX, introduced in 1978. A switch so fully featured, so easy to operate, and so simple to maintain, that over 40,000 are in use today.

And, in keeping with our philosophy of always providing a growth path, we haven't forgotten those customers who may now need to move up to digital technology. Our software upgrades enhance any installed SX-200 analog system with the same advanced features found on the new SX-200 DIGITAL.

Plus one important feature no one else offers.

A future!

MITEL®

Communications Answers That Work... For You.

plain bond paper similar to that used in conventional copying machines. The Murata Business Systems *Viewfax* weds a small video camera to a facsimile unit. This permits transmission of three-dimensional images.

When linked with an IBM-compatible personal computer and some form of image storage, the facsimile device becomes a key element in what CAP International describes as an image communication network. (These networks are expected to play a major role in, among other things, LAN development over the next five years.)

Xerox, Ricoh, and Telautograph are among those who offer facsimile devices suitable for an image communication network.

DataCopy, Panasonic Industrial Computer Products, and GammaLink Synchronous Communications are among the nearly dozen corporations now offering circuit boards and software that can be added to IBM-compatible personal computers to permit them to send messages directly to remote facsimile devices. The entire content of files can be transferred and addition of this communication capability improves the graphic quality of facsimile system reception.

Voice Mail

Voice mail is a comparatively recent offshoot of electronic mail. Its appearance reflects continuing improvement in the performance of private branch office telephone exchanges (PBXs) and replacement of rotary dial telephones with touch-tone devices.

Voice mail networks, like their electronic mail counterparts, are not interactive. But, they do permit essentially instantaneous delivery of messages between individuals and broadcast from individuals to groups.

Of course, it is not possible to create paper copies of voice mail messages. And, as is also true of conventional electronic mail systems, actual delivery of voice mail messages can be delayed when the individual being communicated with fails to check the designated "voice mail box."

However, a voice mail system eliminates the need to have message content reduced to a form that a machine can process. And, it avoids the cost and frustration of "telephone tag."

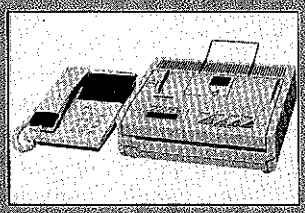
Voice mail is an essentially straightforward process from the system user's standpoint. A message is entered by keying the recipient's destination system address code into the telephone handset and speaking the message. The message sender's voice is recorded in digital form in the "voice mail box", yet tone of voice, inflection and emphasis are retained—qualities not transmitted when a message is displayed on a terminal or computer screen.

VMX, Voice Computing, Rolm, Octel Communications, AT&E Systems, Hewlett-Packard, OPCOM, Toshiba, and Xerox are among voice mail suppliers. Siemens Information Systems, Lan-Tel, Northern Telcom and others offer executive workstations that are especially suited to voice mail networks. They combine advanced telephone handsets with a personal computer. DiversiCom, a unit of American Diversified Capital, offers *CUE,* a nationwide satellite based paging service that acts as a voice mail network.

Audio and Video Teleconferencing

Audio teleconferencing is another form of advanced voice communications. Like voice mail, it can operate wherever there is a telephone. While it is not particularly suited for message distribution, an audio teleconference system makes possible the kind of interactive communication not provided by voice mail. Several people may share in the communications process at each point in the network. Devices are offered by Luma Telecom, Videotelecom, Image Data Corp. and Pictel.

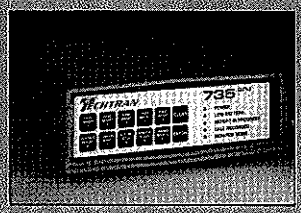
123



Sharp Electronics Corp.
FO-200
Facsimile Machines

Automatic contrast control, high resolution transmission, half-tone reproduction, 2-line lcd display and polling, affordable, small and light enough to fit in briefcase. For office or on-the-road.

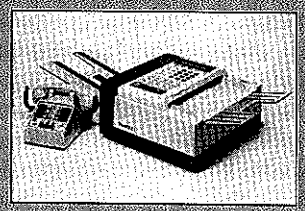
124



Techtran, Inc.
735 Elite
Telephone Accounting System

Compact, solid state call accounting system for small to medium-sized businesses. Comes with 8-hour battery backup, stores up to 30,000 call records, 5 user-specified "one-touch" reports, unlimited variable reports.

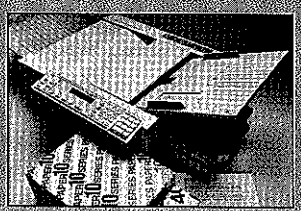
125



Trans-Lux Corp.
TransFAX I
Facsimile Machine

Desktop facsimile capable of transmitting and receiving documents as rapidly as 20 seconds per page. Delivers worldwide compatibility with Group 3 and Group 2 units; sends, receives automatically.

126

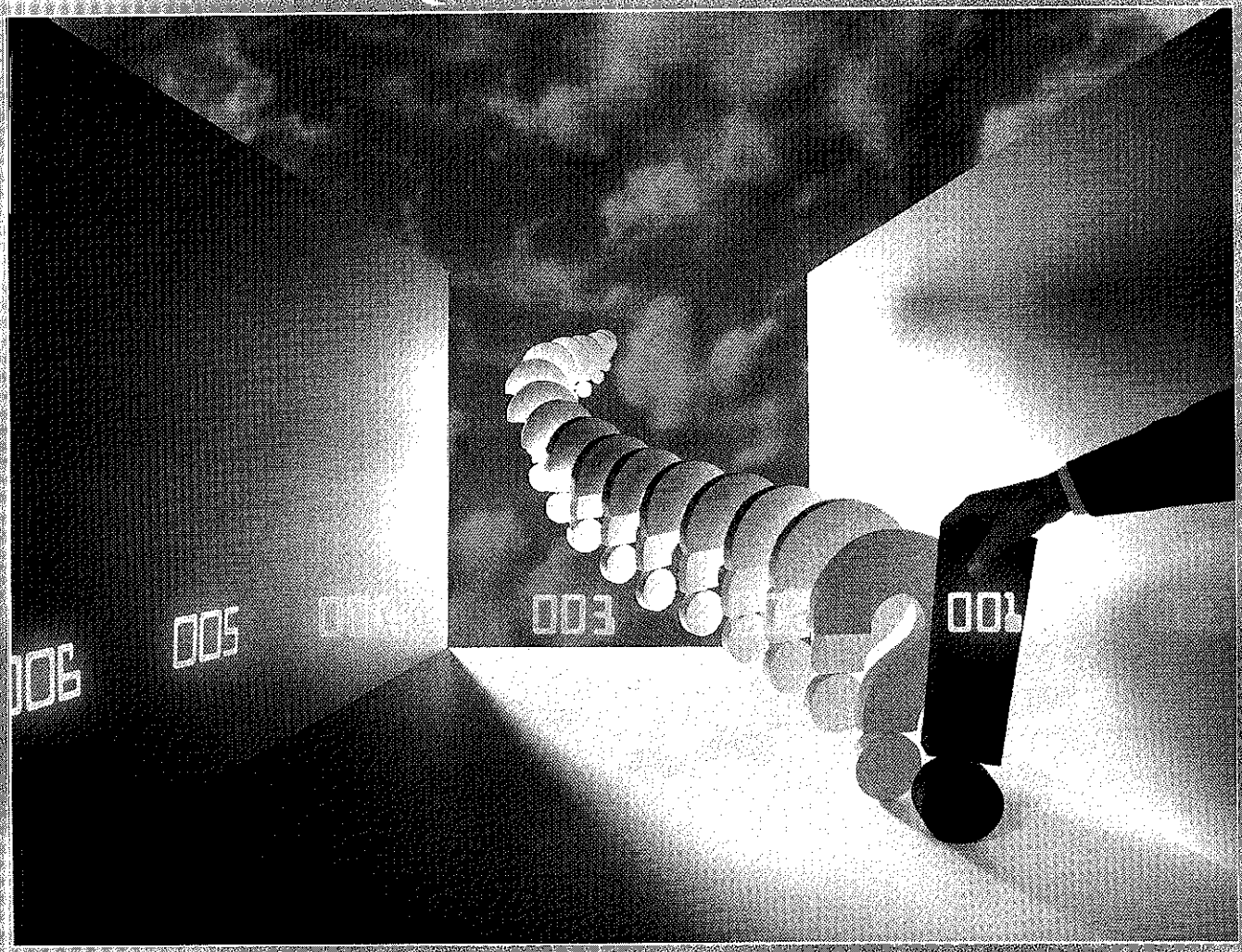


Xerox Corp.
Xerox Telecopier 7020 Facsimile Terminal
Facsimile Machines

Uses same cut-sheet bond paper as in copiers. Designed with thermal transfer technology, which produces crisp black and white images on variety of paper stocks.

About the Author: Belden Menkus is an independent consultant who has been active in office automation since 1958. This is the fifth annual Focus report on this subject that he has prepared. Design by Kellner & Osburn, Inc.

As The Questions Get Harder,



Do Your Answers Get Better?

They'd better. Too much is at stake to base tomorrow's decisions, designs, and systems on yesterday's concepts and technologies. BDM knows how to build you a solid foundation on which you can act with confidence. We perform research and analysis to help you choose an optimum course of action. We can design systems, operations, and programs to implement the action. Then we can support the logistics to make it all come together and the training to make it work.

And we haven't even mentioned meeting your information systems needs. Information is more and more the key to making the right decisions and making the decisions right. Prepackaged information systems aren't the answer. What you need (if you're typical of BDM clients) is not raw data or prodigious printouts . . . but precise, timely information that puts you in effective charge of your world and keeps you there.

So as the questions get tougher, time gets shorter, and the answers are harder to find, call on BDM. We won't let you down, because we won't let up until we get your job done. Right. On time. On budget. BDM International, Inc., 7915 Jones Branch Drive, McLean, VA 22102. Phone (703) 848-5000. Telex 901103.

MANAGING THE COURSE OF CHANGE

BDM

CHANGING THE COURSE OF MANAGEMENT

When lawsuits get out of hand, everybody loses.

Even the best managed claims departments can—and do—become embroiled in endless litigation that wastes time, money and business energy. Often over the smallest of disputes.

There is an alternative.

Across the country large corporations, major insurance companies, small businesses, leading law firms and individuals are resolving disputes before they become litigation nightmares. They are turning to JUDICATE, the National Private Court System.

JUDICATE helps manage legal costs by providing predictable, speedy and cost efficient dispute ending services. Arbitrations and mediations are conducted by a growing panel of nearly 300 former state and federal judges throughout the United States.

Think about what litigation costs you. Then consider the proven alternative, JUDICATE.

For information contact:
William MacQueen, Vice President
National Administrative Offices
1608 Walnut Street
Philadelphia, PA 19103-5406
1-800-631-9900

JUDICATE®
THE NATIONAL PRIVATE COURT SYSTEM

Media Networks puts your local advertising in the right hands.

If your business can benefit by reaching the upscale consumers in your local market, then your advertising message should be running in prestigious national magazines that reach this fast-moving target audience.

Media Networks will place your full page ad in a network of consumer, news and business magazines including *Time, Newsweek, Sports Illustrated, House Beautiful*—and many more. You pay only the local rate for issues delivered directly into the homes of your local business prospects. Yet your ad receives all the impact and attention that only national magazines can offer.

Our free Target Media evaluation will help you select the best magazine mix for pinpoint accuracy in any of over 150 local U.S. markets. So you can reach just the right people, wherever they live.

We'll show you why no one can reach your audience like Media Networks. Place a fast, toll-free call to 1-800-328-0016 or in Minnesota 1-800-642-6303.

Media Networks, Inc.
Reach your customers where they live.

Media Networks, Inc.
1266 East Main Street
Stamford, Connecticut 06902
Telephone: (203) 967-3100

MNi/3M

THE SPREADSHEET CLONES PUT PRESSURE ON LOTUS

ILLUSTRATION BY RICK TULKA

Personal computer knockoffs are not the only clones on the march these days ("Managing Information," *February*). Less expensive copies of well-known software are beginning to make major headway in the corporate market. They are proving so successful, in fact, that Lotus Development Corp. has sued two rival firms for copyright infringement of its hugely successful 1-2-3 spreadsheet program.

Spreadsheet clones first came onto the scene a year or so ago. But the earliest ones were considered inferior and had little impact on the market. "Now, though, the quality and performance of these programs have improved to the point that they are gaining acceptance among big corporate customers," says computer analyst Richard Sherlund of Goldman, Sachs & Co.

The overriding advantage of software clones is their price tag. The Lotus 1-2-3 program sells for a list price of $495 and is discounted at $325 for major sales (500 units and up). In contrast, such leading clone manufacturers as Paperback Software International and Mosaic Software—the two firms being sued by Lotus—list their spreadsheet programs for around $100 and often sell them at half-price discounts. A number of even cheaper spreadsheet clones from the Far East are now entering the market, a development that could bring on a price war, some industry observers believe.

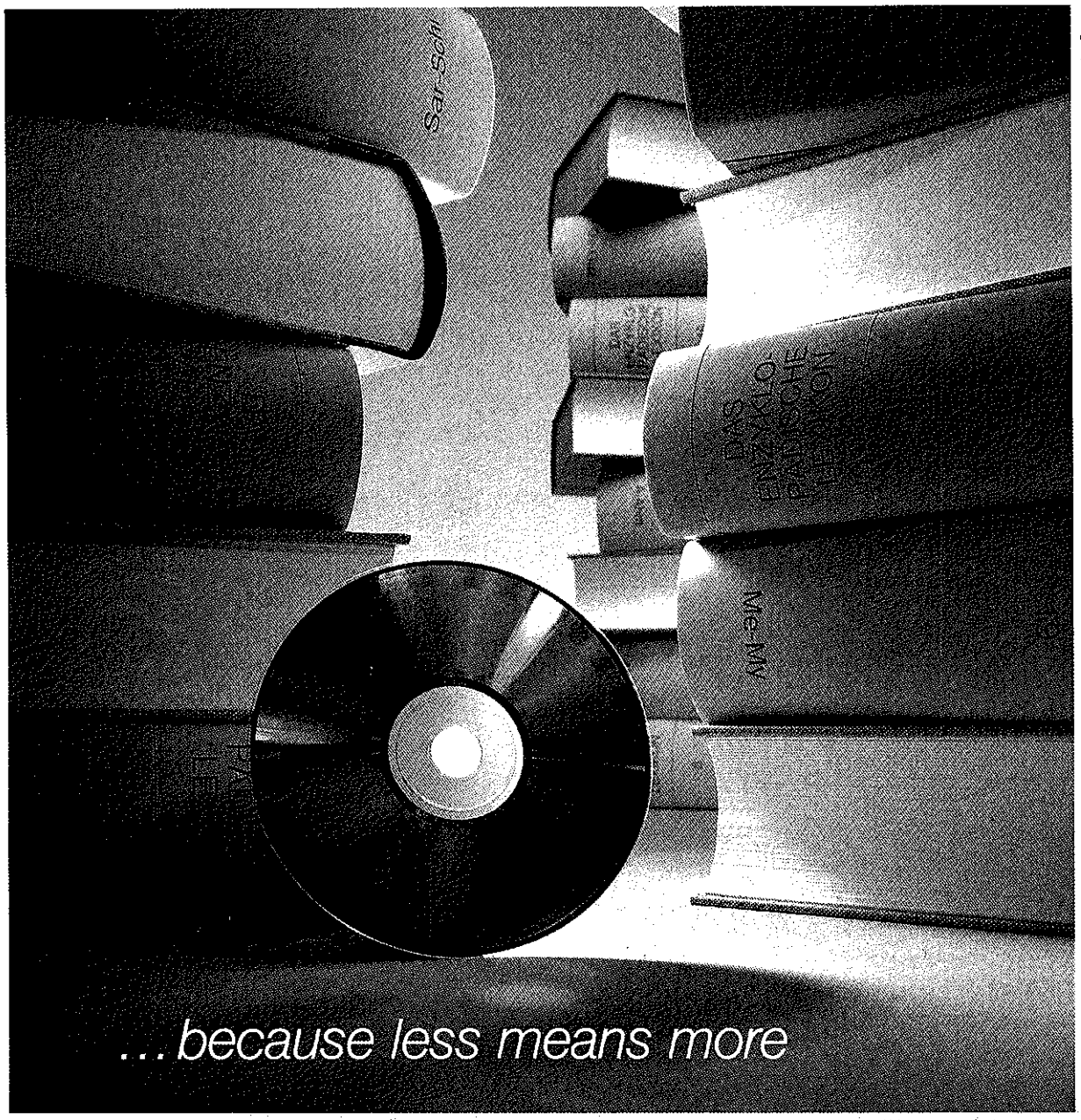
Paperback Software has had considerable success in the corporate market with its spreadsheet program, called VP Planner. Sherlund estimates that it has been shipping up to 20,000 units a month. "We've been able to penetrate some of the country's top banks, insurance companies and aerospace firms," claims Michael Tiktienski, who handles corporate sales at Paperback.

Lotus is not accustomed to that kind of competition. The IBM of the spreadsheet business, it holds 71% of the market and sells around 70,000 units of 1-2-3 each month. But corporate customers are critical of Lotus on a number of counts. Not only is the price of the 1-2-3 too high, they complain, but the firm's licensing policies are too rigid. "Some of Lotus' rules just aren't realistic," says Senior Vice President Joseph Brophy of Hartford, Connecticut's Travelers Corp.

Corporate customers complain that 1-2-3 is too expensive and that Lotus' licensing policies are too rigid

Travelers is among a number of big customers that have been pressing Lotus to give more generous corporate discounts to lower the price differential between 1-2-3 and the clones. The insurance giant is one of Lotus' biggest customers, with around 23,000 1-2-3 units currently installed. But costs could force it to start looking at clones, according to Brophy. As he explains: "In the next few years, we'll probably have 60,000 PCs in use and the same number of spreadsheet programs. Multiply by 60,000 what Lotus charges for each 1-2-3 user and you're looking at an investment of almost $30 million. When you get to that level, clones definitely become a consideration."

In its licensing deals with customers, Lotus allows only a predetermined number of people to use a single 1-2-3 unit concurrently. It also forbids users from copying the various spreadsheet programs they develop with 1-2-3—a rule that Travelers has repeatedly asked Lotus to change, Brophy says, so that it can better manage the way in which spreadsheeting is distributed and tested in the company and also upgrade it as necessary. "We told Lotus that we would keep track of the number of our users rather than have it always monitoring the situation," he



CD-Werbeagentur, Bonn

PR-01.87.2

The vest-pocket encyclopedia is no longer a dream. Modern data carriers, for instance compact discs, can store enormous amounts of information. A fifty-volume dictionary, for example, can be put on a single compact disc. And once the search-word has been fed in, it takes an average of just one second for the desired text to appear on the screen.

The production of machine-readable storage media requires the ultimate in technical know-how. LEYBOLD-HERAEUS, a world leader in vacuum processing technology, has gained a position of distinction especially in the field of thinfilm technology.

In applying ultrathin films no more than a few ten-thousandths of a millimeter thick, absolute precision is essential to ensure the necessary quality of compact discs, diskettes, video discs and video tapes. Such coatings can be produced economically only under vacuum.

LEYBOLD-HERAEUS: Innovative vacuum processing technology

LEYBOLD-HERAEUS

LEYBOLD-HERAEUS INC.
1860 Hartog Drive · San Jose, CA 95131

LEYBOLD-HERAEUS GMBH
Bonner Straße 498 · D-5000 Köln 51

ON WALL STREET

MORE STEAM YET IN THE BULL MARKET

Robert J. Farrell, Merrill Lynch's highly regarded chief market analyst, thinks the roaring bull market has a way to go yet. The Dow Jones industrial average could reach 2,400 at midyear, Farrell says, before an inevitable correction in the second half.

That correction, when it comes, could be more than 15%, Farrell says—in other words, 360 points or more on a 2,400-point Dow. But near term, he sees the market's healthy run continuing, buoyed by liquidity from individuals and foreign investors.

Farrell keeps in close touch with a wide network of institutional investors and also pays close attention to the fundamentals that cause money to flow in and out of various investment vehicles. As a market technician and historian, he also plots the phases of the market itself.

For the past five years, corporations were the heavy buyers of stocks and, before that, pension funds. Now, because of higher stock prices and fewer stock buybacks, corporate buying is no longer driving the market. What will keep it going, Farrell believes, are funds from U.S. individual investors and money from overseas.

U.S. investor savings first flowed into money market funds and then into bond funds. Of the total money migrating into mutual funds last year, Farrell points out, $80 billion went into bond funds while only $20 billion went into equity funds.

Now money is poised to flow into equities and equity funds, Farrell says, over the next several years. Despite the constant talk of speculative excesses, he says, there have been none of the historical signs that precede the end of a long-term bull market. Yet many individual investors were not convinced. "Despite the incredible run-up in the market, not many people have enjoyed it," he says. Now they are deciding to take the plunge. "So essentially, there is a huge pool of money—maybe it's over a trillion dollars—that's in motion," says Farrell.

Another big pool may be in motion from overseas. "There's all this liquidity that has to find a home," Farrell says, "and there is just no other place to go." With P/Es in the Japanese market running fifty times earnings, maybe the lid on U.S. valuations is much higher than anyone thought. "If you put the U.S. in the worldwide scheme of things, the U.S. is doing very well," he says.

Yet Farrell's recent conversations with overseas money managers indicate that foreign funds were not the main factor in the January market runup. So some of the heaviest foreign buying may be yet to come.

Without this flood of new liquidity, the market historically might be ready to top out. Farrell's measure is U.S. P/E ratios. In the inflationary 1970s, price/earnings ratios were only eight to twelve; price-to-book-value ratios also were low and yields were high. In the disinflationary 1980s, P/E ratios have climbed to the fourteen-to-eighteen range. "What we're entering now is the higher end of the valuation spectrum but we still haven't brought in major participation by the individual. And there still is the whole new force of global equity. We will see an outpouring of liquidity that doesn't have anyplace else to go but [U.S.] financial assets."

Specifically, which companies and industries look good? Those that have just begun to outperform the market. Look at how much a company's earnings have already benefited from restructuring, says Farrell.

Which companies have topped out? Those that performed well during the last market stage—defensive growth stocks, big merchandisers, restaurant chains and food stocks. Now they are losing earnings momentum and have slower growth rates. There are some exceptions. A high-growth food stock Farrell still expects to do well is Philip Morris. It has been growing at 18%-to-20%, so it has a lot of momentum. But Campbell Soup Co., growing at a much lesser rate, will not keep pace. Selected financial services stocks will also maintain momentum.

(continued)

Farrell: "There's all this liquidity that has to find a home, and there is just no other place to go"

PHOTOGRAPH BY ERIC KROLL

Try Delaware on for size

Sophisticated business people are tough to impress — but the savviest capitalists know that Delaware is the first state for prosperity.

Business and government work as partners in Delaware. We encourage initiative with the most enlightened corporation laws and tax breaks in America. Recent incentives give start-ups and relocations even greater profit potential.

Our work force is unmatched for skill, stability, and productivity — yet wage rates are below regional averages.

Our qualities of life and leisure attract and hold key people. We enjoy city sophistication without urban hurry, worry or crowds. Both mountains and shore are nearby.

Geography works for Delaware, too. We're in the heart of the mid-Atlantic seaboard, halfway between Washington and New York.

One-third of all American consumers live within 350 miles. It's a strategic location. Yet square footage costs for Class A office and industrial sites, and construction costs in general, are among the lowest in America.

Forty-eight states are bigger than Delaware, but 52% of the FORTUNE 500 are incorporated here. Many more are moving operations here. Contact us — we're not talking through our hat.

Delaware Development Office
Dept. I8601, 99 Kings Highway,
Box 1401, Dover, Delaware 19901
(302) 736-4271

DELAWARE
SMALL WONDER

OUR FLEXIBLE BENEFITS COULD PLEASE EVERYONE IN THIS ORGANIZATION.

Today's workforce is made up of everything under the sun—single workers, single parents, older workers and two-income families. Pleasing all of them has posed a world of problems.

Especially when you consider what their benefits cost employers. It's astronomical.

To help bring these costs down to earth, the CIGNA companies developed a Flexible Benefits program.

It's based on a very simple concept. Choice.

For employers, this means choosing how much they'll contribute to the cost of the plan. And it's defined up front.

For employees, it means tailoring their own plans by picking and choosing from the benefits menu. Benefits that can range from the familiar medical and pension coverages, to child care, vacation days or even cash.

It's the best of both worlds. Costs are now controlled. And employees are now part of the process. The more they understand, the more everyone stands to benefit.

But you're going to need help to make this happen. And that's exactly what our personalized service is all about.

We'll help you and your advisors every step of the way. Through defining your objectives, designing the plan, educating your employees, underwriting the benefits. And to make sure your program runs smoothly, we provide ongoing recordkeeping and administrative support.

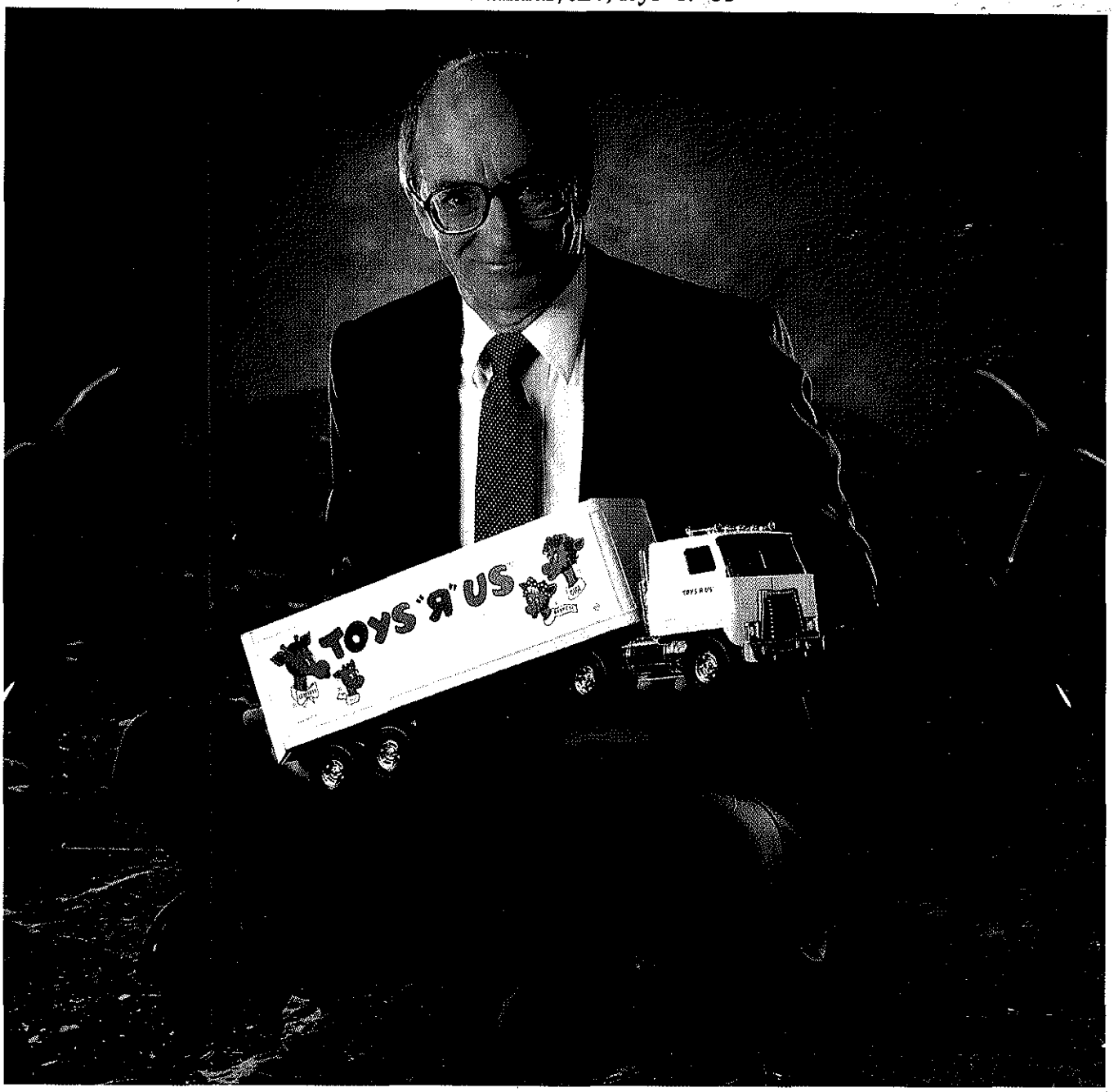
So if your benefits lack universal appeal, write to CIGNA Corporation, Department R6, One Logan Square, Philadelphia, PA 19103.

Because with our Flexible Benefits program you can please everyone. No matter where they are in the organization.

CIGNA

"The Better The Transportation System, The Faster Your Trucks Move."

– Charles P. Lazarus, *CEO,* Toys "R" Us



Not to mention your bicycles, cribs, games, and dolls.

So when Toys "R" Us needed the right location for their corporate headquarters (and 14 of their stores), they chose New Jersey.

"Over 35,000 miles of highway makes for a great distribution network. And we've got easy access to the major airports, and New York's toy industry," says Mr. Lazarus.

Not only will those roads take you to a lot of places, they'll take you to a lot of people. Within a 250-mile radius are 12 states and 60 million consumers. That's one-fourth of the U.S. market.

In New Jersey, we've got a state government committed to being an innovative partner with business. A commitment that finds expression in everything from financial incentives to expert help with site selection, zoning and coping with local regulations.

If you'd like to know more, write Ben Ferrara, Director, New Jersey Division of Economic Development, Box CN 823, Trenton, NJ 08625.

Or call (609) 292-7757.

New Jersey And You, Perfect Together.

Thomas H. Kean, *Governor* Borden R. Putnam, *Commissioner* Department of Commerce & Economic Development

INVESTMENT UPDATE

Here's the current status of a number of investments, and a look at how they have fared over the past month and the past year.

INVESTMENT	(1/30/87) Recent Price or Yield	Value of $10,000 if invested: Month Earlier	Year Earlier
Common Stock (Index fund, capital gains and dividends reinvested)	$27.49/share	$11,327	$13,316
per cent change		+13.3%	+33.2%
Bonds (30-yr., 11¾% Treasury Bond)			
MARKET VALUE	$136.23	$10,053	$11,526
ACCUMULATED INCOME		$72	$994
TOTAL		$10,125	$12,520
per cent change		+1.3%	+25.2%
Money Market Fund	5.50%	$10,046	$10,612
per cent change		+.5%	+6.1%
Gold (Krugerrands)	$409.00/oz.	$10,049	$11,619
per cent change		+.5%	+16.2%
HOUSE PRICES	Recent	Month Earlier	Year Earlier
Existing House	$105,200	$116,100	$100,800
per cent change		−10.4%	+4.2%
New House	$133,400	$124,800	$110,000
per cent change		+6.4%	+17.5%

Sources: Vanguard Group Inc.; Salomon Brothers; Donoghue's Money Fund Report; Manfra, Tordella & Brookes, Inc.; Federal Home Loan Bank Board

If holding on to your job as long as possible is your main aim, you may convince your boss to let you stay on for a year or two longer at full pay until the company can find or train an adequate replacement, and then give you a special severance agreement as a reward. Your best approach is a direct one. For example, you could tell your boss: "Look, I know you are going to need me for at least a while longer. What's in it for me if I stay around for another couple of years?" If he agrees that he needs you, says James Kuhns, a partner in consulting firm Kwasha Lipton, he is likely to throw in enough extra benefits to make your extended stay well worthwhile.

If you prefer to quit the job but keep some compensation coming in, you may persuade the boss to sign you up for an indefinite period as an independent consultant, so the company can continue to draw on your expertise whenever it is needed. But remember, too, that the IRS is now denying business expenses of consultants who do not work for more than one company.

Or you may be allowed to stay on the payroll for several months, until after the window has officially closed—but still get at least the same window benefits whenever you decide to leave. If you do a particularly good job, the company often will give you an extra kicker at the end of your stay, such as a period of paid leave or a couple of thousand dollars in cash.

You may be able to improve on that separation package. If retirement normally involves receiving an annuity for life, you may persuade the company instead to pay you a lump sum, thus putting yourself in full charge of your own retirement. The company also gains by such a deal, Kaye points out, since it doesn't have either the nuisance or expense of paying you for life. Instead, it can wipe out all its responsibilities to you with a single payment. When the maximum individual tax rate drops to 28% by next year, Kaye thinks companies will pay out more lump sums.

—JOHN C. PERHAM

Which companies still have room left to go? Farrell remains bullish for the long term on smokestack stocks that have been through the wringer and are coming back—the survivors in cyclical, economically sensitive, capital goods industries that were hurt by disinflation and have restructured. "They're different companies today than they were five years ago," he says.

Some of these stocks, such as chemicals, forest products and papers, are temporarily overvalued, Farrell says. For example, forest products ran up 30% in January. But their long-term outlook is still good. So wait a month or so until they come off their highs.

For example, Farrell says Champion International Corp., recently around 37, is a buy under 35. Louisiana-Pacific, Georgia-Pacific and Weyerhaeuser are buys with a 10%-to-15% correction from recent highs. In airlines, Delta and American Airlines are Farrell's favorites. In auto accessories, after a 10% pullback from their highs, he likes Toledo-based Dana Corp. and Echlin, Inc. in Branford, Connecticut.

In construction engineering, Farrell likes Combustion Engineering Inc., near its recent price of 38⅝ and Foster Wheeler Corp. after a 10%-to-15% pullback from its recent 17¾. In technology, Farrell says Automatic Data Processing, Inc. would be a buy after a pullback to near 40. And he would favor Motorola in the low 40s as an alternative to Intel. —LEAH NATHANS

DEALING WITH DEFENESTRATION: NEGOTIATE

What should you do if your company offers you an open window to early retirement for, say, three months, with the unspoken threat that if you don't take it you may be fired? Don't jump out that window right away. Bargain.

You would be foolish to take such an ultimatum literally. You are likely to find that your company, put to the test, is willing to give you a better deal. "Probably one-third of all the companies that have opened windows since 1980 have done some behind-the-scenes negotiating with individuals," says James G. Waters, vice president of the consulting firm of Towers Perrin, Forster & Crosby. "Hundreds of individuals have managed to get special deals."

Companies, of course, try to hush up such deals to avoid unrest among other retirees who meekly accepted the package as offered. Because people do talk, the favorable terms you get may leak out eventually. But by then you will have no reason to care.

The special packages companies offer supposedly go to everyone who meets some specific criterion—such as age plus years of service totalling 75, for example. A stingy offer is a cash payment of $50,000 or less, soon spent; a typical offer is a year's salary, plus a pension reduced by a year or two less than it should be actuarially for your age, if you agree to retire quietly now, at 50, 55 or 60, rather than wait till 65. The best offer is five years added to your age and five to your years of service in calculating your pension. That increases your annual retirement income by 30% or more.

Under ERISA, early-retirement offers are required to be nondiscriminatory; the company can't just cherry-pick the individuals it is most eager to get rid of and forget about the rest. It has to adopt some objective criterion and disclose it. And if you qualify, you have to receive the offer. You don't have to accept it.

You may be in a strong bargaining position if you are a clearly superior employee with special skills or know-how. At the other extreme, if you are someone the company is eager to be rid of, compensation experts say you are also likely to wangle a bigger package than originally offered, even if supposedly on a take-it-or-leave-it basis. If you have been downgraded in your job and pay recently, that may be the tipoff that the company will sweeten the pot for you, just to be sure you depart as soon as possible.

Or if you are sixty or over and have been with the company for more than twenty years, you may have a distinct advantage, says Lloyd Kaye, a managing director of the consulting firm William M. Mercer-Meidlinger, Inc. Most big companies, he says, bend over backwards to appear fair when they retire long-service employees. They don't want a messy age discrimination suit and they don't want to damage morale among other workers by appearing hard-hearted towards a veteran employee.

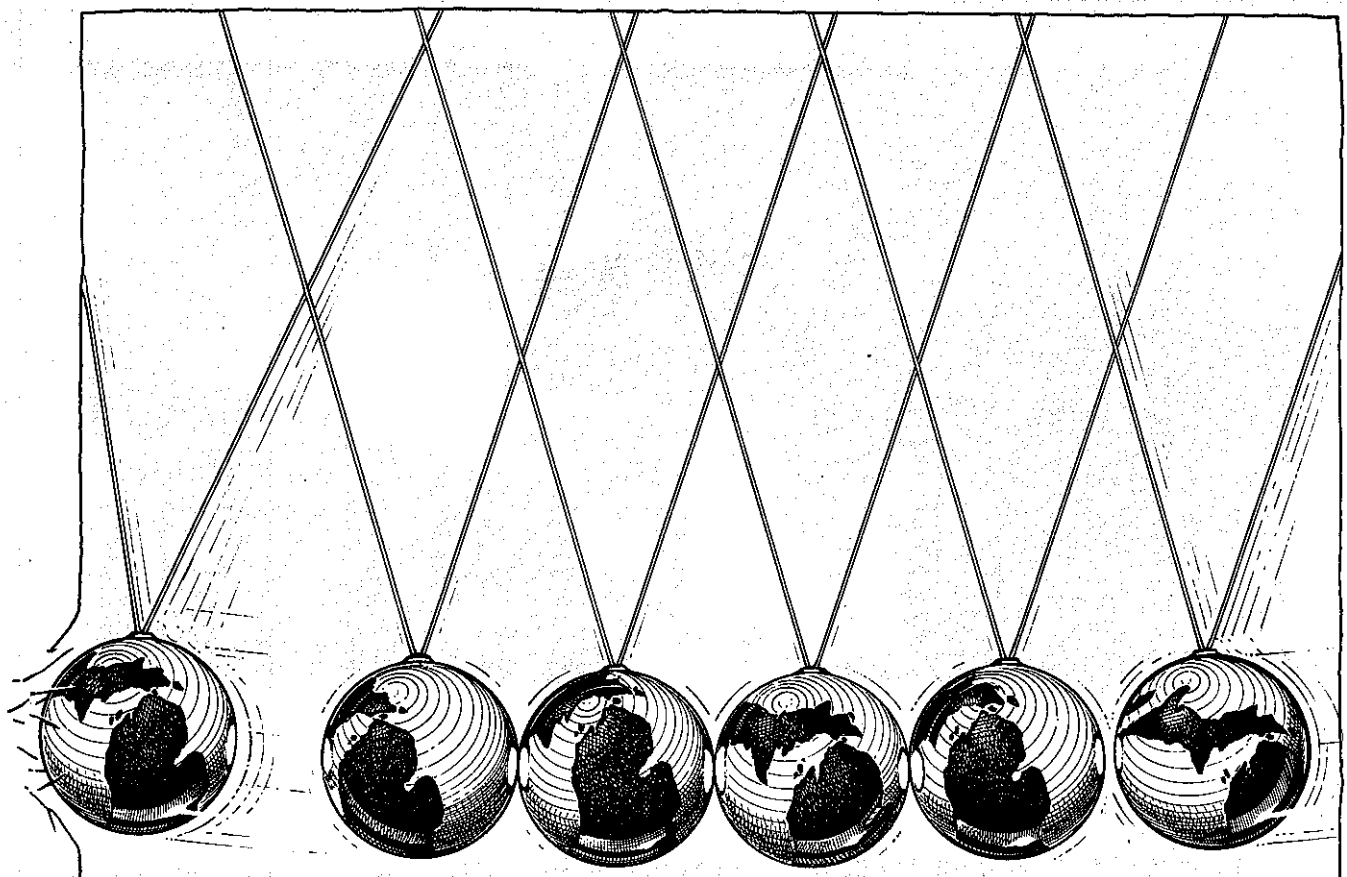
Here are some guidelines for negotiating:

☐ Evaluate your chips even before the company makes an offer, so you'll be ready when the time comes.

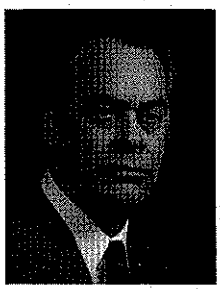
☐ Think hard about what you really want most—more time on the job at full pay or a special package when you leave. Or both.

☐ Be firm about what you will and will not accept.

It is a good idea to make specific proposals to management. "Most people just don't bargain as hard as they should," observes Kaye. *(continued)*



In Michigan, one good idea leads to another.



William Stubbs, VP Mannesmann Demag

Good ideas get a state moving. And idea after good idea have led Michigan right to the center of advanced manufacturing. It's how our state has emerged as one of the top three nationally in industrial research and development spending. And why innovators such as Mannesmann Demag are coming to Michigan.

Mannesmann Demag, a West German material handling firm, looked elsewhere to base its North American product development center, but saw its best opportunity in Michigan. William Stubbs, Vice President of Mannesmann Demag, explains: "We chose Michigan because it is where our customers are. Advanced manufacturers. And just as important, because of its stable, highly qualified work force. As a development company, it's important for us to be in a state with top-notch colleges and training programs that supply workers who can master today's advanced manufacturing."

In Michigan, research and development and advanced manufacturing aren't happening independently of one another. They're put in motion by companies like Mannesmann Demag. Companies that can take good ideas and make them better ideas. One good idea after another. It's why more and more companies are following Mannesmann Demag to make Michigan where the action is.

For more information write:
Doug Ross
Michigan Department of Commerce
Lansing, MI 48909

150 YES M!CH!GAN

Michigan business, the answer is yes.

explains, "but it will not budge on this issue. We're not trying to beat Lotus out of its licensing fees. We simply want more flexibility in our use of the product."

Lotus' suit against Paperback and Mosaic could be a landmark case. It is the first copyright protection litigation by a software leader against competitors. If Lotus wins, it seems sure to put a number of spreadsheet producers out of business, leaving corporate users with only one high-priced choice. Besides that, it could encourage a flood of lawsuits in other areas of the software business and have a dampening effect on R&D.

Industry analysts believe that many companies leaning towards clones will now hold off until the copyright question is settled. As they point out, nobody wants to buy products from a company that could be wiped out. "Lotus has accomplished what it set out to do with this action," says one Wall Streeter. "It has made it harder for other spreadsheet manufacturers to compete."

Meanwhile, Lotus has begun to relax some of its more stringent procedures. For example, a menu of new service features it began offering several months ago now allows users to upgrade 1-2-3- programs directly from their company's host mainframe. In the past, users had to take each 1-2-3 diskette to a Lotus distributor for an upgrade, a time-consuming chore that ranked near the top of the customer complaint list.

Lotus says it intends to make further concessions to customers down the road. "We are making a concerted effort to be more responsive to our users," comments company spokesman Greb Tarbo.

Such responsiveness may ultimately prove the most decisive factor in Lotus' war against the clones. "We like dealing with a single vendor such as Lotus and having the product uniformity throughout that 1-2-3 provides us," Brophy concedes. "I think it all comes down to the fact that we don't want to be taken for granted."

—Laton McCartney

"Help save a generation of children."

Drug abuse is a terrible threat to our country. It's killing our children.

Some die physically. Others lose interest in life itself. They have no hopes, only habits. They're racing through a vague childhood toward a valueless existence as an adult. Many won't make it. Unfortunately, the habit is supported through apathy.

"We build *walls of denial* around the problem," states Nancy Reagan, who joins with Kiwanis International and other organizations in active concern over school-age drug usage. "It's time for us to stop denying the extent of drug and alcohol abuse and bring it out into the open."

Join with our First Lady and make drug abuse a matter of First Priority. Join one of the 4000 volunteer groups who are facing the problem at the community level. The facts are convincing. With massive involvement, we can make a major impact.

Help save a generation of children.

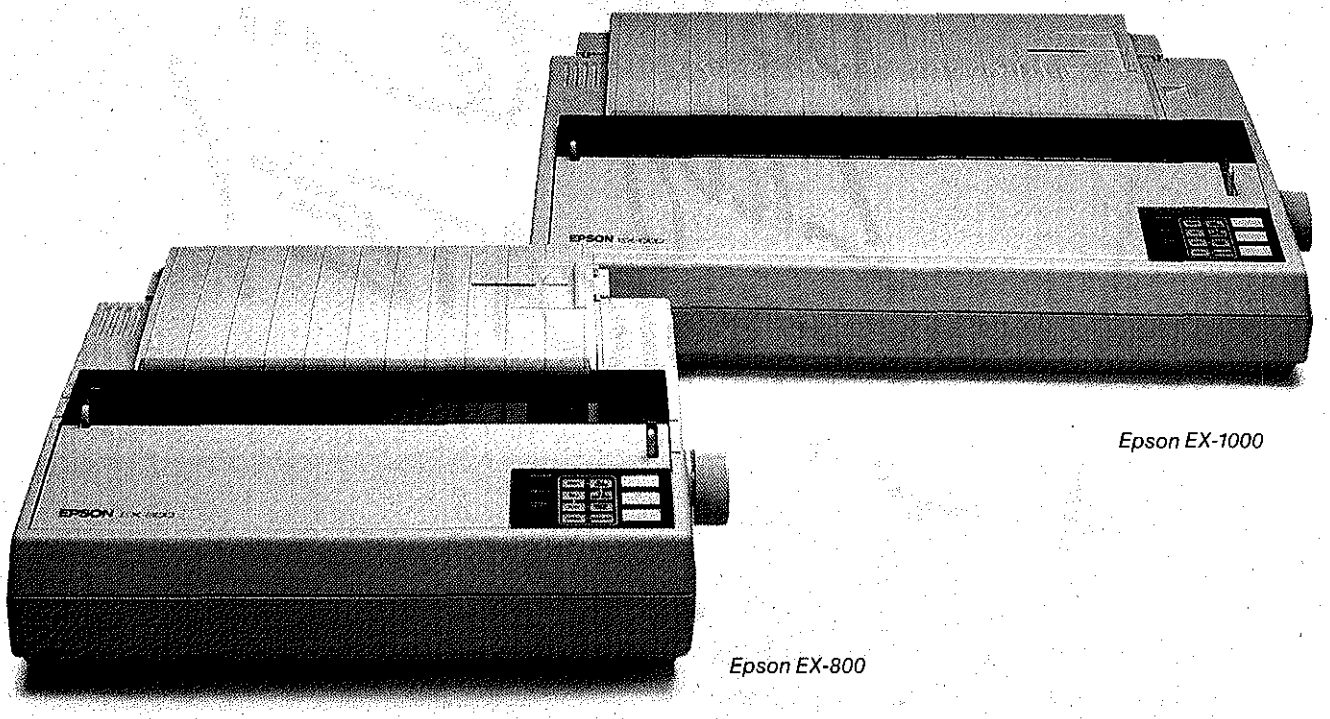
Assist Nancy Reagan, your local Kiwanis club and 4000 volunteer groups making a difference where you live.

KIWANIS INTERNATIONAL

Seventy years of community service.

BUSINESS EXPRESS

THE EPSON® EX-800 AND EX-1000 DOT-MATRIX PRINTERS



Epson EX-1000

Epson EX-800

High-speed printing for life in the fast lane.
If your computer printer is having trouble keeping up with the pace of your business, here's a quick solution: the Epson EX-800 standard-width and EX-1000 wide-carriage printers. They work faster—so you don't have to. How fast? Would you believe 300 characters per second when printing draft copies? Or switch to near-letter-quality mode and get results three times faster than the average daisy wheel printer.

In addition to business speed, Epson has built these printers with business smarts. Like a unique control panel that eliminates cumbersome DIP switches. Paper handling conveniences for easier use. And a low-cost, user-installable color option kit. For a demonstration of Epson's fast-moving new printers, see the authorized Epson dealer nearest you.

EPSON®

ADVANCED COMPUTER
1722 Wilson Blvd.
Rosslyn, VA
703/276-7800

Epson® is a registered trademark of Seiko Epson Corporation.

One of the world's most respected leaders is about to arrive in D.C.

Lufthansa introduces nonstop service from D.C. to Frankfurt.

Starting April 1st, you can experience the outstanding service of a highly respected world leader. Lufthansa.

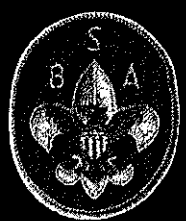
From Dulles Airport, Lufthansa will provide nonstop service to Frankfurt. Plus fast, easy connections to more than 130 cities throughout Europe and beyond.

With worldwide capabilities like these, and a commitment to punctual, dependable service, it's no wonder Lufthansa has earned a reputation for leadership around the world.

Lufthansa

Lufthansa is a participant in United's Mileage Plus program and Delta's Frequent Flyer program. See your Travel Agent.

Before they wore these



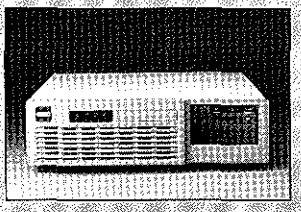
they wore this.

Join The Boy Scouts of America.

Communications Equipment

Circle number on reply card for more information

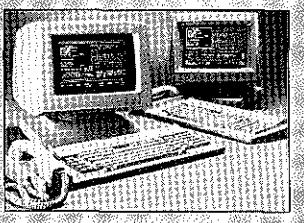
114



Banyan Systems
Banyan/DTS
Networking Equipment

Network server for departmental or small business networks, serving up to 20 users. Provides 5Mbytes RAM, 160 Mbytes storage. 60 Mbyte tape back-up, external battery back-up, 8 serial ports. Supports local-and wide-area networking, mini and mainframe connections.

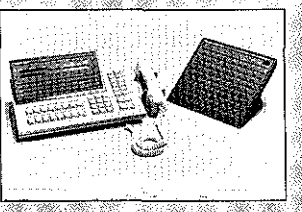
115



Davox Corp.
4900/5900
Networking Equipment

Information from variety of data sources displayed in unlimited number of windows on models 4900/5900 multifunction workstations. Series 5900 features 4/7 color display; series 4900 offers green or amber monochrome display.

116



Fujitsu Business Communications
Focus 50/100 ACS
Telephone Equipment

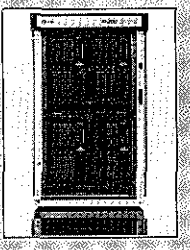
For small business applications requiring from 6 to 110 stations. Features include automatic route selection, toll restriction, speed dialing and outgoing trunk camp on with optional station message detail recording.

117

Northern Telecom
Meridian DU-1 Datavoice System
Multimedia Communications

Multi-processor system designed to replace discrete systems for voice communications, data processing and data communications. Applications accessed by terminals over ordinary telephone wiring.

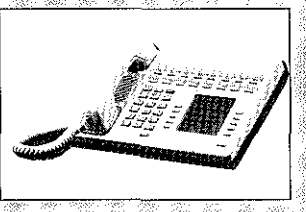
118



Mitel, Inc.
SX200 Digital PABX
Telephone Equipment

PABX can be installed anywhere for use with 40-to-400 lines. Features include complete Hotel/Motel package, powerful ARS/Toll control package, simple Customer Data Entry, LCD console, easy maintenance and tenanting services.

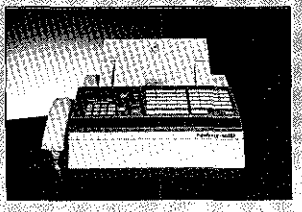
119



NEC America
Electra Mark II
Telephone Equipment

96-port digital hybrid key system supports voice and data communications, offering least cost routing, voice mail integration, SMDR and directory function. Terminals provide direct feature access; can be customized.

120



Panafax Corp.
UF-600SF
Facsimile Machines

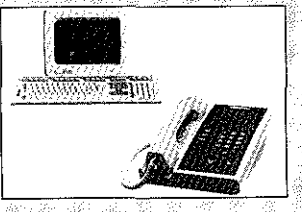
Compatible with CCITT Groups 3-2-1. Comes with 512K byte memory; autodialer; 16-step gray scale; group, delayed, partial transmission; 12 second transmission speed; reverse and remote service diagnostics; delayed polling; built-in telephone handset; activity report; Superfine resolution.

121

Perception Technology
BT-11
Information Response System

Lets touch-tone telephones function as computer terminal; provides communications link between touch-tone caller and computer. Data entry through callers' touch-tone keys; responds in prerecorded human voice. For order entry, status, credit verification, home banking.

122



Redcom Laboratories
VODAS™ (Voice Over Data Access Station)
Telephone Equipment

Simultaneous voice and data communications over existing phone lines, without software modification when used with any Redcom MSU-based switching system. Asynchronous data channel and individual voice channel or operates as single synchronous data channel without voice channel.

viduals or from one person to an entire group.

Messages are entered into most electronic mail systems from the keyboard of a data entry terminal or personal computer. They are retained at the receiving location in a special computer memory segment called a "mail box." Electronic mail messages remain there until they read and acted upon by the addressee.

The only possible delay of a communication in an electronic mail network occurs when recipients fail to check their "mail box" over an extended period. A paper copy of an electronic mail message normally is created only when required.

In a LAN environment, an electronic mail exchange of information usually is confined to a departmental work group or to the entire company. However, electronic mail need not be so limited; network services are making it possible to communicate throughout the world.

Michael Cavanagh, executive director for Electronic Mail Association, notes that these networks "are creating an era of interconnection, not only speeding the orderly flow of information within major companies, but also facilitating retrieval of critical information from external sources."

Interlink Business and Communications Services (known also as IBEC), Western Union, RCA Global Communications, AT&T Communications, and G.E. Information Services are among the suppliers of electronic mail systems interconnection services.

Most of their offerings are international in scope. RCA's *Hotline* and Western Union's *InFact* offer network users access to a wide variety of news, engineering, financial and reference data. G.E. Information's *Quik-Gram* Service permits electronic mail messages to be delivered through regular U.S. Postal Service channels to individuals not part of the basic communications network.

Digital Equipment, G.E. Information Services, Honeywell, U.S. Sprint Telenet, DA Associates, Western Union and Fischer-Innis Systems are among the suppliers of software that enables personal computer users to access various electronic mail network services.

Facsimile

Facsimile image transmitting and receiving devices provide an alternative to keyboard entry of information into an electronic mail network. Facsimile devices can transmit signatures and other graphics information from original documents, something that a keyboard-oriented network can not handle. The devices also provide a time-and-cost-effective alternative to messengers and overnight courier services. Facsimile devices are offered by several sources with improved gray scale capabilities to handle images with complex graphics and fine details.

Facsimile device transmission time per image can be as short as 10 seconds. Slightly longer transmission time may be required with so-called "broadcasting" devices like Harris/3M's *Model 2127,* the Murata Business Systems *Imagemate,* and Ricoh Corporation's *Model 610.* The *610* can send images simultaneously to groups of devices within 16 different predetermined groups.

Panafax Corp.'s *Model UF-600SF* can send images up to 100 predetermined locations worldwide. Ricoh Corp.'s *Model R830* can transmit to 200 locations.

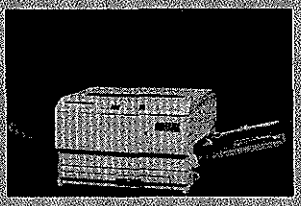
Other innovations recently have appeared in the facsimile field. Ricoh and Sharp Personal Office Electronics each have introduced portable facsimile devices. The latter's *Model UX-30* weights only five pounds. Sharp also has introduced its *Model UX-80,* which is a combination facsimile device and copier. It weighs just 22 pounds.

Xerox and Ricoh have introduced facsimile units that produce copies on

Copiers/Duplicators

Circle number on reply card for more information

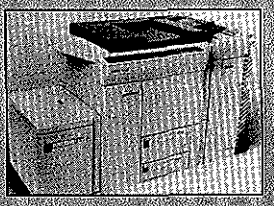
110



A.B. Dick Co.
K122
Copier

Compact make features reduction (77%) and enlargement (122%) and stationary platen. 12 copies per minute of 8½ x 11 originals; 15 copies of 5½ x 8½ originals. Copies onto labels, transparencies, letterhead, color stock. Recommended monthly usage up to 4,000 copies.

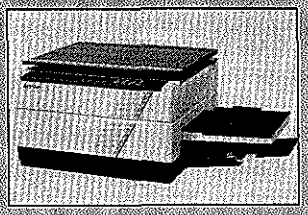
111



Savin
7065
Duplicator

Fastest Savin, this dry toner console model, processes 62 copies per minute; features: 20–40 bin sorter, duplex-to-duplex ARDF, zoom reduction and enlargement, image editing, and guidance display.

112



Sharp Electronics Corp.
CX-5000 Full Color Copier
Copier

Desktop machine uses digital technology. Can reduce by 50% or enlarge portions of original up to 4 times. Uses four color ribbon; can create two-color copy from black and white imput or enlarge color slides.

113

Xerox Corp.
Xerox 1065
Copier

Merge of computer and copier technology makes copier one of the most productive available. Self-adjusts copy quality continuously; adjusts contrast automatically for originals on colored paper without affecting copy speed.

Consultant and *M.1* from Teknowledge.

An EIS provides executives with access to both external commercial data sources such as various Mead Data services, *Dialog,* the Dow Jones News/Retrieval Service, and key corporate databases. EIS offerings include Comshare's *Command EIS* and Pilot Executive Software's *Command Center.*

D&B Computing Services' *NOMAD2* is one of several advanced database management software products that can be used to create an EIS.

A full-feature EIS can monitor such key business activity indicators as inventory levels, cash position, new order activity and stock and commodity indexes; then display critical data.

Command EIS uses its *Execu-View* feature to accomplish this and permits executives to ask questions and specify analyses of particular data as the need arises. (Compuware's *PowerBase* database management software includes a somewhat comparable *DataZoom* file access feature.)

Videodial's *TSV-5000* videotex software has been used by General Foods Information Management to create *Window on the Business.* According to Systems Development Manager Tony Barra, this limited feature EIS provides executives with a daily summary of financial and marketing data. Videodial's *ITEX.25* can be used also in a CICS operating environment to create an EIS. *ITEX.25* extends previously PC-oriented data access capabilities to an IBM 3270 terminal network.

John Nevin, Firestone Tire Co. CEO, has been the key mover in the development of a corporate executive EIS based on *Express,* a data retrieval language developed by Information Resources. Used by 20 key Firestone executives operating IBM PCs, the system uses color graphics to display data and maintains a large-scale budgeting and forecasting function.

Richard Crandall, Comshare CEO, is typical of executives without specific computer skills who champion EIS use. (Even though Comshare markets both software and computer services, Crandall admits he doesn't have a technical background.)

However, he makes daily use of an EIS, based on Comshare's *Command EIS,* that is shared with other members of his management group.

Crandall says it is especially useful in displaying critical information—such as that dealing with specific product reliability—for management group discussion. The EIS permitted him to end circulating reports in paper form among senior Comshare executives. Crandall also reports that he has found that including particular performance measures in the EIS helps focus individual manager attention upon them.

"Productivity Enhancement" Software

New offerings of software designed to improve executive performance continue to appear. Recently introduced products focus on enhancing spreadsheet capabilities as well as aiding in the organization of the individual's daily work load and job performance.

Lotus Development's *HAL* fits into the first of these categories. It expands and extends the features of its widely-used *1-2-3* spreadsheet program. Macropac offers *101 Smartkey Macros for Lotus 1-2-3.* These macros provide that program with a variety of performance enhancing features, such as graphics and text editing.

Multidimensional spreadsheets eliminate the need to create numerous correlated individual displays when extremely complex data must be analyzed. *X-Y-Z Consolidate* from Intex Solutions and McDonnell Douglas Communications' *microCUBE* are among the products available.

The most sophisticated and powerful of these products appears to be Sniper Corporation's *TM/1.* It is a "table manager" that can extract material from databases and can present them for analysis in an array of as many as 60 independently functioning tables.

What'sBest! by General Optimization adds complex decision enhancement support to spreadsheet capabilities. With a single key stroke, it weds data generated by, say, *Lotus 1-2-3* or *Symphony* to a powerful linear programming/modeling mechanism. The product of this relationship is a very complex, decision-aiding analysis of the best possible relationship between critical factors in data arrayed in the spreadsheet.

The second category of executive performance enhancement aids consists of products designed to assist in

FREE INFORMATION BUSINESS MONTH

EXECUTIVE BUSINESS EQUIPMENT PLANNER

The Business Equipment & Systems Planner has been developed to help BUSINESS MONTH management readers become better acquainted with the products and services supplied by leading manufacturers in the office automation field. To receive detailed information on the equipment and services described on this page circle the numbers on the return card that correspond with the listings below. The manufacturer will send you the information directly.

AGS INFORMATION SERVICES, INC.
AGS Information Services, Inc. provides consulting support from coding of programs to senior management consulting, including feasibility studies, analysis, design, implementations, maintenance, conversions, training, documentation and knowledge engineering 90

MITEL
The SX200 Digital PABX family is ideal for businesses with 40 to 400 lines. Its digital switching foundation opens up the next decade of voice and data communications for your business 91

NETHERLANDS FOREIGN INVESTMENT AGENCY
Why have so many U.S. high-tech companies flocked to the Netherlands? Holland's central location, its advanced technological base and the high quality of the Dutch workforce are among the many reasons 92

PUERTO RICO, ECONOMIC COUNCIL OF
For information concerning tax exemption incentives, availability of competitive industrial space, skilled labor and other profit making inducements offered by Puerto Rico, circle reader service number 93

XEROX CORPORATION
For more information on Xerox electronic Publishing Systems Circle # 94

BUSINESS MONTH

NO POSTAGE NECESSARY IF MAILED IN THE UNITED STATES

BUSINESS REPLY MAIL
FIRST CLASS PERMIT NO. 04087 NEW YORK, NY
POSTAGE WILL BE PAID BY ADDRESSEE

ATTN: EVELYN HURDY
BUSINESS MONTH
BUSINESS EQUIPMENT PLANNER
875 THIRD AVENUE
NEW YORK, NY 10022

MARCH 1987

BUSINESS MONTH/ BUSINESS EQUIPMENT PLANNER

Please send the information corresponding to the circled numbers below:

90	91	92	93	94	95	96	97	98	99
100	101	102	103	104	105	106	107	108	109
110	111	112	113	114	115	116	117	118	119
120	121	122	123	124	125	126	127	128	129
130	131	132	133	134	135	136	137	138	139
140									

Are you currently a BUSINESS MONTH subscriber?
☐ Yes ☐ No

TITLE (Please check)
A ☐ Chairman of the Board
B ☐ President
C ☐ Vice-President
D ☐ Treasurer/Secretary
E ☐ General Manager
F ☐ Division Manager
G ☐ Department Manager
H ☐ Management, other
J ☐ Controller
K ☐ Other:_____

Name_____ Title_____

Company_____

Address_____

City_____ State_____ Zip_____

Telephone #_____

VOID AFTER 6/15/87

president of American Management Systems.

EIS will enable corporate executives without computer technical skills to employ complex data resources to enhance their daily work performance. Among other things, an EIS permits drawing on critical data from outside as well as from company data bases. And, it will enable executives to share data within the corporation and elsewhere.

Development of readily available EISs is being accelerated by the introduction of various devices that aid executive use of personal computers. For instance, most people find it easier to talk to a personal computer or to touch a particular spot on a display screen, rather than operating a keyboard. This preference has encouraged continued improvement in voice data entry capabilities and the refinement of touch screen mechanisms.

Current voice data entry offerings include the Voice Connection's *Introvoice V, PR200* by Speech Systems and the *Kurzweil Voiceterminal System* (KVS). All three can be used with IBM and compatible personal computers. All three permit someone to operate a system by spoken commands alone. *Introvoice V* has a 500 word vocabulary; the KVS has a 1,000 word one.

It's also possible to operate a personal computer by simply touching key commands or menu choices when they appear on the display monitor screen. Touch screen overlays, which make this sort of personal computer operation possible, are available from Carroll Touch and can be installed on many existing devices.

EIS development also is being accelerated by continuing improvements in personal computers, advanced information handling software, local area networks (LANs) electronic mail systems, facsimile equipment and voice mail and teleconferencing systems.

Personal Computer Rundown

Steady progress continues in expanding the performance and reducing the cost of both desk top and lap top personal computers. (White Crane Systems has introduced *Brooklyn Bridge*, a software product that facilitates transfer of data files between these two types of personal computers.)

Compaq's *Deskpro 386* heralds the appearance of a new generation of extremely powerful desk top systems. It uses advanced design microchips to operate at processing speeds several orders of magnitude faster than previously considered acceptable for personal computers.

IBM has introduced its *PC XT Model 286*, which performs three times faster than earlier models. It uses an improved keyboard design and can exchange data directly with the IBM PC convertible lap top personal computer. Internal storage capacity can be increased to 12.6 MGBytes.

Tandy Corporation/Radio Shack has introduced its own enhanced version of the IBM PC XT. Its *Model 3000* personal computer runs four times as fast and can support a 40 MGByte hard disk. Epson America, a major printer maker, has entered this segment of the market with its *Equity* line of desk top computers.

Memorex Systems and Harris Lanier Business Systems both have introduced IBM PC AT-compatible intelligent workstations. NCR's *3390* PC-based desktop workstation can be customized to fit six different working environments.

E.F. Hutton & Co. will install 10,000 of the workstations in 400 retail branches and offices worldwide by the end of next year. They'll be used by Hutton account executives in an advanced information processing network. Hutton calls the project the *Advanced Workstation for the Executive (AWE)*.

Panasonic Computer Products provides a unique dual locking system with its *Model FX-800 Business Partner 286* personal computer. Electronic and key-operated locks preclude unauthorized

Latest Productivity Buzzword

It's Executive Management System (EIS)

Increasingly, executive ability to make more effective use of office automation technology is seen as the key to obtaining the corporate competitive edge in the international marketplace. As John Connell, executive director of The Office Technology Research Group (OTRG), says; "The question is no longer whether to acquire machines, but how best to integrate machines into our worklives."

This new perspective on office automation should reflect in continued growth in the acquisition of personal computers for corporate use. George Colony, president of Forrester Research, anticipates that sales of IBM personal computers alone will continue at their 20%-to-25% annual growth rate for each of the next two years. (Yet, there is continued evidence that most executives still are not yet using most of the personal computers already in place as management tools.)

According to a recent Stanford University study, most executives merely use them to review information, rather than for manipulatory available information to forecast or plan. The study does indicate that almost two-thirds of those contacted are regularly using spreadsheet software and almost as many use their personal computers at home.

This new perspective on office automation also is reflected in *Office Automation: Customer Realities and Trends,* a report on a national survey of 140 corporations that already have office-oriented information systems. (The study was conducted by Hammer and Co. for Honeywell.)

It revealed strong executive interest in improved access to large corporate databases, making broader use of electronic and voice mail systems and more sophisticated use of personal computers as executive work stations.

This new perspective on office automation focuses on the linking in the executive work place of more powerful information handling machines, communication technology and software products. One of the latter is described as the "executive information system" (EIS). This is the "engine" that "drives" executive work stations and other advanced personal computers. "We can't build a truly successful executive workstation until we understand how to build a successful EIS," says Fred Forman, corporate technology group vice

MCA's brochure in striped sweater and slacks. McManus spent eight years in Procter & Gamble's marketing department and seven years with a small Connecticut sales promotion company before launching MCA. Similarly, second-in-command President Robert Kamarschen, who served seven years in two well-known marketing pressure cookers—Revlon and Norton Simon—sports a leather jacket and loafers, collects Oriental art and grows the healthiest jade plant in the Northeast. Known as Kam by everyone, he says, "When my head hits the pillow, I sleep."

For corporate marketing experts, the MCA climate offers the opportunity (perhaps for the first time in their working careers) to put their ideas into programs. Moreover, their compensation is tied to the success of their creativity. Bonuses are a share of the profits of each division. "Our managers are more autonomous than those in most companies," insists Kamarschen. "We don't get caught up with management control mechanisms."

MCA uses its unusual combination of high-level marketing expertise and its free-thinking environment when it pitches clients. Unlike most consulting firms, which hire educated but inexperienced business school graduates, MCA consultants have a minimum of eight-to-ten years' experience on the client side. "The difference is short-term thinking versus long-term application," maintains Kamarschen. "Your average consultant is great at giving you a big fat book telling you what to do, but they have never worked hand-in-hand with a company implementing a program."

Much of MCA's client growth in recent years has come from services such as airlines, financial services and telecommunications. Five years ago, virtually all MCA's product consulting revenues came from packaged goods firms. Now, about 40% comes from recently deregulated industries that have become dependent on marketing.

MCA is expanding at 30% a year, but McManus can't identify where future growth will come from. "I don't believe in long-term forecasting," he quips, "because it's hard to fall in love with a new idea when you're locked into something else." ■

FLOWER POWER IN THE SUPERMARKET

Roses are red, violets are blue;
Flowers sell well, whatever their hue.
But in supermarkets, where they're now seen,
The poop on posies is color them green.

by Robert Levy

For years, the market for fresh-cut flowers depended almost solely on sweethearts, shut-ins, brides, the bereaved and Mom. The local florist lived for Valentine's Day and Mother's Day. But flower times, they are a-changing. Increasingly, Americans are buying flowers for any occasion or no occasion, as the Europeans do, and increasingly, at the supermarket.

Fresh-cut flowers are now one of the hottest selling and highest margined items in supermarkets, right up there with Perrier, quiche and toffutti. Floral departments are getting as popular in full-line supermarkets as delis, fresh fish and salad bars. According to *Progressive Grocer*, 57% of big supermarket chain stores and 27% of chains with fewer than eleven stores now stock flowers, about double the number in 1980. In fact, the nation's two biggest grocery chains, Safeway Stores and Kroger Co., each claims to be the world's largest retail florist.

By making it easy and inexpensive to pick up posies on the way to the checkout line, the supermarkets have helped convince Americans that flowers don't have to be for special occasions only. As the American Florist Marketing Council's campaign puts it, "Buy flowers for someone nice—like yourself." It's a little like the greeting card business. A new market segment, "nonoccasional" flowers, is being laid atop the neighborhood florists' traditional market. The supermarkets have helped turn flowers into an impulse buy.

The result: Of the record $8.3 billion Americans spent on flowers and flowering plants in 1986—about $1 billion more than the year before—18% was in supermarkets. Says Anna Frazier, floral merchandising manager of Melridge Inc., a large grower of bulbs and flowers in Aurora, Oregon: "Fresh cut flowers in supermarkets are now the fastest-growing segment of the floral business." Melridge, for example, now ships around 36 million daffodils a year to supermarket accounts, six times the volume five years ago.

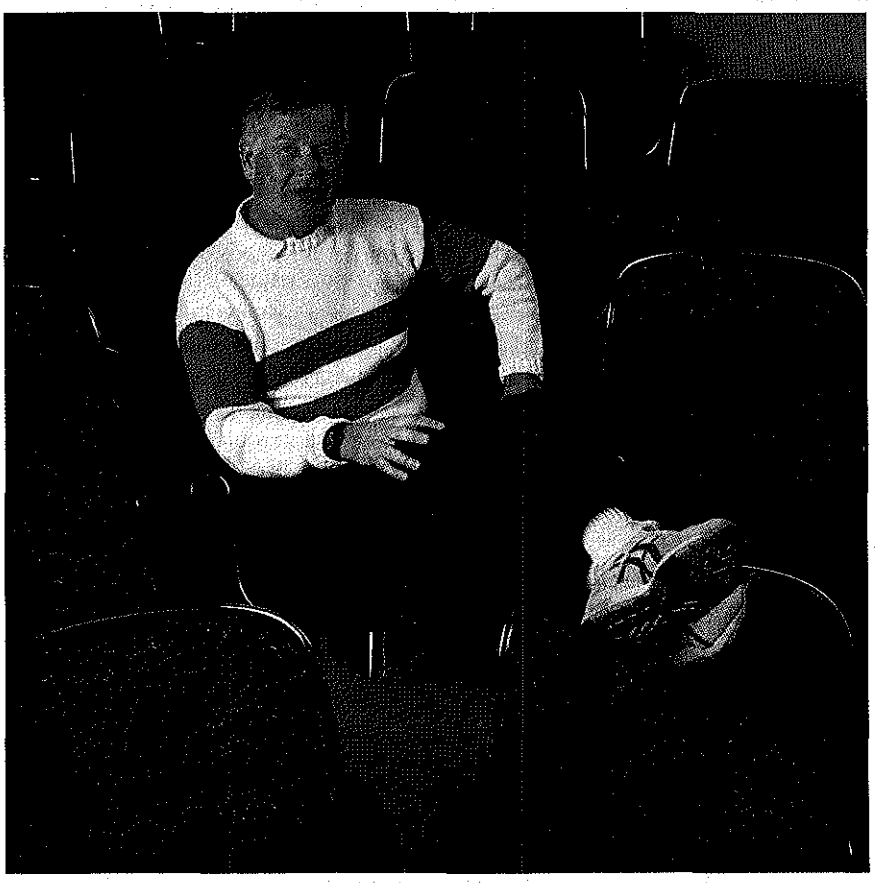
In the average supermarket, flowers account for only about 1% of sales. But it is a profitable percentile. Industry surveys show that flowers average weekly sales of $28 per square foot, more than twice the $12 of produce. And compared with mark-ups of 18%-to-25% for food, flowers routinely generate gross profits of 30%-to-60%.

A good indicator of the profitability involved here is the war of the roses, pompoms and snapdragons between Safeway, the country's largest supermarket chain, and competitor Kroger, which started selling flowering plants back in the Seventies and set up its first full-line floral shop in 1978. Kroger

One-Stop Shopping For Marketing Services

MCA, a unique, entrepreneurial conglomerate, is setting the pace in product development.

by Aimée Stern



Even among such outstanding marketing organizations as A.C. Nielsen, Simmons Market Research and Yankelovich/Clancy Schulman, Marketing Corporation of America stands out. Starting with a stake of $100,000 in 1971, James R. McManus built Westport, Connecticut-based MCA into a $300 million conglomerate that offers marketing services ranging from product development and research to advertising and direct mail.

McManus' timing couldn't have been better. MCA opened its doors in the early days of a major trend in corporate America: going outside for marketing services. Until the mid-1970s, if a company needed outside marketing assistance, in most cases it looked to its advertising agency. But agencies, caught in the same profits squeeze as their clients, found they were better off sticking to their knitting: ads. The resulting vacuum was a boon to MCA and a host of other consultants that specialize in designing and developing new products.

The future belongs to outside services, McManus contends. And to prepare for it, MCA is creating a one-stop product development service. While the company still has to add public relations and corporate identity consulting, a client can now go to MCA for research and development of a new product and remain with the firm through product design, market testing, packaging, promotion and advertising. This diversity gives MCA a fat edge over other marketing services that are limited to one specialty. "The strategy of having everything under one roof works terrifically for them," says Chester Kane, president of rival product development firm Kane, Bortree & Associates.

Nowadays, most companies—even the packaged-goods biggies—have little choice. American business' rigorous restructuring in recent years has pared marketing departments to the bone. And this trend is by no means over. Even at a cost of up to $50,000 a month, most of the nation's top fifty companies, including Coca-Cola, Citicorp, AT&T and Avon Products, find it

Wanted: The Boomerang Executive

Fast-track executives are being lured back to their old companies to fill key management positions.

by Thomas J. Murray

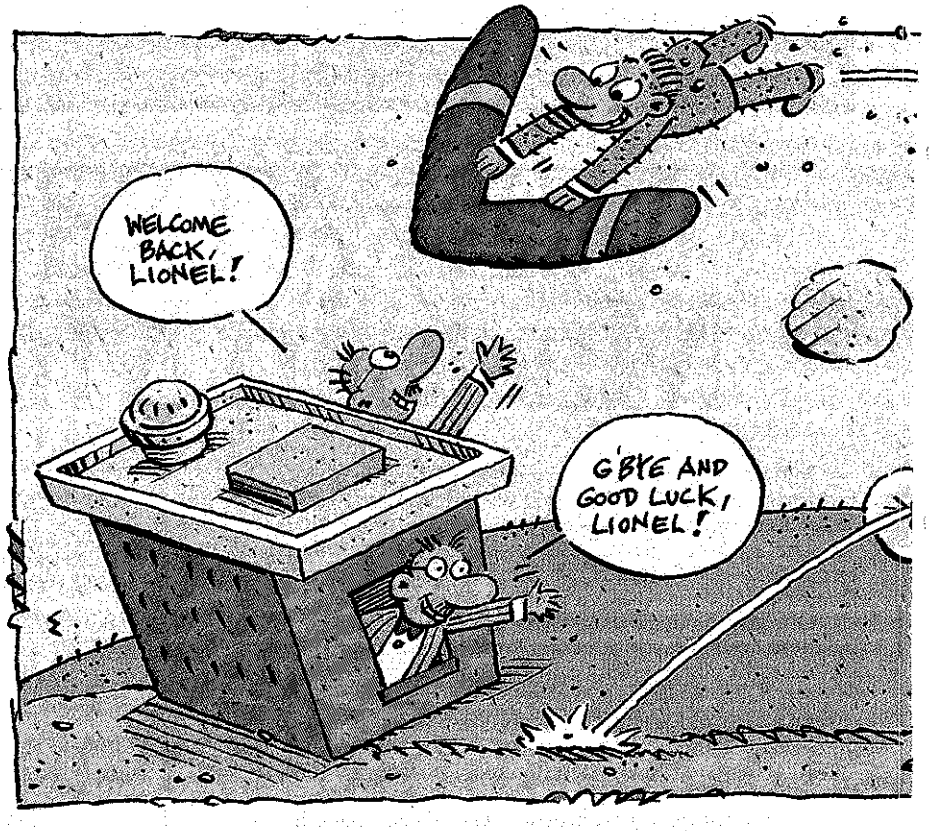
For University of Washington alumnus Stephen A. Darland, the football game between UW and Brigham Young University last October was a special kind of homecoming. Sitting with an old friend, William Lane, general manager of J. Walter Thompson Co.'s San Francisco office, Darland was startled to hear Lane ask him to return to the giant advertising agency after a nearly twenty-year absence. Lane offered Darland, a one-time JWT account executive, the job of deputy general manager, and Darland accepted on the spot. "It was a thrill to be asked back," says the 42-year-old Darland, who was running a small Seattle ad agency at the time. "It's like being called back from the minor leagues just before your team goes into the World Series."

In an era marked by merger mania and massive corporate downsizing, Darland's case would seem to be an anomaly. Since the early 1980s, more than 1 million middle managers and thousands of senior executives have lost their jobs, giving corporate recruiters a bumper crop to pick and choose from.

But the competition for top-notch executives is still keen, and many companies on the hunt are finding that it makes much more sense to hire a known talent than to take a chance on someone new. As a result, more and more former managers are being welcomed back to fill key management positions—particularly at the senior management level, where stability and a sense of continuity are most important. "A resumé is one thing, but it doesn't tell you if an executive will fit in well," notes Ron Gervas, a managing partner at search firm Heidrich & Struggles Inc. "If you know the man, it's likely to be a big advantage."

A number of top-level executives have completed the circle in the last few years. Two notable examples: Allan H. Kurtzman, who was an executive vice president when he left Max Factor in 1976 for Revlon, and later became president of Neutrogena Corp., was lured back to Max Factor as president this past January; and Alfred Goldstein, a former women's apparel executive at Sears, Roebuck & Co., has just been called back to head up Sears' new specialty retailing unit.

Some companies even follow the ca-



nuts job center, which won a high 90% participation rate.

The training was geared to the local job market. Many production workers were steered to courses on military specification soldering, since there were a number of local military contractors. Other courses included auto and diesel mechanics, culinary arts and computer technology. Out of 800 workers, 150 took early retirement, 314 got into long-term training programs and 300 were placed in jobs.

Many of the lessons of conquering worker inertia and a dearth of jobs were first learned at the Ford Motor assembly plant in Milpitas, California, which closed in 1983, idling 2,300 workers. This program pioneered in using sophisticated career assessment, job counseling and outreach to local employers. All told, 500 workers retired, 300 still needed assistance when the program folded and 1,500 found employment.

Now, Ford has institutionalized that process in its Reemployment Assistance Centers, "one stop service centers," which are contractually funded. Ford contributes 10 cents for each hour worked by a United Auto Workers member. The RACs have outreach programs and career counseling. They develop individual plans to direct workers to high school equivalency training or vocational training depending on locally available jobs. As of November 1986, 5,911 workers had been trained, with 4,575 finding jobs at an average hourly wage of $7.13.

Government financial help requires advance notice. If aid from government programs is sought before the termination date, companies can get either Washington or the state to pick up most of the tab. To pay for Ford's Milpitas program, the government spent $4 million; while Ford, UAW and private foundation money contributed $3.3 million in cash and services. Ford figures that its $650,000 cash outlay was recouped by reduced workers' compensation costs because of the good will generated by the program and by lower unemployment insurance costs. B&W put up $284,000 for its program; the government kicked in $359,000. Stroh spent $1.2 million and got $600,000 from the state of Michigan. GE spent only $400,000, but Washington picked up $1,025,000, Maryland $200,000.

The Canadians get a reemployment program up and running in four or five days.

When it comes to finding jobs for laid-off workers, "We're from the government and we're here to help" is not a joke in Canada. The Canadian Industrial Adjustment Service has been held up as a model. The agency can get a reemployment program up and running in four or five days at a total cost of about $20,000 per company.

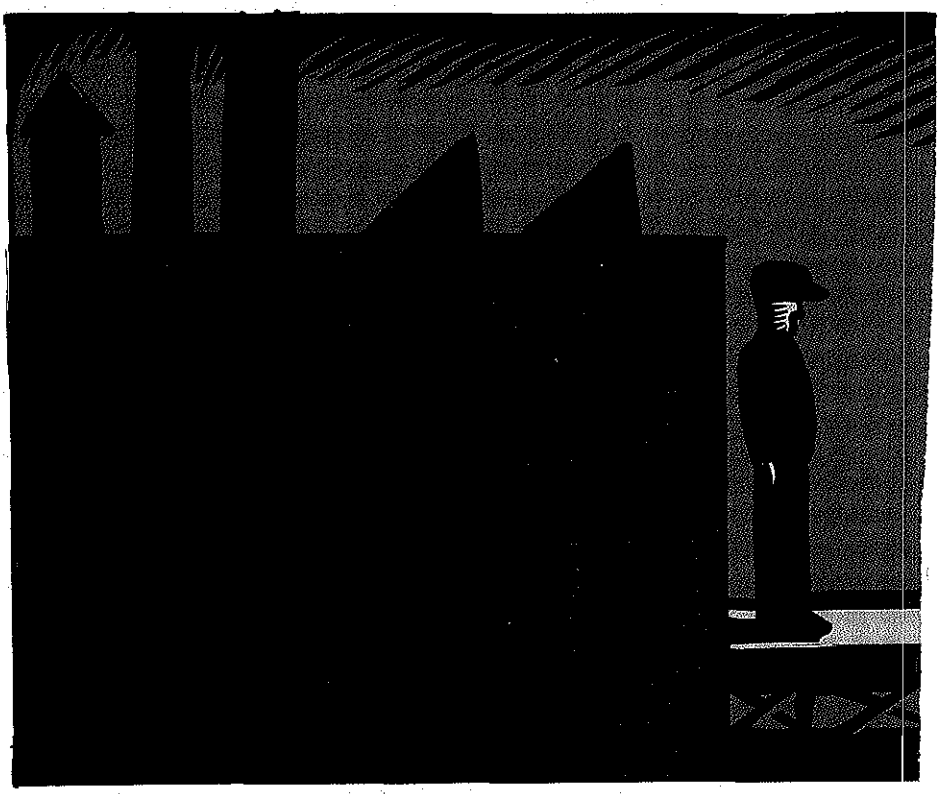
The typical effort lasts two or three months, reports Pierre Leclerc (who runs the $9 million a year program with a headquarters staff of three). Under its professional guidance, a joint labor-management committee is formed, there is job search counseling, and the employer solicits area companies for jobs. A few early success stories get the snowball rolling. Usually 80% of the workers participate, and jobs are found for two-thirds of them at a IAS cost of $171 per worker. Impressed by these results, the National Governors' Association has agreed to start a pilot program with the DOL in six states to test programs based on the Canadian model.

Now, the Democrats in Congress, intent on rewarding their labor constituency with more to laid-off workers, have put money for retraining high on the list. To head them off, President Reagan has proposed spending $980 million ($500 million is new money) on retraining. It looks inevitable that funds will be found, but will they be spent more effectively than in the past? ■

A Consensus on Helping Idled Workers

Successful company programs show the way. But will Congress learn the lessons?

by Daniel Forbes



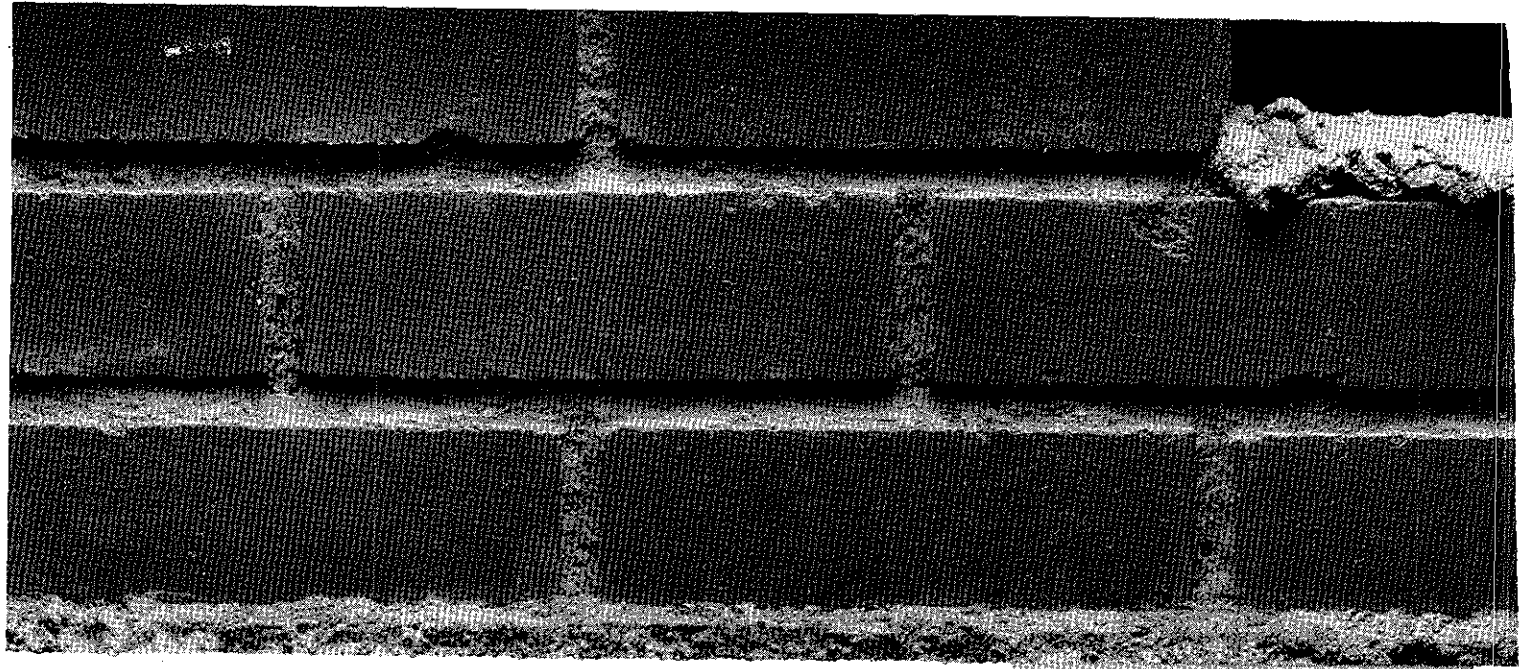
Between 1981 and 1986, companies laid off almost 11 million Americans. Production workers with bills to pay and kids to raise were let loose on a job market in which manufacturing jobs were virtually unobtainable. And most private and government programs to retrain or find jobs for this growing army of jobless cost too much and helped too little. But in the past few years a consensus among policymakers, employers and government is emerging on how to help idled workers.

The closing of the Brown & Williamson Tobacco Corp. Petersburg, Virginia, plant provides a textbook case. B&W worked with the union, the employees and the community. Professionals taught employees job seeking skills, the company tracked down locally available jobs and directed them to training. Despite Petersburg's depressed economy, 56% of the laid-off workers found new jobs; 20% retired. Although most workers took big wage cuts at their new jobs, this is a genuine happy ending and the B&W workers applaud the company's efforts.

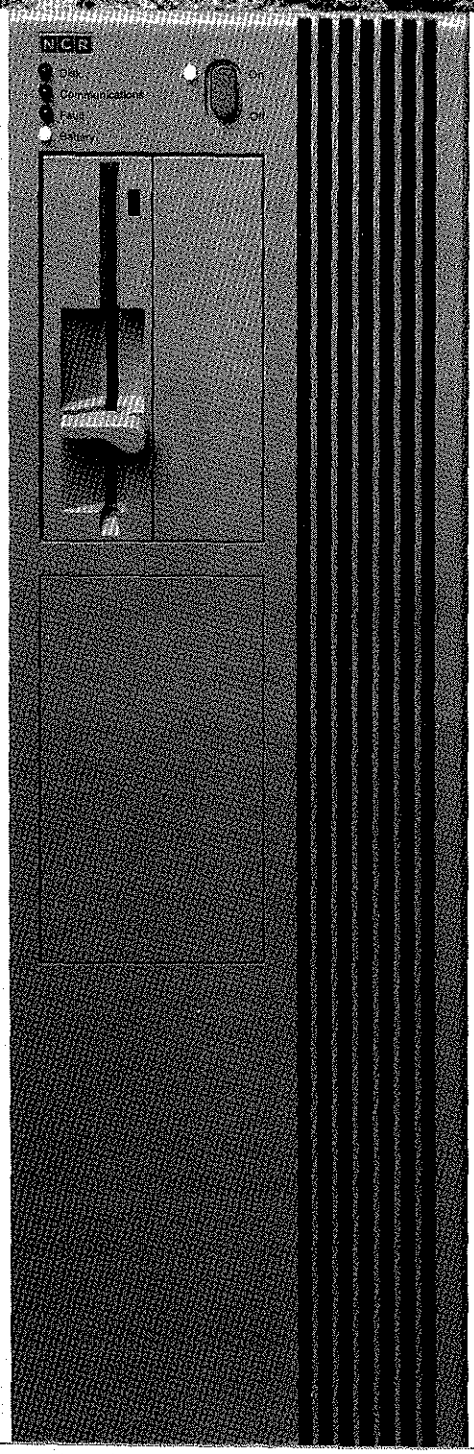
Consumer products companies such as B&W, Firestone Tire, Ford Motor, Stroh, GM, AT&T, Levi Strauss and GE appear to be on the cutting edge of programs to help. Spurred by concerns over worker retaliation or product boycotts, companies that once might have padlocked the gate in the middle of the night have found it in their enlightened self-interest to retrain and find jobs for idled workers.

These programs emphasize reemployment over retraining. Most manufacturing workers are proven quantities who have been trained before, and only about one-third are interested in formal training. Reemployment experts, who have studied program after program, now agree that a sweeping outplacement effort to get laid-off workers as fast as possible into a new job at a living wage is the most productive. "Most people need to get on a payroll quickly and want a job, not training," says Bill Batt of the Department of Labor.

A major study published last December by the Department of Labor recommended a host of procedures that had been successfully tested in company programs. And its recommendations have been largely echoed by such groups as the Business Roundtable, the Ford Foundation and the



BUILD YOUR FUTURE ON A SOLID FOUNDATION.



cording to MCC executives, only a handful of members have either the resources or the inclination to develop the technology they get from the consortium into usable products. "If MCC's shareholders don't move more rapidly, they will find that the two- or three-year lead in technology that MCC provides them will evaporate," contends Admiral Bobby Ray Inman, the consortium's former director, who is considered most responsible for getting it off the ground.

This stalemate raises anew the question of whether cooperation in R&D à la the Japanese is possible in a country where corporate secrecy is a way of life. Turning technology into products fast enough to compete in world markets is one of corporate America's most serious problems, and it is precisely the problem that MCC was intended to solve. Product life cycles have become so short and global competition so severe that U.S. companies have had to concentrate most of their research efforts on just keeping up with next month's products—leaving promising new technologies to languish in university labs or surface in the products of foreign rivals.

The model for MCC was Japan's near-legendary VLSI project in the 1970s, which enabled Japanese firms to leapfrog the U.S. in semiconductor technology. That effort was coordinated and partly funded by Japan's Ministry for International Trade and Industry in cooperation with several big companies. When MITI announced in 1981 that it was embarking on the even more ambitious Fifth Generation project (essentially a plan to reinvent the computer using U.S.-inspired futuristic research concepts, such as artificial intelligence and parallel processing), the U.S. was goaded into action. The Defense Department initiated ambitious new research programs, and industry formed MCC.

Largely to the credit of Inman, MCC did better than expected in getting research under way. He got the shareholders to agree on research programs

The emphasis on secrecy has spilled over into the operations of MCC itself.

in four different technology areas: semiconductor packaging, computer-aided design, advanced computer architectures and computer software. And when some members refused to send their best researchers to MCC and sent mediocre ones instead, he resolutely sent most of them back. Eventually, he succeeded in building a highly respected staff by hiring mostly outside researchers. Shareholders and observers alike agree that the consortium would not have had a chance without Inman's charisma and connections to influential people in industry and government.

Since the beginning, however, MCC has found it difficult to strike the delicate balance between research that is practical enough to be relevant to industry and yet generic enough so that competitors don't mind sharing it. For one thing, fear of giving away a competitive edge keeps the flow of information one-sided; members get information from MCC but contribute relatively little expertise to the consortium. Members also are wary of subsidizing their competitors by supporting the kind of research they are doing in-house; they therefore tend to participate in technology areas in which they are weakest and keep their strengths to themselves.

This emphasis on secrecy has spilled over into the operations of MCC itself. Each of the four research programs is kept totally separate, and results from one program are not available to shareholders participating in the others. Even program reports are subject to an elaborate security classification system. "It would have been better to make it so that everybody participates in everything," says Thomas Tang, research vice president of NCR Corp. and a member of MCC's board of directors.

These boundaries between programs have made the organization much less efficient, critics say. For example, work in the software program is related to work on parallel computer architectures, and both programs overlap computer-aided design. Yet researchers are prohibited—at least officially—from comparing notes. Moreover, MCC is now thinking about splitting up the artificial intelligence program into several smaller programs in order to attract more members, according to Tang.

The competition also fuels a debate over how close MCC research should come to actual product design. Antitrust law bars the consortium from designing products, but it has some latitude in selecting research topics and supporting the research that it hands over to shareholders.

If research becomes too product-specific, MCC risks losing its strongest members, which already have the ability to develop such technology and are reluctant to subsidize weaker competitors. But the weaker members, which are far more numerous, want MCC to deliver more product-specific technology. Inman, who resigned from MCC last December, has been outspoken in his criticism of this attitude. "Too many of them are waiting around for a virtual product design to emerge before they examine what's happening and why they might use it," he says.

As a result, MCC will have to spend more time and energy than anticipated persuading shareholders to use the technology it has developed. "So far, we have taken the attitude that shareholders assume the reponsibility for using the technology," explains MCC chief scientist John Pinkston. "But we have got to take a more active role." Pinkston figures that one-quarter of MCC's budget will now go into training researchers, sponsoring seminars for top management and other methods of promoting its research results.

from a small tool builder into a system alongside other producers' equipment.

But these efforts will be too little and too late for firms such as Cincinnati's Lodge & Shipley Co., which is selling out to Belcan Corp., an engineering company. After 95 years in the lathe business, Lodge & Shipley can't keep itself in the technological forefront. "The further we got into that kind of effort, the more we realized the importance of control engineering," says William L. Dolle Jr., the company's president. "We got into projects where the engineering hours were greater than the direct labor hours."

Nor will import restrictions find customers for the smaller firms. For example, Wedco Technology, Inc., has lost money ever since it bought its way into machine tools three years ago, according to Vice President William C. Willoughby. Wedco's machine tool operation is now on the block.

A larger tool builder, Willoughby believes, could find economies of scale in engineering and bid preparation that Wedco's sixty-employee Wadell Equipment Co. in Edison, New Jersey, cannot. "It's not a market the Japanese are after. It's just a market that's extremely expensive to deal with. There are not too many customers," Willoughby says.

Government programs also fail to address the industry's long-term problem: a changing world. Many parts nowadays are made of plastics or lightweight composites that don't require extensive machining. "We've changed materials," says Cincinnati Milacron Chairman James A. D. Geier. "Things are no longer going to be built out of the materials they were built out of."

Thus, the need for machining of metal is diminishing. Even if the plastic piston doesn't arrive tomorrow, there may be new ways of making it out of metal, says Arthur D. Little & Co. consultant Harry Mathews. "There are new technologies," he reports. "They can do casting and molding of very complex and finished metal parts. So when you look in the future, you see a reduced need for machine tools."

And what about American competitiveness? To answer that question, another must be asked: What do we mean by competitiveness?

If the survival of U.S.-based manufacturers of machine tools is at issue, the government needn't worry. After five years of intense restructuring, the industry's leaders are positioned to survive. They have slashed capacity and fended off Japanese companies that have sought to establish bases in the U.S. The Reagan Administration's program will augment their profits in the short run and slow the invasion of imports.

If "competitiveness" means maintaining a large machine-tool manufacturing base in the U.S., the Administration's current policies can not help to reverse the technological changes that are shrinking demand for traditional machine tools. To prepare for this new world, the machine tool giants are already diversifying into new businesses. Milacron has spread into plastics machinery and Cross & Trecker has a new software subsidiary. Ex-Cell-O Corp., another of the industry's long-time leaders, had transformed itself from a machine tool manufacturing company into a diversified industrial concern before Textron Corp. snapped it up last fall.

Such diversification is clearly not what those concerned about machine tool "competitiveness" have in mind. But it represents a predictable commercial response to the realities of the market, economic realities the government is mistaken in trying to second-guess. Attempting to keep the U.S. strong in sectors that are declining is a recipe not for competitiveness, but for obsolescence. ■

WILL WE LACK MACHINE TOOLS FOR THE NEXT WAR?

Imagine a major war. Without a large machine tool industry, what would the country do?

That national security concern is the rationale for the Reagan Administration's program to help the tool builders. Modern tanks and aircraft use metal parts that require highly precise machining. If the machine tool manufacturing base shrinks further, Defense Department analysts worry, it will endanger America's ability to wage a prolonged conflict.

But it was the tool industry, not the government, that first raised the national security issue, in its petition for import quotas. The reason: The government can grant trade relief for defense reasons even when an industry is not seriously injured by imports—a case the tool builders couldn't make.

Edson I. Gaylord, president of Ingersoll Milling Machine Co. in Rockford, Illinois, and an outspoken opponent of protection, contends that national defense is a red herring. "If it's a fifteen-minute war, you don't need stuff like machine tools," Gaylord argues. "If it's a long drawn-out affair like the 1940s, that involved all of American industry. To pick out one little sector and say this is essential is absurd."

The government's program assumes that five years of protection will assure the industry's survival. But it is unlikely tool builders will voluntarily maintain the vast capacity required for defense production at a time when non-defense customers are vigorously seeking ways to avoid machining metal. "That's the kind of process other industries are trying to get away from, because it's so expensive," asserts analyst John Alic of the Office of Technology Assessment.

Measures to steady the flow of defense orders, easing the industry's cyclicality, would probably help more than protection to keep tool builders in business. In the long run, if the Defense Department wants to keep the nation's machine tool plant at its present size, it may have no choice but to foot the bill.

Trying to Survive In a Changing World

Neither government help nor better machine tool industry management will reverse the shakeout ahead.

by Marc Levinson

By all rights, America should be king of the machine tool trade. When it comes to drilling, cutting, grinding and shaping metal parts for everything from gears and pistons to rifle tubes, U.S. companies produce technologically advanced machines that no other country can match.

Instead, the industry is mired in troubles. Nearly 50% of the machine tools shipped to U.S. factories came from abroad last year, while domestic makers' shipments of $2.8 billion were barely half their 1981 highs. Since 1982, hundreds of firms have shut their doors and industry employment has plummeted from 98,000 to 50,000.

In the current debate over America's international competitiveness, machine tools is precisely the kind of basic industry the politicians want to preserve. And their concern is justified: Capital goods are the vital core of the country's industrial base and its national defense (*see box, page 48*).

But the crusade to save machine tools exemplifies the difficulty of designing a "competitiveness policy." Foreign competition bears little responsibility for the industry's woes. Largely to blame are poor management, a sharp slump in capital spending that robs the industry of revenues, the cyclicality that has sapped the financial resources of small tool shops and the development of plastic and composite materials that are making traditional metalworking machine tools obsolete.

The federal government has made one of its strongest commitments to help this small but vital industry. In December, President Reagan announced a five-year program of import quotas, research grants and closer ties with defense projects. Congress chimed in, requiring the Defense Department to buy only machine tools made in the U.S. or Canada. These measures are the leading edge of policy thinking about aiding depressed industries.

The government negotiated five-year voluntary import restraint agreements (VRAs) with Japan and Taiwan and threatened similar steps against Swiss and German producers. These actions should keep prices up, much as they have with Japanese autos.

Privately, many in the industry admit that, more than anything else, bad decisions of years past haunt tool builders today. When the auto and aircraft industries retooled in the late 1970s, tool builders had more work than they could handle. Many focused on highly sophisticated, multimillion-dollar products: hundred-yard-long automated lines to bore holes in tens of thousands of engine blocks, or flexible manufacturing systems that turn out thousands of different parts in any order without the help of a human hand.

Customers seeking to spend, say, $300,000 for a standard numerically-controlled milling machine faced long waits and high prices. "Lead times had gotten rather long," suggests J. David Morrissy of the Office of the U.S. Trade Representative. "That impelled a lot of users to look overseas."

Meanwhile, Japanese tool builders marketed computerized stand-alone units. And producers in Taiwan zeroed in on the bread-and-butter, low-tech market, such as non-numerically-controlled lathes.

The Japanese had few direct competitors in the mid-tech market: The U.S. giants pursued the higher-tech segment and the machines of smaller U.S. shops were often technologically backward. In the low-tech sector, U.S. makers had no technological edge and higher labor costs. By 1986, seven out of ten machining centers sold in the U.S. came from Japan.

With imports dominating the middle- and low-tech markets, small U.S. companies were pushed to the margin. Ironically, the industry giants' strategy also came a cropper. When the totally-automated factory turned out to have limited commercial appeal, the leading firms were left holding some of the world's most advanced technology—without buyers.

The industry was painfully sorting out its problems, long before it caught the Administration's attention. Left to their own devices, tool builders

He has the carriage of a Southern aristocrat and a spare style that reflects his Scandinavian heritage. Courteous but distant, the self-contained, businesslike Bentsen seems to reflect his parents' South Dakota upbringing more than his own in Texas. His style is well-suited to the inside game he plays as well as anyone in the Senate. "He's a strong leader," says New Jersey Democrat Bill Bradley, "very organized, very thorough, and would prefer a bipartisan approach. He knows the importance of planning and organization. He's also clear about his agenda, and he listens to people."

Bentsen can be either tough or a consensus builder, depending on the situation. During the Carter Administration, he chaired the Joint Economic Committee, and didn't hesitate to criticize the Democratic President. He moved the JEC in a radically new direction of support for boosting business investment, and still managed to produce the only unanimous report in decades—with conservative House Republicans and liberals like Ted Kennedy both signing on. Jack Albertine, then committee staff director and now vice chairman of Farley Industries, recalls, "He just worked the phone all the time, cajoling, convincing. He made the case with Kennedy that the only way to pay for his social programs was through productivity increases."

Last year, Bentsen confronted the House on its proposal to finance the environmental Superfund with heavy taxes on the petrochemical industry. Arguing that innumerable industries throughout the country created toxic waste, his combination of substance and threats to kill the legislation, which House liberals badly wanted, led to a broad-based tax on all manufacturers, not just petrochemicals.

Lobbyists find him exceptionally knowledgeable, but they know he can play hardball. Says one former aide, "He knows who his friends are. He knows who contributed to him, and who gave to his opponent. He talks about marking it down."

Now that he is Finance chairman, the contributions are rolling in. He recently offered lobbyists a chance to breakfast with him once a month during this Congress—for $10,000. Then he quickly changed his mind after an avalanche of adverse publicity. Says Bentsen: "I'm not known to make many mistakes, but when I do it's a doozy, and in forming that breakfast club I really blew it. I didn't anticipate the perception of it."

Bentsen's career has taken some surprising turns. A World War II bomber pilot, he was elected to the House in 1948 and became a protegé of then-Speaker Sam Rayburn. But frustrated by the long path to power in the House and by the low pay (Congressmen then made $12,500 a year), he quit in 1955 to build a business empire based on insurance and banking. In 1970, a millionaire in his own right, he returned to politics and beat liberal incumbent Senator Ralph Yarborough in a bitter primary, attacking him from the right, and then defeated George Bush in the general election.

His next step was to confound conservatives who expected him to be a dependable ally. Indeed, he has backed liberal causes from federal regulation of private pensions to Medicare. At the same time, he has been a steady friend of business on most issues. Recently, many of his fellow Democrats have moved towards Bentsen's essentially centrist stance. "Ideologically," he says, "I'm in the position the Democratic Party is moving toward. I've just been there all the time."

Bentsen predicts 1987 will see "no major substantive changes in tax law. I would like to move soon on technical corrections, and that could be difficult. . . [As far as tax hikes] I see no scenario for taxes without the President's participation. You can't override a veto, and there's no point in taking those bruises with no substantive gain."

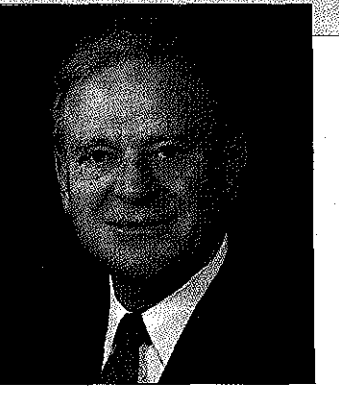
This is typical of Bentsen, who doesn't start a fight to make a point. When he takes on an issue, it is something he believes can win. So when the tough-minded Texan pushes a bill, his colleagues know he is determined to go all the way. "I've been told I win my share," smiles Bentsen. ■

IN A BIND: CEOS WANT AND FEAR FEDERAL HELP

As the politicians of both parties maneuver to make hay out of trade-cum-competitiveness, BUSINESS MONTH decided to find out what role corporate America thinks the government should play in restoring the U.S. to its former preeminence in the world economy. So we surveyed the 200 members of the Presidents' Panel, comprised of CEOs from a wide spectrum of American industry.

The top executives are deeply disturbed by the ongoing trade deficits. But they fear that many of the policies suggested in the name of competitiveness will bring more federal intrusion in the private sector. "Legislation will not correct the situation," maintains Chairman T.F. Russell of Federal-Mogul Corp. "It will require additional taxes on the public and/or business." Adds a major food company CEO: "Competitiveness is basically a company matter."

Moreover, the panelists say that many of the proposals being bandied about in Washington have an all too familiar ring. "Some

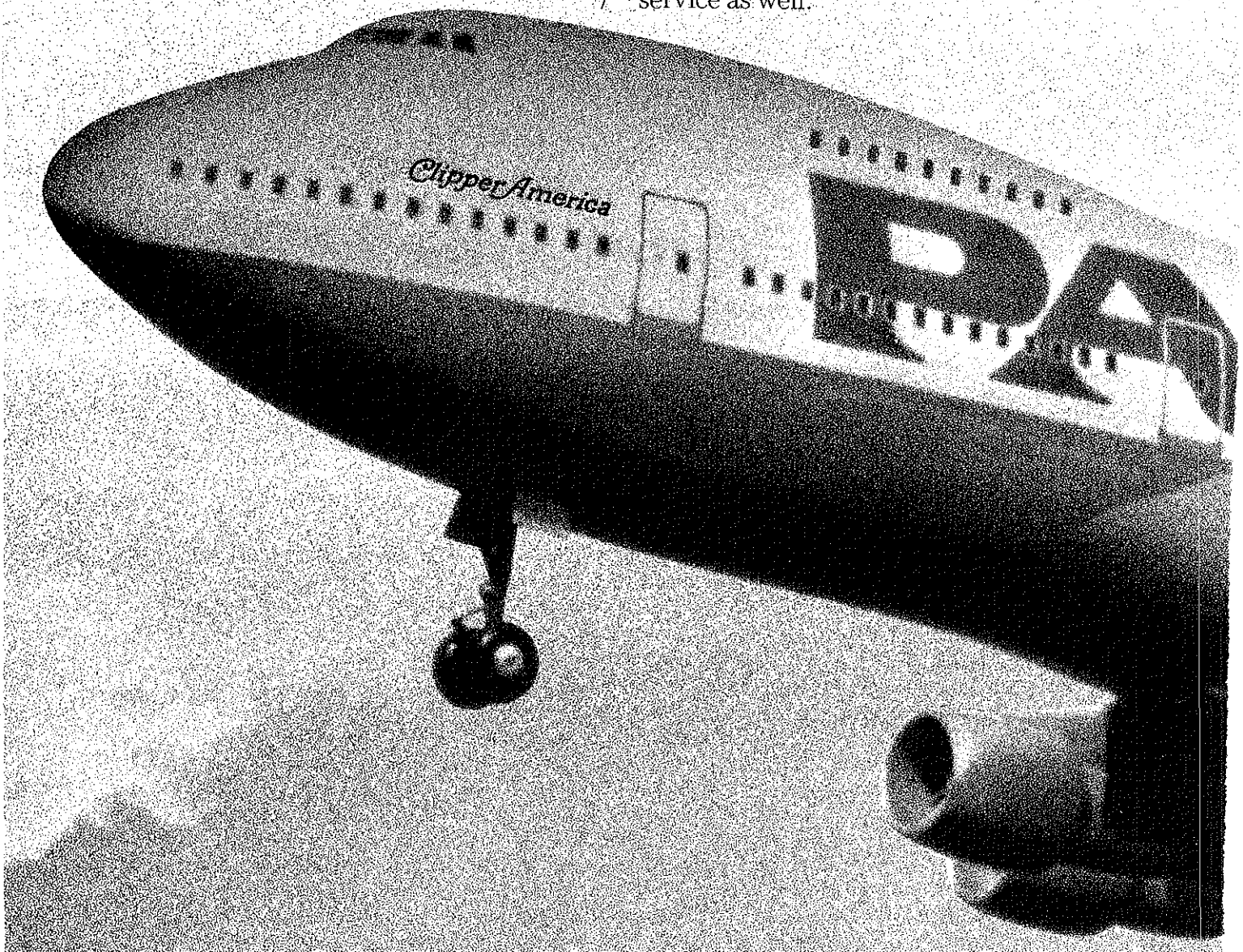


Chairman Donald Lennox of Navistar: "Legislation should be designed to open foreign markets to our products"

YOU EXPECT MORE
AND YOU

There are few names left in commercial enterprise that still raise expectations among their customers.
Pan Am is one of them.

And we intend to live up to our name.
At a time when airlines shout about price and whisper about service, Pan Am is determined to provide both low prices and fast, courteous, reliable service as well.



EXPECT MORE

Why Lloyd Bentsen Will Get His Trade Bill

The canny chairman of the Senate Finance Committee is maneuvering to fend off protectionism yet help business.

by John M. Barry

A few weeks ago, U.S. negotiators went to the brink of a trade war with the European Community. When Spain and Portugal hiked tariffs on American corn and sorghum, the U.S., frustrated and angry, threatened to slap 200% tariffs on European gin, wine and cheese. Only minutes before the levies were to take effect, the EC caved in, agreeing to roll back the new tariffs and even to lower those on 26 other U.S. products. The lesson: Holding a gun to the heads of other nations works.

That is precisely the approach Senator Lloyd Bentsen has been advocating for nearly ten years. Now, as chairman of the Finance Committee, the cagey Texan is in a position to do something about trade policy. He intends to.

Already chairing hearings the day the new Congress convened, Bentsen plans to use trade legislation to strengthen the nation's manufacturing base. Without a strong manufacturing sector, Bentsen insists, the U.S. will be like a colony, importing manufactures and exporting raw materials.

Bentsen recognizes the complexity of the issue. "Trade legislation by itself will not correct the trade imbalance," he says. "It's many-faceted—Third World debt, currency exchange rates, our productivity, the budget deficit." He does not dispute the estimates that only $15 billion-to-$20 billion of the $169 billion trade deficit is accounted for by unfair practices. "But legislation makes a difference," he says. "People blame the budget deficit as the major problem, but that's an oversimplification. The trade and budget deficits play off each other [because the trade deficit hurts GNP and increases the budget deficit]."

Bentsen's bill, which is cosponsored by a Senate majority of 30 Democrats and 24 Republicans, attacks the trade issue on many fronts. Among its key provisions:

☐ Mandates more aggressive presidential action against unfair practices. It requires the Administration to identify and initiate actions against "market distorting" policies, such as subsidies, dumping and trade barriers. U.S. retaliation would be mandatory at the end of a long process. It also calls for more protection of U.S. firms' intellectual property rights.

☐ Makes it harder for injured industries to qualify for relief from import competition, but also assures them of help if they do qualify. Bentsen doesn't want to protect dying industries; but he does want to insure that an industry gets temporary relief—for example, through quotas—if that will allow it to become competitive. The bill also prohibits the International Trade Commission from refusing relief because a manufacturer is profitable, if the profit comes from substituting imports for domestic production.

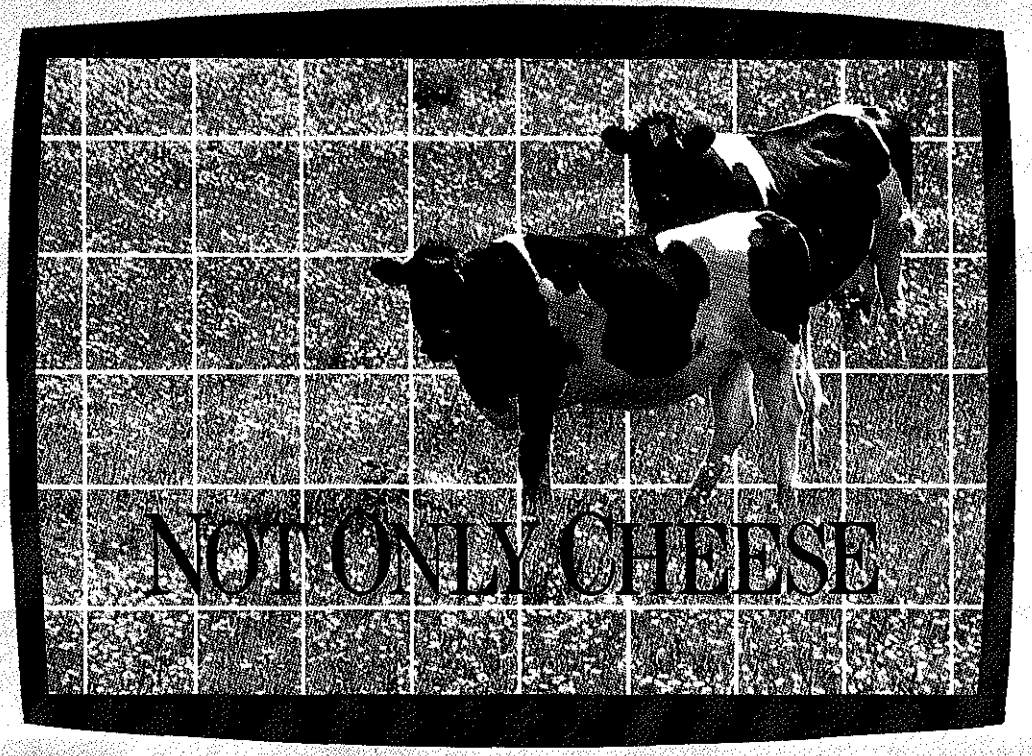
☐ Refocuses Trade Adjustment Assistance to workers, possibly including a voucher to the worker for up to $4,000. Funding would come from an import duty of up to 1%.

☐ Authorizes a new round of negotiations with the General Agreement on Trade and Tariffs and requires close White House consultation with Congress throughout the negotiations. It also pressures the Administration to articulate its GATT strategy, the coordination of international macroeconomic policy, Third World debt, and efforts to adjust exchange rates with countries such as South Korea and Taiwan, which peg their currencies to the dollar. "We want to make them come up with a policy," Bentsen says. "That helps them as much as it helps us."

☐ Establishes a national trade council in the White House, similar to the National Security Council.

The bill pointedly does not include the 1986 House bill's most controversial provision: retaliation in the form of possible quotas—although the President was given the power to waive them—if countries with massive trade surpluses did not reduce them. Bentsen originally backed the proposal, arguing that the protectionist label opponents tacked on it was unfair and oversimplified. But this year, he wants to avoid even the appearance of supporting protectionism.

Many legislators of both parties are



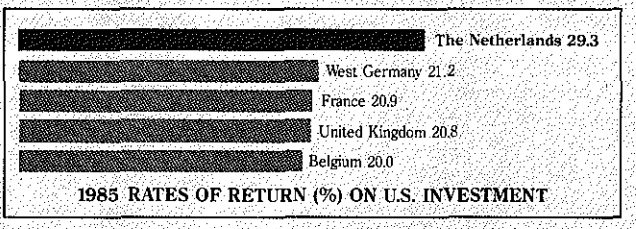
BUT ALSO CHEMICALS, PLASTICS...

THIS IS THE NETHERLANDS: Not only the second largest exporter of agricultural products in the world, but also a major manufacturer and exporter of industrial and consumer items. Many U.S. corporations manufacture in the Netherlands for their international markets, including:

• INTERNATIONAL FLAVORS AND FRAGRANCES—exports flavors, fragrances and aroma chemicals worldwide from its three Dutch plants, representing its *largest overseas investment.*

• WITCO—manufactures white oils and other specialty chemicals for Europe, Africa and Asia in Koog a/d Zaan, its *largest overseas investment.*

• GENERAL ELECTRIC'S PLASTICS GROUP—supplies Europe, Asia and Africa with engineering thermoplastics from Bergen op Zoom, GE's *largest overseas investment.*



The average rate of return on U.S. direct investment in the Netherlands has been much higher than the European norm throughout the 1980s.

ARE YOU IN THE NETHERLANDS YET?

If not, please contact:
Mr. Pierre Dobbelmann
Executive Director
United States & Canada
Netherlands Foreign Investment Agency
One Rockefeller Plaza
New York, NY 10020
(212) 246-1434

The Netherlands
Right
in the
Center
For Investment

A boy and his bike should never be apart for long. And in Fort Collins, Colorado, they seldom are, because the city's Meridian SL-1* Integrated Services Network is more than a PBX. It's a way to know which boy belongs to which bike. And more.

It networks 200 workstations, two DEC and two Hewlett-Packard minicomputers, a Sperry mainframe and, of course, their entire phone system. And it prepares them for a future where sharing voice, data, text and image will be as easy as using a phone. Call (800) 328-8800.

nt northern telecom

*Trademark of Northern Telecom © 1987 Northern Telecom Bicycle courtesy of The Murray Ohio Manufacturing Co.

member of one vintage champagne producer. "We could no longer afford to keep all our precious eggs in one increasingly threadbare basket."

Currently, the worldwide luxury trade is earning France an estimated $3 billion a year. And by the end of the decade, three international conglomerates—Louis Vuitton, Yves Saint Laurent and Moët-Hennessy *(see sidebars)*—will be dominant, with Pierre Cardin a possible fourth, according to securities firm Nivard, Florney & Cie.

As the larger companies keep diversifying, one worry is that they risk losing their identity. They are already beginning to look alike, with increasingly similar product lines such as wine, cosmetics and perfume.

An even bigger danger is that they may be tempted to lower the prices and quality of their goods in the face of increasing competition from each other and from other foreign luxury groups, such as Italian shoe and leather maker Gucci and Japanese cosmetic firm Shiseido Co. "As more companies move in on the prestige end of the market, the temptation to cut corners in order to maximize market share and maintain earnings must increase," says Nicholas Sampson, who manages European investment strategy for Britain's Norwich Union Life Insurance Society.

But executives such as Patrick

THE REFASHIONING OF YVES SAINT LAURENT

For Yves Saint Laurent, France's top fashion designer, building an international conglomerate has been a tortuous experience. In 1971, Saint Laurent was forced to sell his ready-to-wear clothing and perfume businesses to Squibb Corp. in order to raise cash for his money-losing haute couture operation, and it looked as if the small empire that bore his name was about to fade away.

But within two years, Saint Laurent and his longtime partner and business manager Pierre Bergé had turned the haute couture business around and were able to buy the clothing operation back from Squibb. In an even bigger coup, they have now brought Saint Laurent's perfumes (Rive Gauche, Paris and the highly successful Opium) back home. Last year, Yves Saint Laurent SA acquired Squibb's Charles of the Ritz subsidiary, which owns the perfume line, for $630 million—winning the company in the face of tough competition from Revlon and Avon in the U.S. and Japan's Shiseido.

"The deal makes us a world-class company," says Bergé, who engineered it. It also fulfills Saint Laurent's desire "to play a greater role in the creation and development of the perfumes and cosmetics sold under my name."

The acquisition, though, required outside financing. And to get it, 25% of Yves Saint Laurent was sold to Italian financier Carlo de Benedetti. Taking in an outsider is an unusual step for a French luxury firm, but Bergé is enthusiastic about the new partnership. Noting the added financial clout it gives the company, he says, "This will allow us to plan a more powerful expansion than ever."

Saint Laurent himself, a notoriously reclusive and temperamental creative genius, rarely gets involved in the business operations of the company, preferring to lock himself away in his cluttered studio. His exclusive designs are eagerly sought by fashionable rich women everywhere, and, unlike most haute couture houses these days, that side of the business is highly profitable.

But the bulk of the company's sales and earnings now comes from applying Saint Laurent designs to the upper end of the ready-to-wear market and from licensing his name for a whole range of products, from cigarettes and watches to bed linen. Over the past decade, Bergé has negotiated licensing deals with manufacturers around the world, making Yves Saint Laurent a household name from Moscow to Martinique. An estimated 75% of earnings (which the privately held company does not reveal) now comes from abroad, and the name has taken on an international significance of its own. "We have ensured that the Yves Saint Laurent name will stay alive for decades on clothes, perfumes and other luxury products," Bergé says.

With Charles of the Ritz, a well-known, worldwide marketer of toiletries and cosmetics, Yves Saint Laurent's sales have hit the $1 billion mark. Once that acquisition is digested, which Bergé thinks will take around two years, he has others in mind—perhaps a champagne company or a top-ranked vineyard, he says. More immediately, plans are afoot to take Yves Saint Laurent public next year. Bergé's ultimate goal: "To create the dominant prestige-brand company in the world."

TYEN FOR CHRISTIAN DIOR

French Luxury Goods Go Global

Onetime small, family firms are becoming broad-based empires, with interests from New York to Tokyo.

by David Fairlamb

Ever since the Sun King, France's Louis XIV, dazzled seventeenth century European aristocrats with his glittering lifestyle and extravagant tastes, French luxury goods have been the sine qua non of the rich and famous everywhere. Just as sumptuous Gobelin tapestries and finely decorated Sèvres porcelains were once the ultimate status symbols of discerning blue bloods from London to Vienna, so are Louis Vuitton leather goods, Yves Saint Laurent fashions and fragrances and Dom Perignon champagnes prized today by monied classes from Tokyo to New York as the hallmarks of stylish living.

Yet for centuries, the mainly small, family-run French firms that dominated the luxury trade made little or no effort to exploit the worldwide demand

MOËT: FROM CHAMPAGNE TO ROSES

When Alain Chevalier took command as chairman of Moët et Chandon in 1970, he found a successful but static one-product company. "Earnings were healthy," he recalls, "but we were overexposed to the fickle champagne market and the vagaries of the French weather. And there was no room for growth."

The brilliant onetime civil servant and secretary-general of the state-owned Sacilor steel company embarked on an ambitious expansion plan, and over the past fifteen years he has transformed the small, straitlaced, provincial company into one of France's most dynamic international conglomerates. These days, the venerable vintner is selling roses, cosmetics and cognac as well as champagne, and its sales passed the $1 billion mark in 1985.

Chevalier's first move was to consolidate Moët's position at home. He bought the prestigious Mercier and Dom Perignon champagne companies, then arranged a merger with 120-year-old cognac producer Hennessy, renaming the company Moët-Hennessy. Making his first bid to break out of the alcohol market, in 1973 he acquired a controlling interest in the Christian Dior perfume and cosmetics group.

But it was obvious, Chevalier says, that real growth would depend on tapping the demand for French luxury goods abroad. In 1972, Moët acquired the Domaine Chandon vineyard in California's Napa Valley, becoming the first European vintner to participate in the fast-developing American wine business. At first, the champagne families of Reims and Epernay were horrified. But when they saw the cash flow, they changed their minds and followed suit.

Moët's California vineyards now turn out some 5 million bottles of high-quality sparkling wine a year and are very profitable, according to Patrick Houël, the company's finance director. "And having an American wine operation," he points out, "protects us against currency volatility, particularly now when the weak dollar makes French wines very expensive for U.S. consumers."

Fellow vintners were also startled when Moët diversified into the U.S. horticulture business. A stake in French rosebush firm Georges Delbard led to the company's 1982 acquisition of Armstrong Nurseries, the third-largest American rose producer. Due to a thoroughgoing restructuring of the company, Armstrong suffered substantial losses in 1984 and

Lynch, IBM and Citicorp. Philip Morris, Sears and First Chicago also showed big percentage increases between January 1986 and January 1987.

Japanese can invest either through the TSE or U.S. exchanges. The institutions buy in New York to have access to the full range of American stocks. Thus the table *(right)* largely reflects trading by individual Japanese. But analysts say it is a good indicator of overall trends.

Clearly, the image of the company in Japan is important. Disney, for example, is well known because of the tremendous popularity of the Disney theme park that opened in Tokyo in 1983 and the wide range of Disney products marketed in Japan.

But Japanese investors also keep up with the financial performances of their U.S. investments. Trading fell off heavily between January 1986 and January 1987 in such issues as ITT, General Motors and BankAmerica, all of which had earnings problems.

Japanese institutions buy many stocks that are not yet listed on the Tokyo Exchange—for example, Digital Equipment and Cray Research, both market leaders in an industry important to the Japanese. Dun & Bradstreet, Federal Express and Abbott Labs are also on Okada's buy list, as well as utilities such as Nynex Corp., Bell Atlantic Corp., Duke Power Co. and Citizens Utilities, an over-the-counter stock.

Institutions also share individuals' enthusiasm for TSE-listed U.S. blue chips, though. These are the best understood U.S. stocks, after all. "The Japanese buy into companies they understand from their own experience and which have a large market presence in Japan," says Michael Metz of Oppenheimer & Co.

Public interest in Japan increased sharply after the U.S. stock market's record 60-point September drop. In November, NHK, the Japanese national broadcasting network, devoted a special program to the U.S. market. "I think that was a turning point in Japanese awareness," says Okada.

Now, the Japanese are third behind Great Britain and Switzerland in foreign equity investment in the U.S., and increasing their holdings at a faster pace. The $17 billion that flowed in last year through September was more than twice the total for all of 1985 and many times the $2.7 billion of 1984. If the yen remains stable, Okada believes the Japanese could put at least $25 billion into U.S equities this year. P. Maureen White, manager of international research for The First Boston Corp., wouldn't be surprised if it's much more, perhaps $34 billion.

The fact is, the U.S. stock market has become a better buy for the Japanese than their own *(see page 81)*. The Nikkei Dow Jones Index of Japanese stocks gained 42% in 1986. Price/earnings ratios on the TSE are at astronomical levels of fifty or sixty compared with about seventeen in the U.S. Moreover, the average yield on U.S stocks is about 3.4%, versus about 0.6% for Japanese stocks.

Too, the government raised the limit on Japanese institutional investment outside the country from 10% of total portfolios to 30%.

Although U.S. brokers and investment bankers are steadily gaining visibility in Japan—so far fourteen American investment banks have set up shop in Tokyo—the Big Four (Daiwa, Nomura Securities, Nikko Securities and Yamaichi Securities) are still the brokers Japanese listen to, says one Wall Street analyst. "It's one thing for Merrill Lynch to tell Japanese investors to put their money into U.S. equities, but it didn't happen until Daiwa and Nomura said so," he says.

Substantial Japanese investment in U.S. equities will continue, says Okada, as long as the necessary conditions exist: A stabilized yen, the lower dollar, the high prices of Japanese stocks and the expanding presence of Japanese investment firms in New York. Only a catastrophe in the market would shut off the flow otherwise, he says. And even then, it would not be permanent. The Japanese, he says, are in the U.S. stock market to stay. ■

NOT MADE IN JAPAN

The number of U.S. issues on the Tokyo Exchange more than doubled in the past year, with the fourteen trading for the full year showing a 186% rise in volume.

	TRADING VOLUME JANUARY 1987	JANUARY 1986
American Express	3,576,300	•
Dow Chemical	1,769,200	57,800
Disney	1,721,450	358,050
Merrill Lynch	1,379,500	296,600
IBM	847,890	350,580
Citicorp	799,100	1,299,600
PepsiCo	763,500	•
Philip Morris	620,650	108,370
Sears, Roebuck	414,650	85,250
McDonald's	414,160	•
Exxon	312,700	•
Weyerhaeuser	311,700	•
First Chicago Corp.	294,400	15,600
Waste Management	285,750	•
Procter & Gamble	275,500	•
US West	271,300	•
Eastman Kodak	209,300	•
FPL Group	195,700	•
Eli Lilly	166,200	•
RJR Nabisco	140,000	•
Bell Atlantic	132,750	•
General Motors	83,250	18,400
3M	64,280	15,860
Chrysler	46,300	•
Ameritech	41,250	•
E.I. duPont de Nemours	27,000	•
SmithKline Beckman	24,550	•
ITT	21,700	81,400
Security Pacific	18,950	26,050
Bank America	9,700	62,500
IU International	8,600	•
Chase Manhattan	2,500	27,150

• Not traded in Jan. 1986 Source: Tokyo Stock Exchange

C O R S I C A

Picture the economies of a compact car. Now picture them with total leg room within tenths of an inch of the most popular *mid-size* car.

Picture power, comfort, smoothness, space and quiet.

Picture rounded glass and doors that wrap up into the roof. In the most aerodynamic sedan ever from Chevrolet.

Introducing Chevy Corsica. A car so new it will not only raise your expectations of what a compact fleet car can be. But what your next fleet car can be.

And give you another reason why, when it comes to business, fleets do more business with us than with anybody else.

THE Heartbeat OF AMERICA

WHO'S INTRODUCING A NEW COMPACT COMFORT AND RIDE IT'S ALREADY BEING

CHEVROLET

into eight different currencies. "We started off in fixed-rate dollars and ended up in floating-rate yen," he says. "We look globally when we decide to borrow money."

Clark's job is made easier by American Express' big investment in technology. The company spent close to $1 billion last year alone automating its business units. "No, I am not a techie," quips Clark. Nevertheless, he spends much of the day looking at both his Quotron and the management information screen in his office. Technology allows him to see at day's end who owes how much to Shearson, or how much in travelers checks is inventoried in a politically risky country.

Still, Clark believes that the "people skills" of an investment banker are crucial, too. Says he: "It all comes down to knowing your customer and depending on sound business notions that are the fundamentals of finance."

HANS G. STORR
PHILIP MORRIS

In the high-stakes game of international finance, Hans Storr is something of a legend. But he knows the risks on a gut level. As a ten-year-old boy in Depression-era Germany, Storr watched his father pick up the pieces of a bankrupt business. The memory is still very much with him. "What you learn is that there are cycles in inflation, in consumer prices," he says. "It gives you a certain caution. I tend to go with fundamental market moves."

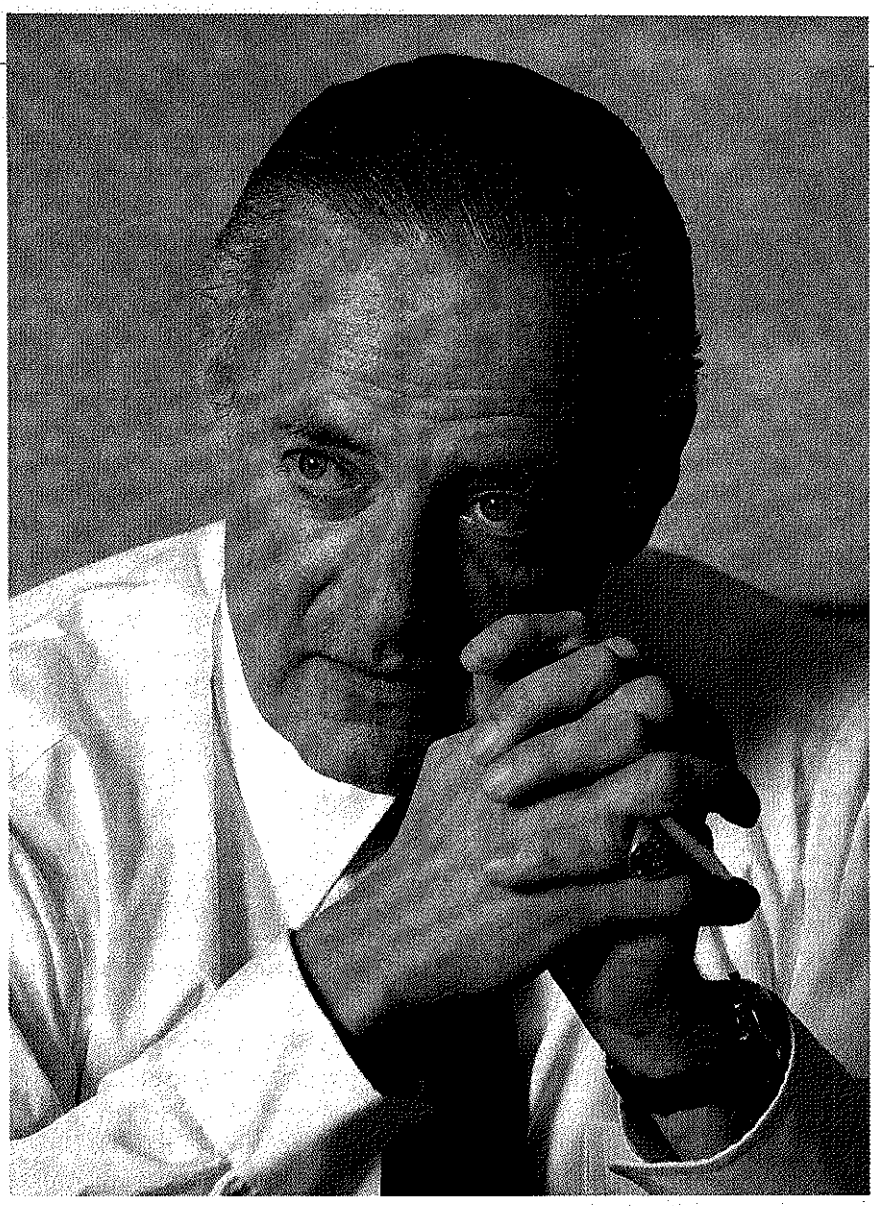
That inbred cautiousness doesn't mean that Storr has automatically shunned debt as chief financial officer of Philip Morris Co. After all, he presided over the $5.6 billion acquisition of General Foods, which ran the company's debt-equity ratio up to 1.69:1 from .63:1. Indeed, it was Storr's ability to forecast interest rates that allowed the thriving consumer products firm to manage so much debt. And one year after the merger, Storr is well on his way to trimming the debt-equity ratio back to his targeted 0.9:1.

Once the decision was made to buy General Foods, Storr's ability to raise money abroad was crucial. Several major American banks turned him down, reluctant to lend such hefty sums without knowing the acquisition target. But for a decade, Storr had been building an international presence by listing the company's stock on eight foreign exchanges and cultivating relationships with foreign banks. Thus he assembled an international syndicate of banks that provided $2.3 billion of the $5.6 billion. That was the breakthrough; U.S. lenders put up the rest.

Storr cut the cost of this money to the bone in ingenious ways. First, he correctly bet on declining interest rates by using variable-rate instruments for about $1.5 billion of the short-term debt. Also he diversified, raising money in everything from Euroyen to Swiss francs later swapped into dollars. "We brought into play every new debt instrument that you could use," he says. The result: At the end of 1986, there was no diminution of earnings from the massive deal.

Storr has been diversifying out of the dollar since it began its decline in February 1985. He doesn't confine himself to the major foreign currencies, but uses offbeat ones like the Australian dollar as well. "Don't do all your financing in yen or deutschemarks," he says. "Keep your eggs apart; don't scramble them."

Storr steers clear of an exclusive relationship with any one investment bank. He solicited five competitive bids, for example, when it came to is-



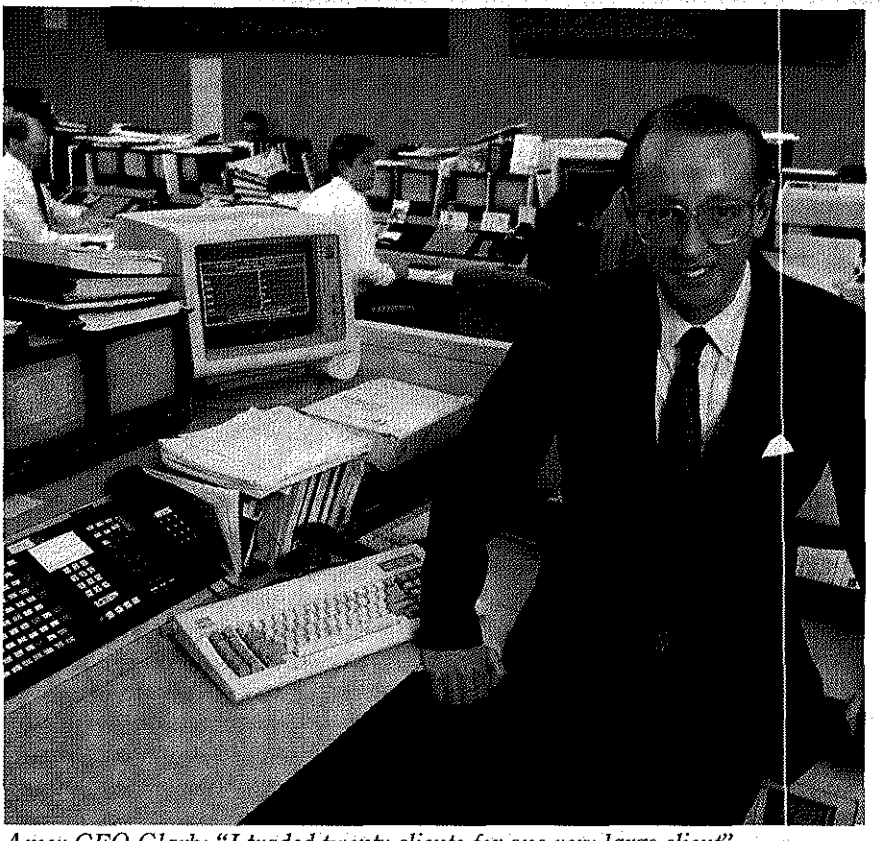
Carbide's Stephenson: "If anyone makes money, it should be our shareholders"

PHOTOGRAPH BY ROE DI BONA

CFOs in The Trenches

Chief financial officers have become the point men in today's corporate combat. The rewards are up—but so are the risks.

by Leah Nathans



Amex CFO Clark: "I traded twenty clients for one very large client"

PHOTOGRAPH BY MARIA ROBLEDO

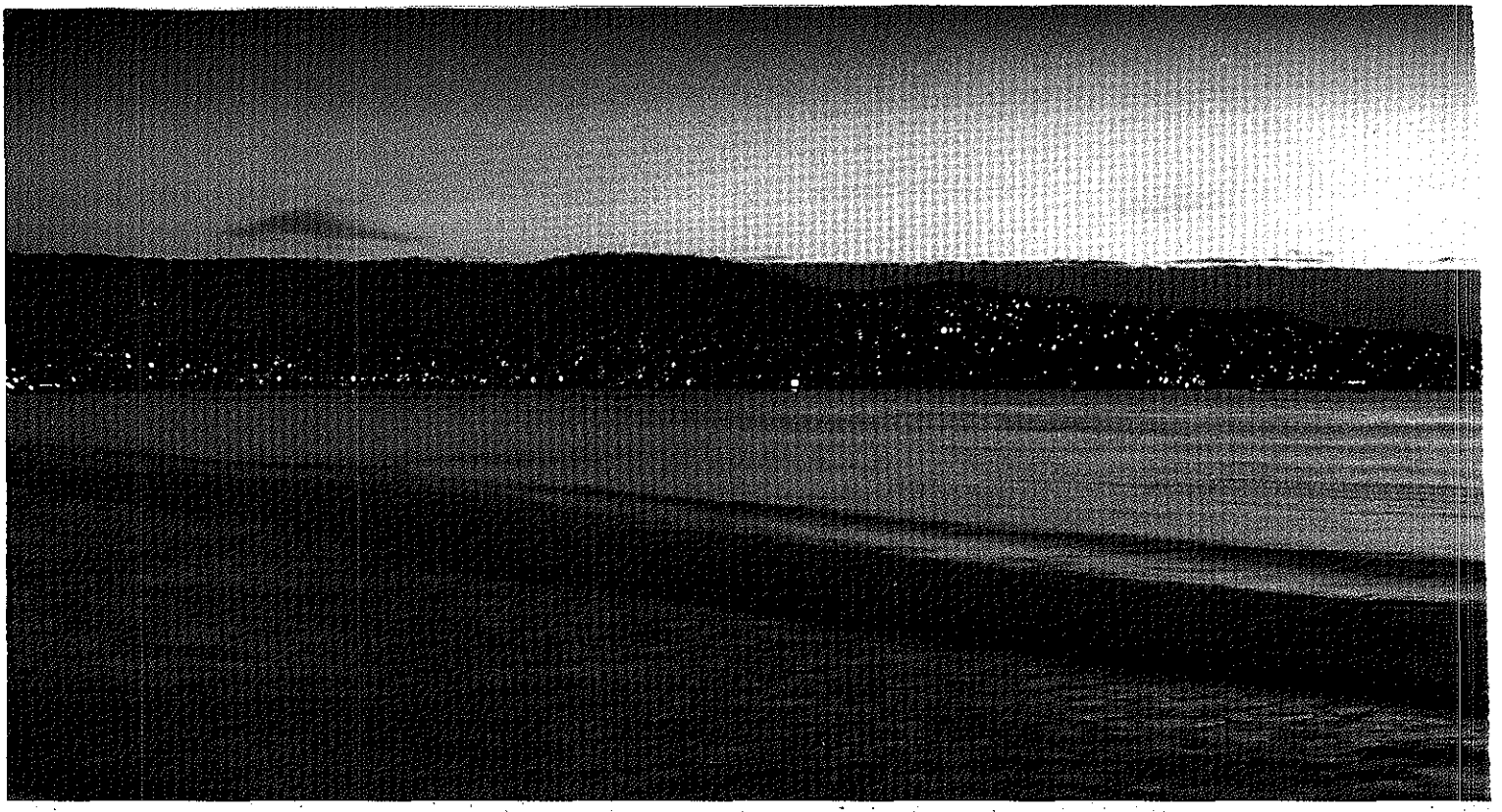
Remember when the lawyers used to fight the takeover battles? Remember when issuing equity or debt largely involved a friendly investment banker who went back decades with the company and whose recommendations you could take even if you didn't totally understand them? Remember when currency trading was a good thing to stay out of?

Ah, those were the days for chief financial officers.

No more. Nowadays, CFOs are the shock troops of corporate combat, the point men in everything from British tax law to the fine print of Wall Street's latest financial products. They are also in charge of the technology that gathers the critical information and data on which companies run these days. And there's not much room for error. With corporate survival often a matter of financial expertise, CFOs "don't have the opportunity to make serious mistakes," says management consultant Gregory Presley of Cresap, McCormick and Paget. If a CFO doesn't understand such minefields as global finance, "he probably won't be there very long," adds headhunter Robert Lamalie of Lamalie Associates, Inc.

Nowhere are the stakes higher than on the takeover front, where a CFO's expertise—or lack of it—in restructuring, stock buybacks, exotic financings and poison pills can put not only his own job at risk, but his boss's—in fact, the very existence of his company. Nor does the CFO any longer have a cradle-to-grave relationship with his investment banker. Companies want their investment bankers to be competitive these days, and a CFO has to be able to evaluate the competitors and the deals they offer.

Then there are the esoteric areas of new legislation, regulation and accounting rules, international tax law or



Trust the Monterey Sheraton to be the perfect host. They trusted us with their telecommunications system.

When a particular item is selling quickly, the computer alerts the buyer to reorder; if an item isn't moving, the computer clues the buyer to discount the price and cancel future orders.

The much faster replenishment of merchandise allows a company to maintain stock on a much more constant basis. "The result of that has been an 25% increase in our sales volume," says CEO Ren Carlisle of Carlisle's, an Ohio department store chain that is using H.O.T., "and that's without any increase in inventory levels."

Carlisle's also has been able to reduce its lead time on stocking inventory by almost a month. "That gives us a much more efficient use of our inventory dollars," Carlisle says.

Although the system is designed for large retailers, Haggar also is offering it to smaller firms, with Haggar handling the bulk of the computer work. So far, five retailers with a total of about 600 stores are plugged into the system. Another twenty are said to be testing it.

Merger Roundup

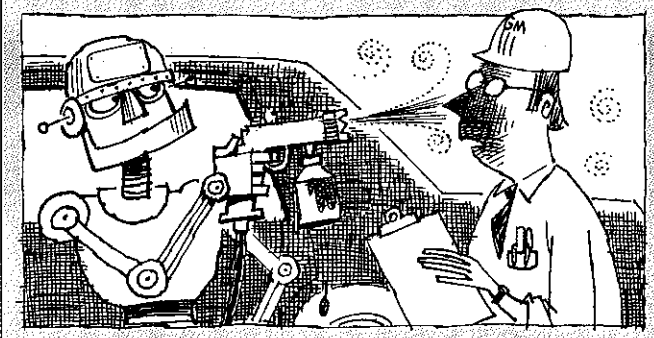
Like Kasper Gutman, the acquisitive fat man in *The Maltese Falcon,* corporate raiders are not easily discouraged. After two months of coveting Owens-Illinois Inc., during which it twice upped its original takeover offer to $60.50 a share, investment firm Kohlberg Kravis Roberts & Co. finally got the diversified packaging company to agree to a $3.6 billion buyout. And Chicago physician LeRoy Pesch, whose $1.7 billion takeover bid for American Medical International Inc. was coldly rebuffed, vowed to continue pursuing the nation's fourth-largest hospital chain.

At long besieged BankAmerica Corp., however, there was jubilation when First Interstate Bancorp. gave up the chase. Deciding that the sale of assets by BankAmerica had lessened its value, First Interstate withdrew its $3.2 billion merger proposal. And Diamond Shamrock Corp. stopped corporate raider T. Boone Pickens' takeover bid with a complex restructuring plan (*page 7*).

Still, a number of mergers came off without a hitch. Stone Container Corp., the world's largest producer of unbleached packaging products, signed a deal to acquire Southwest Forest Industries, Inc., a big maker of linerboard, for $416 million. And Piedmont Aviation Inc.'s outside directors recommended that the carrier accept Norfolk Southern Corp.'s $981 million bid over two proposals from USAir Group Inc. ■

TECHNOLOGY

General Motors Is Now Laying Off Robots, Too



Even the robots are being fired at General Motors Corp. At one of its Michigan assembly plants, GM is replacing the robots that were used to paint car bodies with a new generation of simpler, non-robot painting machines.

The robots followed the car down the assembly line, painting all the while, so that the line would always keep moving. Trouble is, the paint was so splotchy that it had to be evened out by human workers. The new machines remain stationary—as did workers of yesteryear—but the paint adheres to the car more evenly, and workers are needed only to touch up areas around the doors and windows.

Such gaps between automation theory and practice are one reason the outlook for the U.S. robotics industry is far less promising than in years past. Five years ago, industry analysts and executives were predicting sales of $1 billion by 1985. The actual 1985 total was only $442.7 million, and last year was probably even worse, says Donald A. Vincent, executive vice president of the Robotic Industries Association. ■

MARKETING

Southwestern Bell's Tough-Times Ad

If it does nothing else, corporate advertising accentuates the positive. But Southwestern Bell has been getting remarkable consumer response to a television commercial that emphasizes the tough times that have hit the region.

Entitled "Welcome Back," the sentimental TV spot features a small shop owner who had been forced to lay off a long-time employee who was also a friend. But by continuing to advertise in Southwestern Bell's Yellow Pages, the the shop owner's business has improved to the point that he is able to hire his friend back. The spot's tag line: "Southwestern Bell Yellow Pages. It's the best partner a business ever had." The unspoken message: You may lay off your last worker, but don't quit running that ad.

"That commercial was done with the oil markets in mind," explains Don Fisher, Southwestern Bell's media relations manager. And while Bell is not saying how much business the spot has attracted. "There's no doubt people are getting our message," Fisher claims.

The ad has attracted attention from agencies whose clients are feeling the pinch, although no one has followed Bell's lead as yet. Explains Peter Bogda, executive vice president of Dallas' M/A/R/C market research firm, "Ninety-nine out of 100 advertisers would not talk about the bad. It's not the accepted position." ■

FREE INFORMATION BUSINESS MONTH

Literature on products advertised and featured in this issue is available free from the companies listed below. Just circle the numbers on the attached postcard that correspond with the products or companies you are interested in.

PRODUCTS & SERVICES

1 AGS Computers
2 Atlantic Aviation
3 Chevrolet Fleet Sales
4 Hitachi America Ltd.
5 Mitel
6 NCR Corporation
7 Oldsmobile Cutlass Ciera
8 Xerox Corporation

PLANT SITE

9 Delaware Development Office
10 Louisiana, State of
11 Michigan Department of Commerce
12 Missouri Division of Community & Economic Development
13 Netherlands Foreign Investment Agency
14 New Jersey Department of Commerce & Economic Development
15 Puerto Rico, Economic Council of
16 Southern Indiana Gas & Electric Co.

ANNUAL REPORTS

17 Leybold-Heraeus GmBh

BUSINESS MONTH

NO POSTAGE NECESSARY IF MAILED IN THE UNITED STATES

BUSINESS REPLY MAIL
FIRST CLASS PERMIT NO. 0487 NEW YORK, NY

POSTAGE WILL BE PAID BY ADDRESSEE

ATTN: EVELYN HURDY
BUSINESS MONTH
FREEFAX MAIL SYSTEM
875 THIRD AVENUE
NEW YORK, NY 10022

BUSINESS MONTH/ FREEFAX MAIL SYSTEM

MARCH 1987

Please send the information corresponding to the circled numbers below:

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30

TITLE (Please check)
A ☐ Chairman of the Board
B ☐ President
C ☐ Vice-President
D ☐ Treasurer/Secretary
E ☐ General Manager
F ☐ Division Manager
G ☐ Department Manager
H ☐ Management, other
J ☐ Controller
K ☐ Other:_____

Are you currently a Business Month subscriber? ☐ Yes ☐ No

Name_____ Title_____

Company_____

Address_____

City_____ State_____ Zip_____

Telephone #_____

CARD VOID AFTER 6/15/87

THE MONTH'S ACTION Jan. 15-Feb. 13

	Close	Point Change	Average Daily Volume in Millions
DOW JONES *Industrials*	2183.35	+112.62	—
NYSE *Composite*	159.56	+7.47	244,093
AMEX	316.25	+23.75	19,092
NASDAQ *Composite*	412.48	+19.91	199,045

Insider Scandal Spreads

The path from Ivan Boesky has led to the arrest for insider trading of three top Wall Street professionals.

Martin Siegel, a former takeover specialist for Kidder, Peabody & Co. and lately cohead of mergers and acquisitions at Drexel Burnham Lambert, says he sold tips on takeovers to Boesky and swapped information with Goldman, Sachs & Co. For this, he was fined $9 million and barred for life from the securities business.

Siegel also informed on others, naming Robert M. Freeman, 44, head of arbitrage for Goldman, Sachs; Richard B. Wigton, 52, a senior arbitrageur at Kidder, Peabody and Timothy L. Tabor, 33, a former arbitrageur at Kidder, who until January was head of arbitrage trading at Merrill Lynch & Co.

The growing circle of individuals and firms threw new doubt on the privacy of corporate information in takeover battles. Chief financial officers, shocked at the prestigious Wall Street names that are involved, say that the revelations will affect their choice of investment bankers. "The whole investment banking business depends on mutual trust," says Arden Engebretsen, CFO of Hercules, Inc. "All you can do, really, is hope that you have put your trust in the right people." ■

INTERNATIONAL

After the Guinness Scandal: An SEC in Britain?

The City of London's thriving financial community has traditionally set great store on self-regulation. But the recent Guinness scandal has stirred widespread demands for tougher regulation and the establishment of a U.S.-style Securities and Exchange Commission.

The affair dates back to late 1985 when the Argyll Group plc made an unwelcome takeover bid for whiskey-producer Distillers plc. In January 1986, brewing group Guinness plc stepped in with a competing offer and three months later a sharp rise in its stock price helped its bid to succeed. Now, however, Guinness and its investment advisers are being investigated for stock manipulation. Guinness is alleged to have bribed Ivan Boesky, Switzerland's Bank Leu and other major market players to buy Guinness shares at crucial times during the battle for Distillers.

The pro-free-market Conservative government has thus far rejected calls for more regulation of Britain's financial community. But as the investigators unearth more misdeeds at Guinness, the pressure for a more effective regulatory system is mounting. And the opposition Labour party says it will establish an independent watchdog agency if it wins the general election expected later this year.

Kohl's Dilemma

West Germany's center-right coalition government was reelected on the slogan "Don't meddle with prosperity." But conservative Chancellor Helmut Kohl will need to do plenty of tinkering if he is to keep Europe's strongest economy booming.

Although Bonn policymakers still officially insist that last year's performance—a record $51 billion trade surplus, zero inflation, consumer spending up 4.1% and a 2.5% rise in real GNP—can be repeated this year, they privately admit it is unlikely. The surging deutschemark (up 50% against the dollar over the past twelve months) is sapping demand for German goods abroad, while slowing consumer spending (a modest 2% increase is forecast this year) is beginning to hurt at home. Says Frankfurt economist Eberhard Baer: "The five-year economic recovery looks set to peter out. Growth could be down to 1% this year."

As a result, Kohl is being urged to reflate the economy. European politicians are pressuring him to introduce Reagan-style tax cuts in a bid to stimulate domestic consumption and slash the trade surplus. U.S. trade officials want interest rates cut.

Cautiously unadventurous by nature and worried about the inflationary impact of any expansion program, Kohl would prefer to sap demand by trimming the government's huge social welfare expenditures. But faced with mounting pressure at home and abroad, he is expected to compromise and push forward modest tax cuts originally scheduled for 1988. "That will stimulate demand and keep the economy growing this year," Baer says. "But ultimately, Kohl will have to introduce wide-ranging economic reforms or preside over an economy that is slowly grinding to a halt." ■

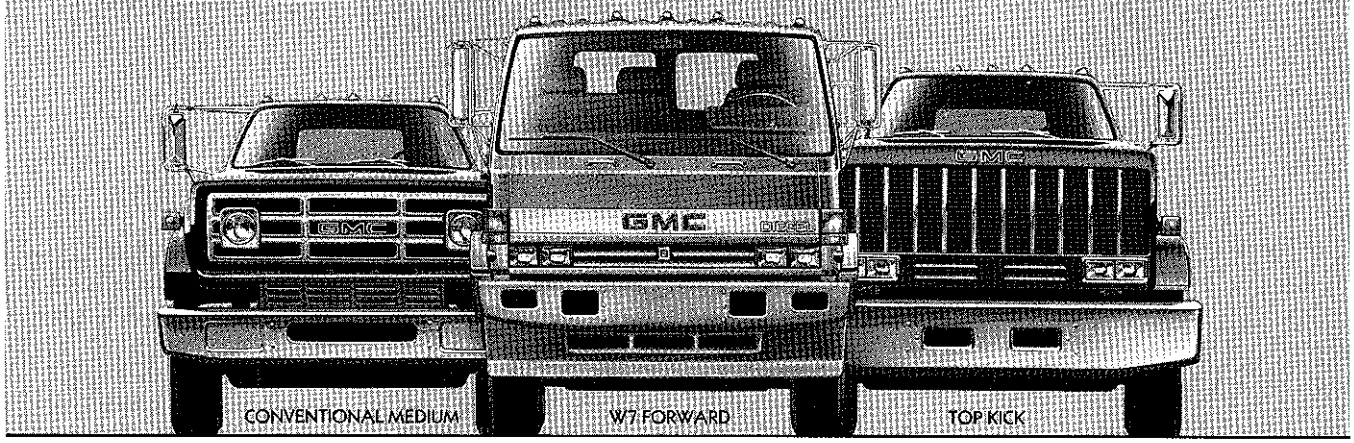
Helmut Kohl: Economic reform or stagnation

WIDE WORLD

GMC TRUCK

GREAT RATES

ON MEDIUM AND HEAVY DUTIES



7.9% Annual Percentage Rate GMAC Financing*

NEW GMC TRUCKS
On all new and unused 1987 and prior year Medium Duty Conventionals, Top Kicks, Heavy Duty Astros, Brigadiers and Generals. Also available on new 1986 and prior year W7 Forward models.

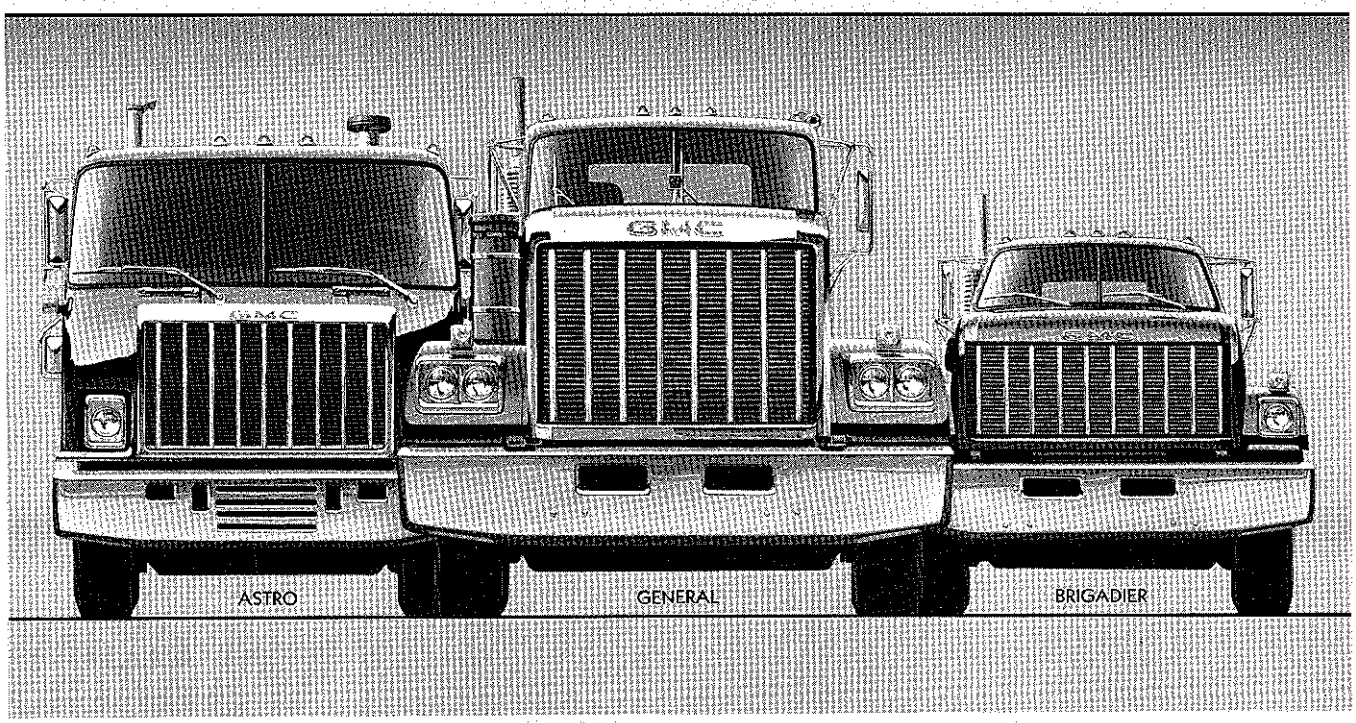
9.9% Annual Percentage Rate GMAC Financing*

USED TRUCKS
On all used GM Medium and GMC Heavy Duty trucks financed through GMAC and delivered from stock. See your GMC Truck Dealer for details.

If you have been waiting for a great financing opportunity on a new GMC Medium, Heavy or Used GM Truck, get on down to your participating GMC Medium or Heavy Duty Truck Dealer today. They've got the trucks, options, and financing to get you on the road fast.

CASHBACK OF $1000.00...On new 1986 and prior year W7 Forward Models you may select the 7.9% financing or $1000.00 cashback on W7 models delivered on or before January 31, 1987, (April 30, 1987 on W7R042HV models).

* You must take delivery from dealers' stock by March 31, 1987, (January 31, 1987 on W7R042 and April 30, 1987 on W7R042HV models). See your participating GMC Truck Dealer for qualification details. Dealer financial participation may affect consumer cost. Fleet sales not eligible.



make the deal worthwhile to customers.

Detroit's Warranty War

On top of rebates and cheap financing, Detroit is trying still another ploy to get John Q. Public to buy a car: the extended warranty.

The warranty war was kicked off by General Motors in January with a six-year, 60,000-mile warranty on the powertrain (engine and transmission) and six-year, 100,000-mile corrosion protection. Ford Motor matched the GM offer. And Chrysler, which had been offering a five-year, 50,000-mile warranty since 1982, raised the stakes to seven years and 70,000-miles and added a seven-year, 100,000-mile rust-proofing warranty.

Upping the ante further, GM then announced a seven-year, 100,000-mile warranty for the Cadillac Allante that covers the powertrain and all major components and parts and even provides a rental car while repairs are being made.

The extended warranties are, of course, still another desperate gimmick by the automakers to stimulate business. During January, GM's sales plunged 61%, Chrysler's 47% and Ford's 40.5%. Meanwhile, their inventories are bulging—up to a 100-day supply for some GM models.

Unlike the low-cost financing offered last fall, extended warranties are not particularly costly for the carmakers in the short-term. Moreover, the money to cover them will be placed in a fund, and industry executives figure the interest on that money will cover extra warranty costs. The big losers will be auto dealers who pick up a few extra bucks offering rust-proofing as an option and independent mechanics who do the bulk of auto repair work once warranties expire. ■

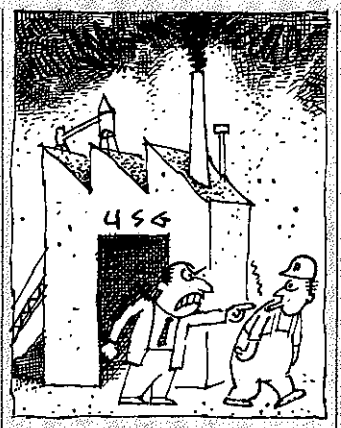
MANAGEMENT

USG's Smoking Ban: Some Tough Civil Liberties Issues

USG has banned smoking by its workers not only on the job but anywhere else. This laudable sounding action, however, is probably prompted by some other motivation than winning plaudits from the Surgeon General. A tip-off: The ban applies only to the company's USG Acoustical Products Co. unit, where workers are exposed to glass and woolen fibers—not to office workers in company headquarters.

That suggests USG wants to limit liability in future damage claims like the asbestos suits that put Manville Corp. into Chapter 11. USG itself has been a defendant in many of the 40,000 asbestos lawsuits filed to date. If factory workers quit smoking, then any damage that they suffer from inhaling industrial fibers might be moderated—or at least USG could claim so in court.

But can USG get away with interfering in the private lives of its employees? The company plans to require workers to take periodic lung function tests to make sure they are not sneaking a smoke at the corner bar or at home. That's not "illegal per se" for a private company, says Jay A. Miller, executive director of the American Civil Liberties Union of Illinois, although it would be unconstitutional if the government tried to do it.



Even so, USG may have challenges to its ban. Smokers could contend that they are addicts and that the company is violating the laws protecting the handicapped. And because more blacks smoke than whites, even racial discrimination could be argued.

Downsizing GM's Annual Report

Many investment experts are disturbed, if not outraged, by the Securities and Exchange Commission's decision to let General Motors Corp. and presumably other companies issue "summary" annual reports—that is, minus the audited financial statements. Surprisingly, there is no law that requires companies to send out annual reports.

Claiming it wished to help unsophisticated investors, GM asked the SEC if it could send stockholders a summary with financial highlights, basic financial statements, an accountant's report and a narrative discussion of the data in lieu of a full annual report. Since such a report satisfies none of the SEC's filing requirements, GM proposed to do that in a press release containing full audited financial statements; in the 10K filed with the SEC; and in a supplement to the proxy materials.

But most experts hate the idea. They point out that editors truncate long press releases and that shareholders get to see the 10K only by writing for it. Says Professor Abraham Briloff, the accounting expert: "I think the shareholders are being shortchanged. Most of them don't read proxies and won't send for the 10K. It might be different if everything were going well at GM, but in the wake of the Perot affair, this is no time for them to resort to a short form."

Nor is it just individuals who use annual reports. "I work with many institutional investors, and believe me, they read annual reports very carefully," says Robert Amen, an investor relations consultant in Greenwich, Connecticut. "A terse summary isn't enough. Dropping the annual is a big mistake." Mark A. Steinkrauss, director of investor relations for Digital Equipment Corp., agrees. "We want to give our stockholders more information, not less," he says.

The summary report has been talked about for years. Deloitte Haskins & Sells studied the pros and cons in 1983

siana, Texas and other petroleum-producing states, and also reactivate export markets for American firms in oil-producing countries.

The consensus among economists is that the economy will gain strength as the year progresses: the fifty economists polled last month by *Blue Chip Economic Indicators* foresee real output growing by only 1.7% through March, but moving ahead at a relatively healthy 2.9% clip by the last quarter of the year.

But the price for this good news is higher inflation. After rising by only 1.9% last year, consumer prices may jump by 4% or more in 1987. Fairly stable wages have been a major boon to U.S. manufacturers since 1984. If inflation forces wages up, American industry will lose many of the competitive advantages of a lower dollar.

Jim Baker's Dollar Strategy

The recent sharp slide in the dollar has created an air of crisis in the international currency markets and a sense of outrage in both Bonn and Tokyo, which are bridling at U.S. pressure to stimulate their economies.

With the dollar now worth about 150 yen and about 1.80 deutschemarks, economists believe the U.S. currency is just about where it should be. And Federal Reserve Chairman Paul Volcker has warned that a further slide could set off another U.S. inflationary spiral. Yet Treasury Secretary James Baker continues to orchestrate a dollar decline to both bring pressure on Japan and Germany and to demonstrate to the protectionists in Congress that the Administration is doing something about the massive U.S. trade deficit.

At press time, the Group of Five leading industrial nations (Great Britain, France, the U.S., Japan and West Germany) were about to hold an emergency summit meeting in Paris to discuss the situation. Baker has been privately pressing the G-5 nations to establish "reference ranges" for the dollar, deutschemark and yen. The G-5 nations would then intervene to keep the currencies within the set limits. If the Treasury Secretary's proposal is ultimately accepted, it would be the first significant step back towards fixed exchange rates since the Bretton Woods system was abandoned in 1973.

But both Tokyo and Bonn are resisting the idea. The likely short-range solution: The Japanese and Germans will make some modest pledges to stimulate their economies and Washington will stop talking down the dollar. This will buy time and stop the dollar slide, which is beginning to concern the Reagan Administration.

James Baker

WIDE WORLD

Weak Dollar Strengthens Profits

The declining dollar was supposed to help U.S. companies compete. And it is. Economists are forecasting steadily rising corporate profits this year, culminating in a 12%-to-15% increase in the fourth quarter over the generally strong earnings recently reported for the fourth quarter of 1986. The weak dollar, they say, is a major reason.

It's not that American companies are selling that much more abroad. They're selling more at home—expanding their U.S. market share at the expense of higher-priced imports. Major beneficiaries include paper, chemicals and consumer durable goods. Pharmaceuticals are also expected to benefit substantially. The construction industry is a mixed bag—strong earnings for firms that build single-family homes, not so strong for commercial and multi-family building.

To some extent, almost every U.S. industry is expected to share in this pleasant experience—except automobiles. "American auto companies are just not well run," says Lacy H. Hunt, chief economist with Carroll McEntee & McGinley. ■

INDUSTRIES

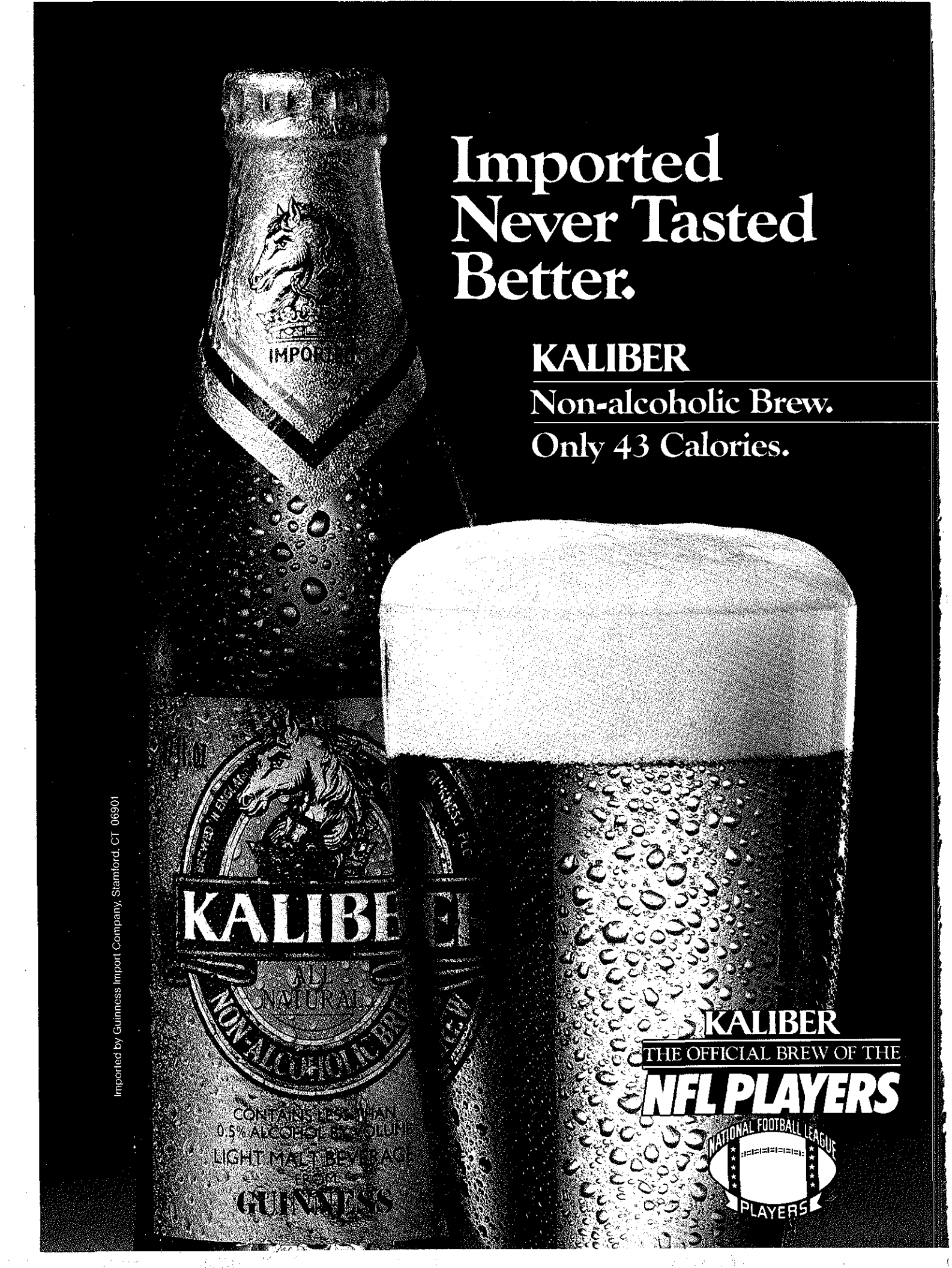
Some Attractive New Toys For the Baby Bells?

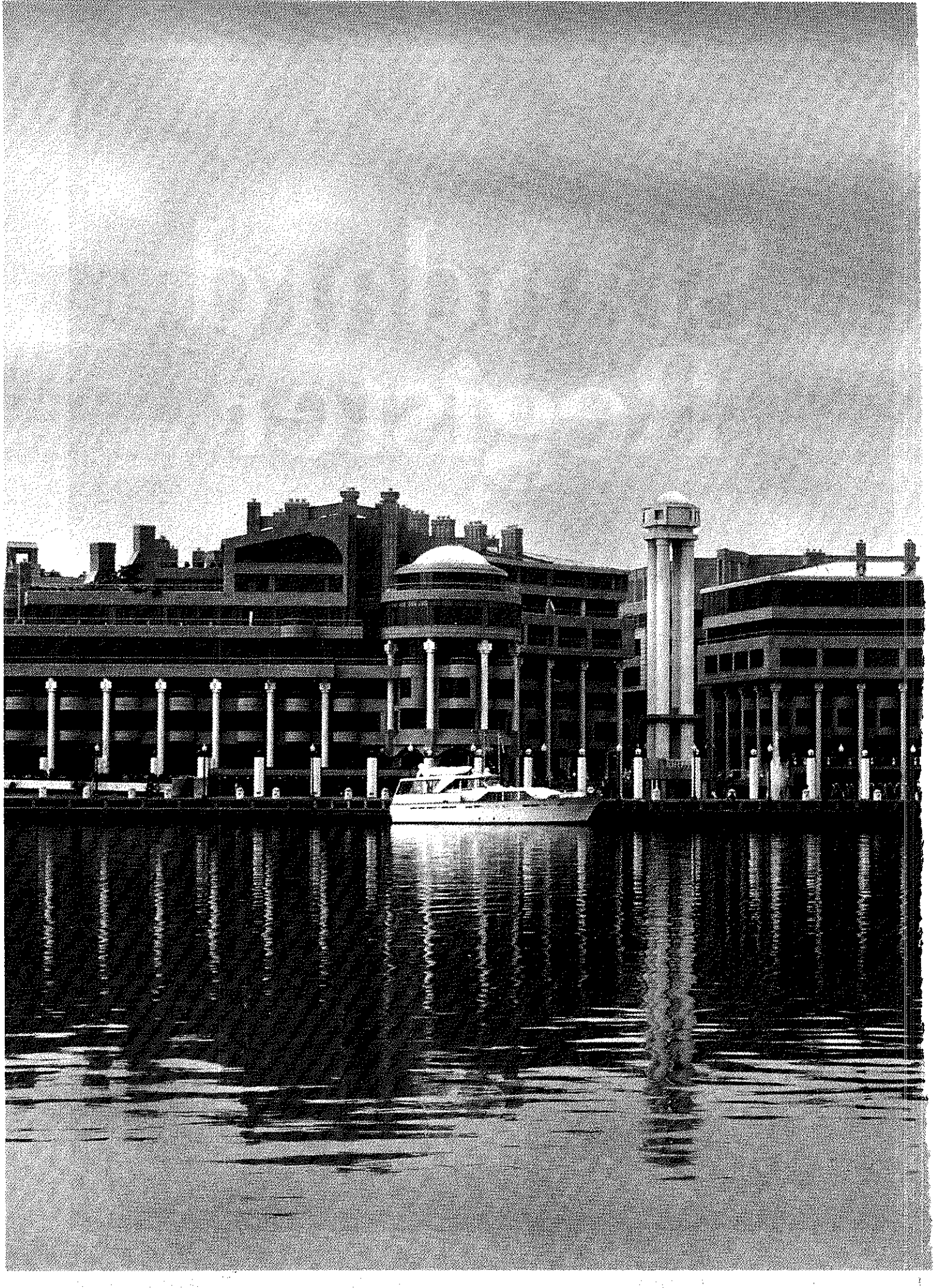
The Baby Bells are anticipating an early Christmas. This spring, Judge Harold Greene will rule on whether the seven regional telephone companies spun off from the old Bell system will be permitted to manufacture telephone equipment, offer long-distance service and transmit data. Industry watchers believe that Greene—the man who broke up AT&T—will okay the making of equipment, but will hold off on the long-distance question until next year, and on information services until 1990.

Analysts expect the Baby Bells to get into the equipment business without delay once the approval is given. "They all have very strong cash flow," says Philip J. Sirlin of Sanford C. Bernstein & Co. "So they will have the money to enter this new business quite readily." Because the equipment field is so competitive, though, profit margins are expected to be skinny.

Long-distance service could be significantly more profitable. "They probably will provide only regional service and only to big, special customers such as state governments and big corporations," says analyst Fritz Ringling of the Gartner Group. Most of those lines are already in place.

As for data services, two big issues must be resolved before they could get the go-ahead. Because the operating companies control the lines over which their own and their competitors' data would be transmitted, the question of whose traffic has


Imported
Never Tasted
Better.
KALIBER
Non-alcoholic Brew.
Only 43 Calories.
KALIBER
ALL NATURAL
NON-ALCOHOLIC
CONTAINS LESS THAN 0.5% ALCOHOL BY VOLUME
LIGHT MALT BEVERAGE
GUINNESS
KALIBER
THE OFFICIAL BREW OF THE
NFL PLAYERS
NATIONAL FOOTBALL LEAGUE
PLAYERS
Imported by Guinness Import Company, Stamford, CT 06901



BUSINESS MERGER

THE EPSON® EQUITY™ II COMPUTER AND LQ-1000 PRINTER

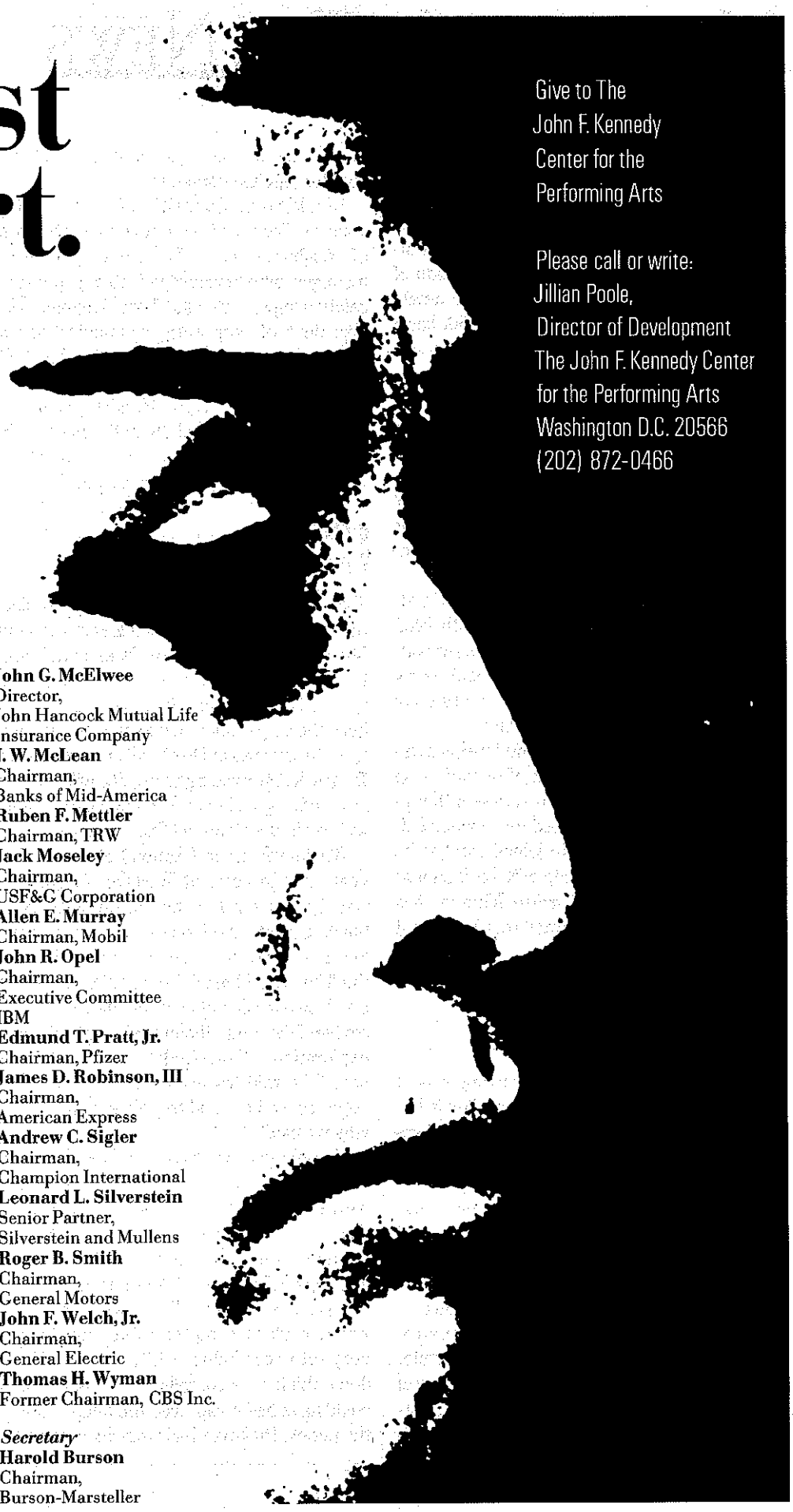
A perfect match for business productivity.
Here's a real performance team: the Epson Equity II personal computer paired with Epson's new LQ-1000 wide-carriage printer. Equity II gives you 640KB standard IBM®-compatibility and power to spare. Plus a list of features you'd pay extra for in other computers. Meanwhile, the LQ-1000 gives you results. With 24-pin letter quality output that will astound you. And fast draft speed with just the touch of a button.

Speed and ease of use are built into the entire Epson printer line. That's why they're America's business choice. All our products are built to the same rigorous standards of reliability that have made Epson an industry leader in computer products for over a generation. Visit your authorized Epson dealer to find out more about how a complete Epson system can work for you.

EPSON®

OFFICE AUTOMATION, INC.
7300 Pearl Street
Bethesda, MD
301/951-3600

Invest in Art.



Give to The John F. Kennedy Center for the Performing Arts

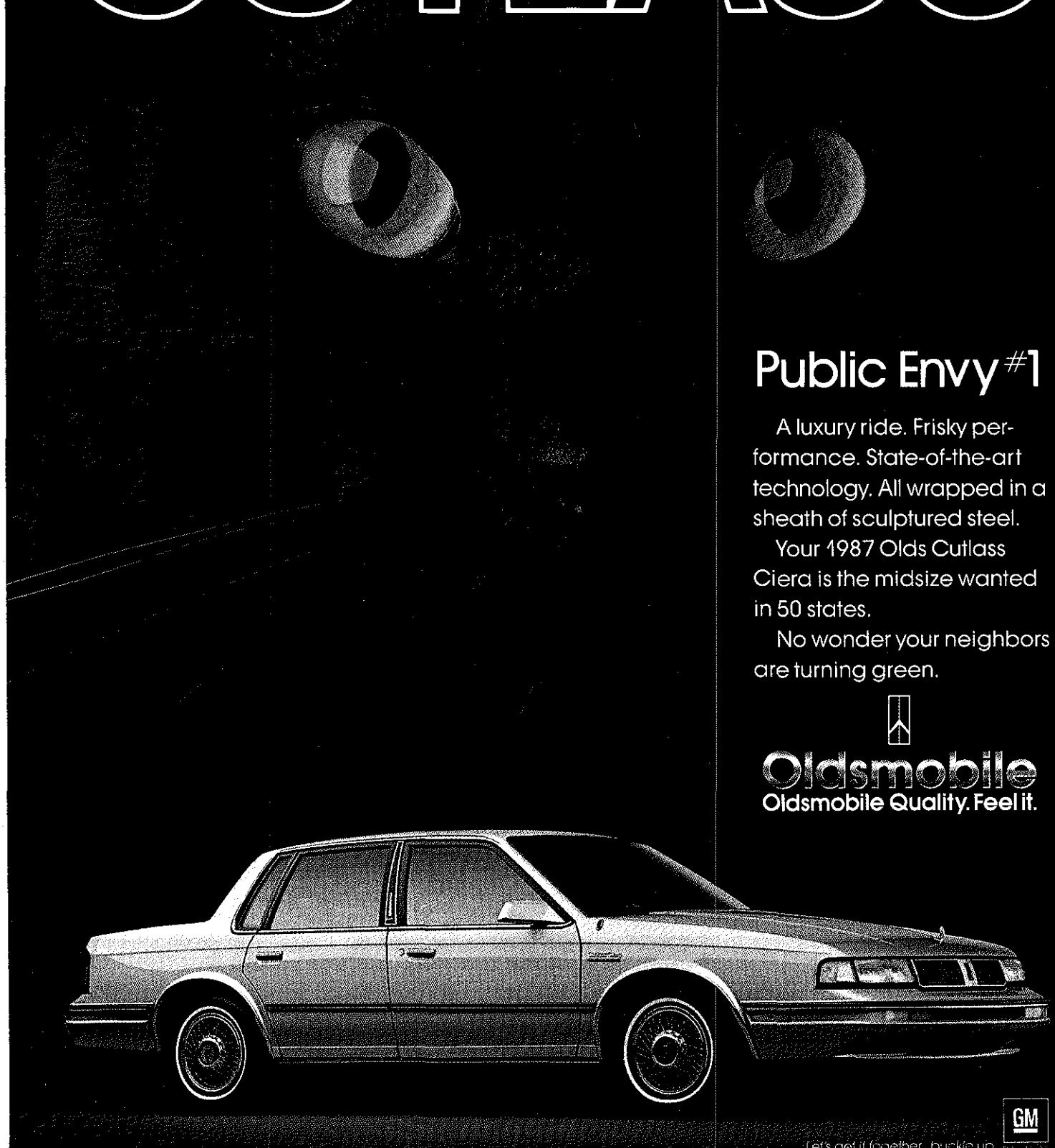
Please call or write:
Jillian Poole,
Director of Development
The John F. Kennedy Center
for the Performing Arts
Washington D.C. 20566
(202) 872-0466

Chairman
1986 Corporate Fund
James E. Burke
Chairman,
Johnson & Johnson

Vice Chairmen
Stephen D. Bechtel, Jr.
Chairman,
Bechtel Group
Robert A. Beck
Chairman,
Prudential Insurance
Theodore F. Brophy
Chairman, GTE
Charles L. Brown
Former Chairman, AT&T
John L. Clendenin
Chairman, BellSouth
Lodwrick M. Cook
Chairman,
Atlantic Richfield
Donald F. Craib, Jr.
Chairman, Retired
Allstate Insurance
John J. Creedon
President,
Metropolitan Life Insurance
Thomas H. Cruikshank
Chairman, Halliburton
James L. Ferguson
Former Chairman,
General Foods
John H. Gutfreund
Chairman,
Salomon Inc
John R. Hall
Chairman,
Ashland Oil
Robert A. Hanson
Chairman,
Deere & Company
Edward L. Hennessy, Jr.
Chairman,
Allied-Signal
William R. Howell
Chairman,
J.C. Penney
Edward G. Jefferson
Finance Committee
Chairman, DuPont
David T. Kearns
Chairman, Xerox
James L. Ketelsen
Chairman, Tenneco
Charles F. Knight
Chairman,
Emerson Electric
Howard M. Love
Chairman,
National Intergroup
John G. McElwee
Director,
John Hancock Mutual Life
Insurance Company
J. W. McLean
Chairman,
Banks of Mid-America
Ruben F. Mettler
Chairman, TRW
Jack Moseley
Chairman,
USF&G Corporation
Allen E. Murray
Chairman, Mobil
John R. Opel
Chairman,
Executive Committee
IBM
Edmund T. Pratt, Jr.
Chairman, Pfizer
James D. Robinson, III
Chairman,
American Express
Andrew C. Sigler
Chairman,
Champion International
Leonard L. Silverstein
Senior Partner,
Silverstein and Mullens
Roger B. Smith
Chairman,
General Motors
John F. Welch, Jr.
Chairman,
General Electric
Thomas H. Wyman
Former Chairman, CBS Inc.

Secretary
Harold Burson
Chairman,
Burson-Marsteller

CIERA CUTLASS



Public Envy #1

A luxury ride. Frisky performance. State-of-the-art technology. All wrapped in a sheath of sculptured steel.

Your 1987 Olds Cutlass Ciera is the midsize wanted in 50 states.

No wonder your neighbors are turning green.

Oldsmobile

Oldsmobile Quality. Feel it.

GM

Let's get it together. buckle up.

AGS knows . . .
one mind can influence an entire organization.

Just as the skipper of a yacht charts his crew to victory, strong leadership in building strategic systems gives a corporation the winning edge. To achieve competitive superiority, many of the world's largest and most dynamic organizations have chosen AGS consultants to design, build and maintain their information processing systems.

The 1,800 professionals at AGS have been instrumental in developing today's most challenging and complex systems. Their knowledge and expertise have played a key role in designing the computer systems for the most recognized names in computer manufacturing, telecommunications, financial services, manufacturing and government agencies.

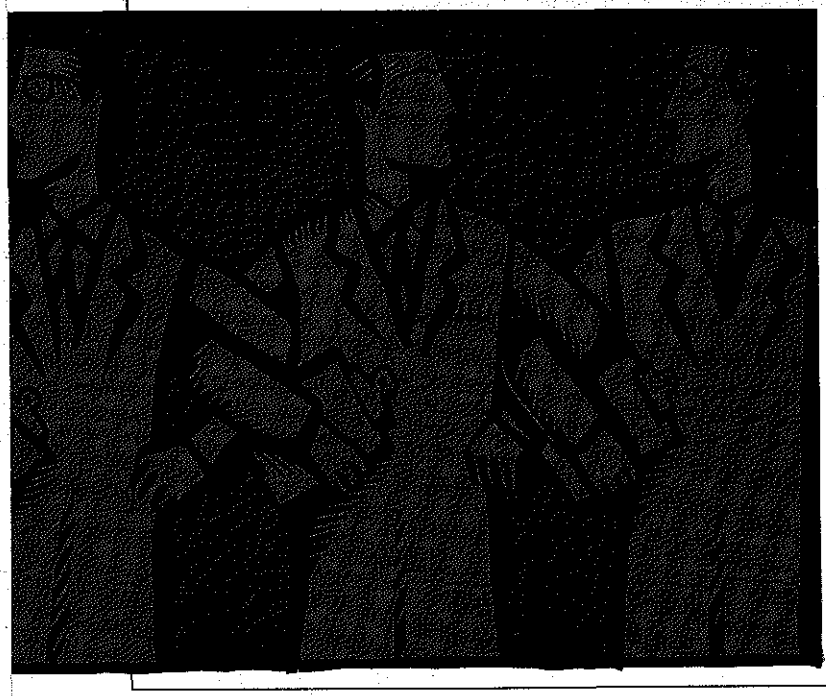
To find out how your organization can benefit from a strategic system, send for our brochure, "In systems development..." Write AGS Information Services, Inc., 1139 Spruce Drive, Mountainside, New Jersey 07092.

33 offices throughout the United States and Europe.
Also serving the Federal Government marketplace.

AGS

BUSINESS MONTH

Feature Departments



49

COVER PHOTOGRAPH BY ROB KINMONTH

WHO

YOU:

Accountant, Banker, Baker, Traveling Salesman. Go-getter, Fast-tracker. They can all use the AT&T Card.

In fact, anybody who travels a lot can benefit from it. Because calling with the AT&T Card keeps you close to the people you need to talk to.

The AT&T Card will free you from coins and delays, give you an itemized record and AT&T's lowest rates for state-to-state calling, next to direct dialing. It costs less than calling collect, or making coin calls out-of-state. And you can use it to call almost anywhere in the world and to call home from many foreign locations.

So, if you travel a lot, get the AT&T Card and plug into the AT&T Long Distance Network. It's as simple as dialing

1 800 CALL ATT, Ext. 229.

AT&T

The right choice.