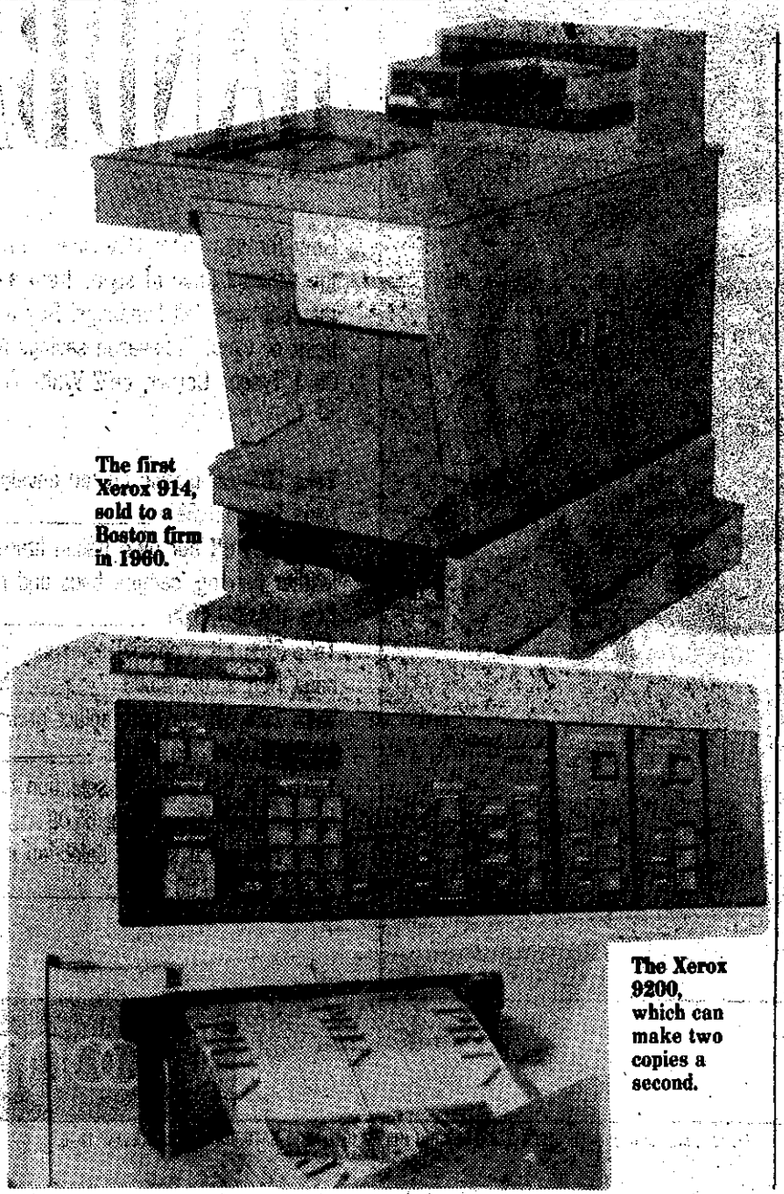
The Deans of Duplication

Celebrating 25 Years Of a Xerox Original

By Michael Kernan
Washington Post Staff Writer



The first Xerox 914, sold to a Boston firm in 1960.

The Xerox 9200, which can make two copies a second.

You never saw so many blue suits.

The Xerox 914 Copier, the original, is 25 years old, and yesterday Xerox Corp. gave a 914 to the Smithsonian.

It wasn't your usual executive lunch: The room was filled with the very men who put that pioneering machine together, designed it, and manufactured and sold it.

This is one of the more hair-raising sagas of American industry, about a modest firm in Rochester, N.Y., named the Haloid Co., with 500 employes and a president named Joseph C. Wilson who was willing to spend—in perfecting and producing an invention that nobody knew for sure was really wanted—more than the firm made for an entire decade.

In the most literal sense, he bet his company on it.

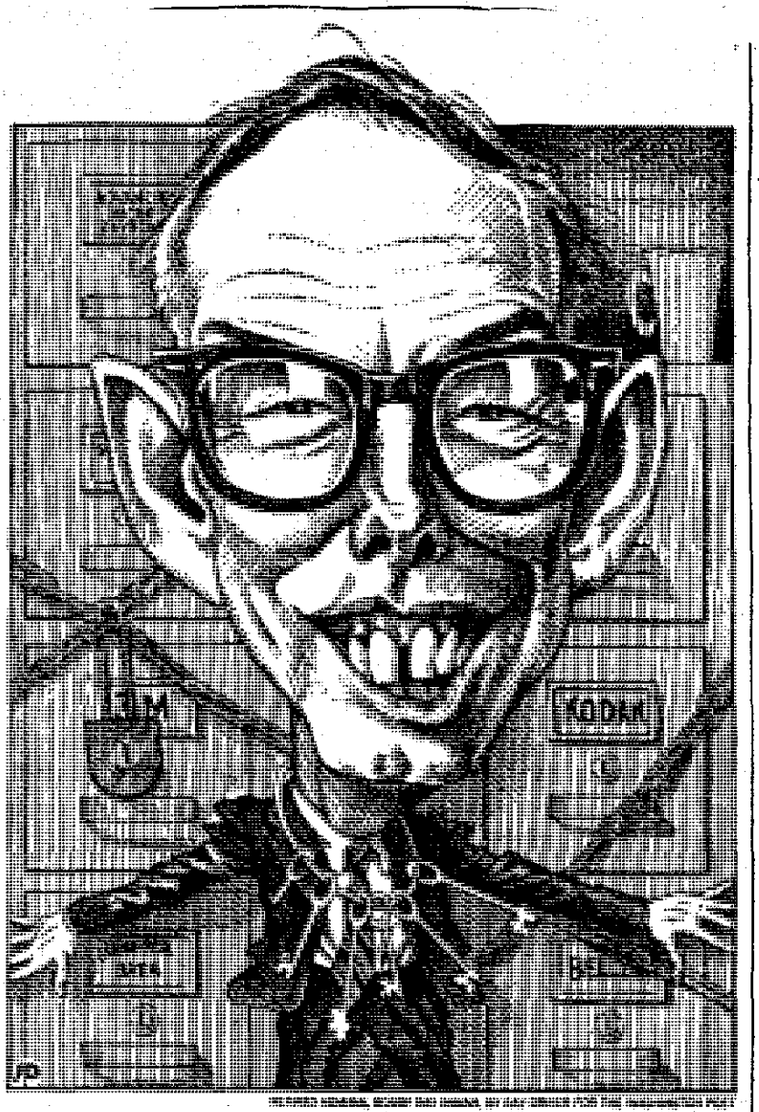
"Joe Wilson found himself," said

See XEROX, B2, Col. 3

Adm. Inman In Command At Consortium

MCC Research Team Ready for Business

By Michael Schrage
Washington Post Staff Writer



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See MCC, D8, Col. 1

The Washington Post 8-21-85

Copying Success

XEROX, From B1

David T. Kearns, the present chairman of Xerox, "in the position of having spent money he didn't have to build a machine he couldn't sell."

He did, however, think of a way to sell it. And created a $27 billion industry. And also made it economically feasible, for the first time in history, to print, just like that, a single copy of anything you wanted on paper.

And when Kearns called the copier "a marvelously free expression of a free society," he wasn't just waving his teeth. For, as one Xerox veteran pointed out, in the Soviet Union, where every sheet from every copier has to be logged, tagged and accounted for, underground literature is reproduced with carbon paper . . .

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In the beginning, there was this inventor.

His name was Chester Carlson, and he was a 29-year-old patent attorney who spent his weekends in a small room over a bar in Astoria, on Long Island, trying to build a copying machine. It was 1938.

Since the word xerography didn't exist, Carlson went to the public library and looked up articles on the ways that light affects matter. Seeking techniques that the big photograpiic companies probably wouldn't have bothered to explore, he hit upon electrostatics as a means of picking up an image and putting it down somewhere else.

But he was no good at lab work. How do you spread melted sulfur on a metal plate while preventing the substance from bursting into flame? Once you get it there, how do you give it an electric charge? Things like that.

Carlson's solution was radically simple: From a job ad in a technical magazine, he hired an unemployed physicist named Otto Kornei to work as long as Carlson could afford him. Within three weeks, on Oct. 22, 1938, Kornei had produced a glass plate with "10-22-38 Astoria" inked on it. He rubbed it with a silk handkerchief, giving it an electrostatic charge, then shone light through it.

The light neutralized the charge except where the inked marks were. When Kornei dusted the plate with powder, grains stuck to the charged areas, and when he laid waxed paper on the plate, the powdered image was transferred.

That historic device is already at the Smithsonian.

Other people had made paper transfers, of course. There were the wet-paper techniques—Thermofax by 3M, Verifax by Kodak—and there was carbon paper, which smudged your fingers. The great thing about Carlson's copies was that they were on ordinary paper . . . and they were dry. That's where the word Xerox comes from, in fact: the Greek *xeros* means dry.



The original Xerox machine and some of its developers, 25 years later.

Carbon paper, the workhorse of the office, was about to become—like the horse—obsolete. But it would take awhile.

For inventor Carlson, all thumbs in the lab, also was no salesman.

"He never came directly to Haloid," said Horace W. Becker, the engineer who helped bring the idea to the production line. "Tried to sell it to several large corporations, but they weren't interested. Then finally, the Haloid people saw something about it in a magazine, and in 1944 Wilson bought limited rights in it."

What did Haloid, a manufacturer of photocopy paper with sales of $5 million a year—and particularly Wilson, its driving force—see in a dry-copy machine? This is the fascinating part: Whatever he saw, it wasn't in sharp outline. It was hazy—a potential, a dream, a hunch. Yet Wilson had absolute, total, out-the-window faith in it: a machine that could make clear, dry copies on ordinary paper must be useful to somebody.

"When I got there in 1959," Becker recalled, "Wilson asked me to estimate what it would cost Haloid to produce this machine; he'd never done any market research himself. I gave my estimate, and the room went very quiet. The company had already spent several times earnings on the thing. So they tried to find someone else to build it."

Bell and Howell said the idea would never fly; the image would blur. IBM called for an Arthur D. Little survey. The survey showed that very little copying was done in the American office, not enough to warrant building more than, say, 5,000 machines.

"What they didn't ask," Becker said, "was: 'Why?' "

Why so little copying was done was that wet-sheet copies were a nuisance and cost 19 to 25 cents each.

"What they really researched was the carbon paper market. Nobody was looking at the possibility of copies being made at point of receipt."

Nobody, in other words, realized that the people who received a memo might want to copy it. In those far-off days, offices were tyrannized by the buck slip, a memo with various names on it that was initialed and passed along. A buck slip could take weeks to circulate through a large office staff.

Wilson pressed on. Over 12 years, Haloid spent $75 million to develop the machine, more than the firm had spent on all of its products in its 40-year history, and twice its earnings from all of its operations in sensitized papers.

When at last Wilson had his product ready to sell, he found himself pitted against Kodak's Verifax and 3M's Thermofax, both selling for under $400 and small enough to fit on a desk top. His new machine sold for $29,500 and was as big as a desk, weighing 648 pounds.

Wilson's solution was almost as ingenious as the Xerox machine itself: He offered to lease it for a mere $95 a month, with the first 2,000 copies free and additional copies costing 5 cents each. Plus, he would make repairs himself. Plus, the user could cancel within 15 days.

"Nobody bought it at first," Becker said. "But there weren't many cancellations, and few repairs. It ran pretty good. We could have done a better job if we'd had two more years, but then there wouldn't have been a company anymore."

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In 1960, Haloid Xerox Inc. changed its name to Xerox Corp. and sold its first 914 to Standard Pressed Steel of Boston. From the first day, the machine was mobbed by users. In the first month it made more than 100,000 copies.

Xerox had stumbled on an astonishing fact: A vast, unsuspected market was sitting right under everybody's nose. It was thought that 5,000 machines would saturate the market. Within two years, Xerox had produced twice that many; by the end of the 1960s, production passed 200,000. And copies: Xerox had figured maybe 10,000 copies a month from an average machine. Right from the start, machines were turning out more than 10 times that number. People in offices all over America were lining up to make copies. Some machines made 5,000 copies a day, and 120,000 a month was nothing special.

Even before the company went on the New York Stock Exchange in 1961, some of the faithful had bought stock. But the engineers, as Becker says, though they believed in the product, "saw only the problems; we weren't sure the company knew what it was getting into. The thing wouldn't feed, the motors wouldn't work, the relays didn't relay, and anyway, we were only going to make 5,000 of them."

As everyone knows, the stock split and split and zoomed out of sight. A share of Haloid Xerox bought over the counter in 1959 for about $100 would be worth something like $3,150 today.

Said Becker: "I didn't buy any, but my wife Gloria bought some on her own, without telling me. I'm very polite to her now."

Incidentally, the 914, named for the 9-by-14-inch paper it could take, ran somewhat better than pretty good. "There are still about 1,600 of them flailing away," Becker said. Of course, at seven copies a minute they are a mite slow compared with the 120 copies a minute the Xerox 9200 is capable of churning out; and the gray-scale reproduction has been improved since the 914, as well as paper-handling ability. Today, Xerox copies can be made for 2.5 cents a click. But the 914 is still around.

Paul A. Strassmann, a former Xerox vice president, is considered the philosopher of copying and has written a book about it. "One way of measuring the evolution of mankind," he said, "is through communication. Gutenberg was a watershed in western civilization. He made everybody a reader. Before, only priests and a few others had books. But it didn't come for free; printing was costly. Five hundred years after Gutenberg there were only 200,000 printers in the world.

"The significance of the late Chester Carlson is that he made everybody a printer. He brought printing to the masses, as Gutenberg brought reading. Suddenly you have 20 million printers in the world. This is an enormous democratization. Until recently, information was a privileged possession, but after Carlson—and Wilson's principle of transaction pricing—information becomes a commodity. Xerography makes information a commodity. Suddenly you can buy and sell information."

And the computer, he says, has taken the process one giant step further. In the next stage, Strassmann says, beyond Gutenberg and Carlson, everybody will be an author. The prospect is numbing.

Wall St Journal
7-8-83

FEDERAL AGENCIES with the worst public images are the Labor and Energy departments, according to a Roper public opinion poll. They suffer from public disdain of unions and from high energy prices. But 10 other departments get "favorable" ratings from a majority. A surprise: Highest rated is the Postal Service.

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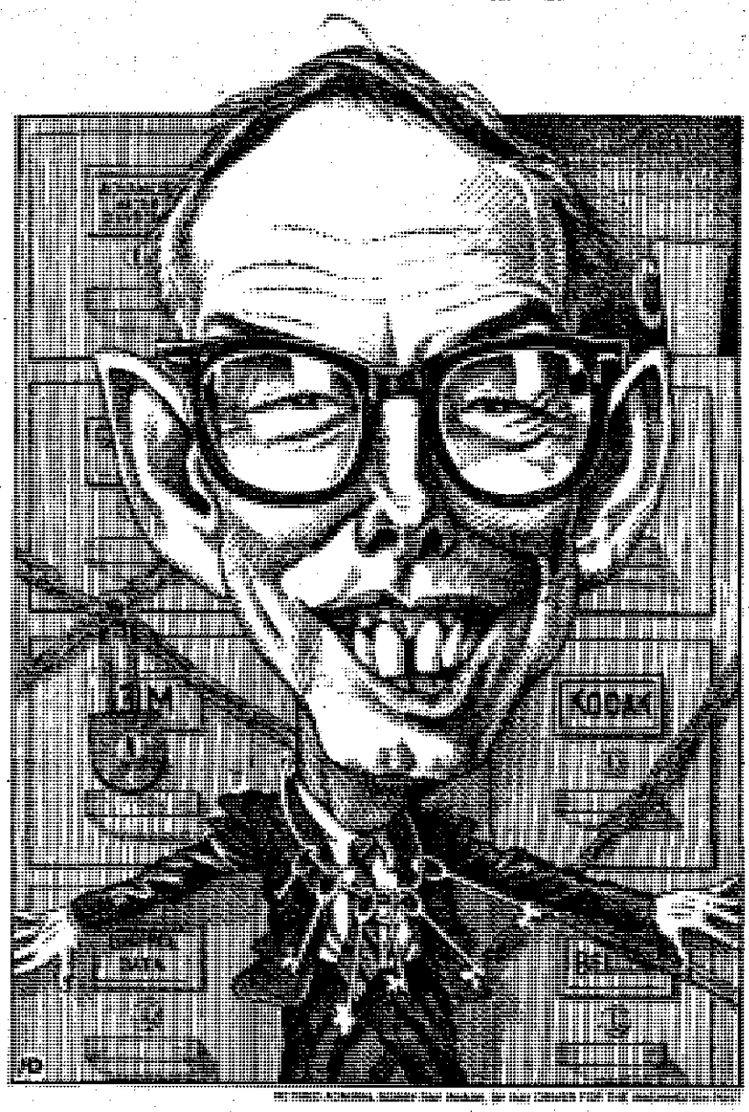

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But MCC's member companies and Inman all concede that the real test of the consortium is just now beginning: Will MCC's research and development efforts ultimately translate into innovative products and services that give its members a technical edge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

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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.

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"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.

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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.

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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.



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The Oak Ridger

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DOE puts patent waivers on hold after Dingell questions policy

By JOE CULVER

The Department of Energy's more liberal patent policy permitting patent waivers and licensing for a fee of patents developed at Oak Ridge National Laboratory is on hold while DOE decides what to do about questions raised by Rep. John Dingell, D-Mich., in letters to DOE and to the Department of Commerce.

The liberal patent policy is regarded as an important element of technology transfer from ORNL to private businesses that might want to locate along the Tennessee Technology Corridor or in the industrial park being developed by Martin Marietta Energy Systems.

The immediate local result of DOE's reaction to Dingell's letter is that three patent waivers that were nearing final agreement are now in limbo. Wayne Range, local DOE spokesman, would not identify the three patents.

Dingell, in a letter dated April 22, tells Energy Secretary John Herrington to provide information about several issues. He also says, apparently on behalf of the subcommittee on oversight and investigations, of which he is chairman, that the subcommittee "expects you to inform us of any future efforts by that agency (Commerce) to 'run' the DOE or to dictate its policies or to try to dismiss DOE employees."

Dingell's letter also criticizes DOE's record in consumer affairs, and expresses concern that DOE is developing patent policies without public input and with only limited input by the DOE offices of competition and consumer affairs.

"We had authority from Washington to permit three patent waivers," Range explained in response to questions this morning. "We felt that in view of that letter, and particularly one part of the letter, we should seek additional guidance from Washington" before going any further with those waivers.



DINGELL

'Ask that nothing be finalized (with Martin Marietta patent waivers)'

Dingell requested in his letter to Herrington that no negotiations be concluded with Martin Marietta Energy Energy Systems until the subcommittee has received a full reply to the letter.

DOE entered into a memorandum of agreement with Martin Marietta last year on technology transfer. The agreement is signed by Kenneth Jarmolow, president of Energy Systems, and Joe La Grone, manager of DOE's Oak Ridge Operations.

The memorandum expresses understanding [illegible]

rights and the ability to place t in the private sector "is a ce requirement to substantial suc in the transfer of technology f the government sector to private sector."

It also recites that some of final commitment Martin Mari made regarding regional econc development was made under assumption [illegible] could rapidly assigned within the pri sector.

While Dingell's letter does not what changes, if any, the gressman wants, there is a sug tion that Dingell is concerned as Martin Marietta gets more of patents on inventions at ORNL will become more difficult for ot companies or firms to take adv tage of technology developed government laboratories.

Another thing that seems to be major concern to Dingell — it is first issue raised in his letter — that DOE seems to be downgrad its Office of Competition.

He points out that a n organizational chart for DOE's fice of Assistant Secretary of C gressional, Intergovernmental a Public Affairs shows that compe tion will be included in a new Off of Domestic Issues.

"Department of Energy offici indicated" at subcommittee he ings in September and in subs quent correspondence "that DO planned to move competition to t Office of the Assistant Secretary f Policy and to better utilize that fice. The chart appears to aband that plan. Please explain why Dingell writes. "Why are the co petition and consumer affairs fun tions being further downgrad within the DOE?"

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Last November, more

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Patent awards

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ROUTING AND TRANSMITTAL SLIP

Date: March 26, 1985

TO: (Name, office symbol, room number, building, Agency/Post)	Initials	Date
1. Dr. Merrifield		
2. Dr. Williams		
3. Lanse Felker		
4. Mike Rubin		
5. Fred Knickerbocker		

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As Requested		For Correction		Prepare Reply	
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Comment		Investigate		Signature	
Coordination		Justify			

REMARKS

The analogy between the management problems of local schools and the Federal laboratories is easily drawn from this article.

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Norman Latker, Director, Federal Technology Management Policy Div.	H4837 HCH
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The Oak Ridger

37TH YEAR—NO. 74 OAK RIDGE, TN., THURSDAY, MAY 2, 1985 25 CENTS

DOE puts patent waivers on hold after Dingell questions policy

By JOE CULVER

The Department of Energy's more liberal patent policy permitting patent waivers and licensing for a fee of patents developed at Oak Ridge National Laboratory is on hold while DOE decides what to do about questions raised by Rep. John Dingell, D-Mich., in letters to DOE and to the Department of Commerce.

The liberal patent policy is regarded as an important element of technology transfer from ORNL to private businesses that might want to locate along the Tennessee Technology Corridor or in the industrial park being developed by Martin Marietta Energy Systems.

The immediate local result of DOE's reaction to Dingell's letter is that three patent waivers that were nearing final agreement are now in limbo. Wayne Range, local DOE spokesman, would not identify the three patents.

Dingell, in a letter dated April 22, tells Energy Secretary John Herrington to provide information about several issues. He also says, apparently on behalf of the subcommittee on oversight and investigations, of which he is chairman, that the subcommittee "expects you to inform us of any future efforts by that agency (Commerce) to 'run' the DOE or to dictate its policies or to try to dismiss DOE employees."

Dingell's letter also criticizes DOE's record in consumer affairs, and expresses concern that DOE is developing patent policies without public input and with only limited input by the DOE offices of competition and consumer affairs.

"We had authority from Washington to permit three patent waivers," Range explained in response to questions this morning. "We felt that in view of that letter, and particularly one part of the letter, we should seek additional guidance from Washington" before going any further with those waivers.



DINGELL

'Ask that nothing be finalized (with Martin Marietta patent waivers)'

Dingell requested in his letter to Herrington that no negotiations be concluded with Martin Marietta Energy Energy Systems until the subcommittee has received a full reply to the letter.

DOE entered into a memorandum of agreement with Martin Marietta last year on technology transfer. The agreement is signed by Kenneth Jarmolow, president of Energy Systems, and Joe La Grone, manager of DOE's Oak Ridge Operations.

The memorandum expresses understanding that ...

rights and the ability to place t in the private sector "is a cer requirement to substantial suc in the transfer of technology f the government sector to private sector."

It also recites that some of final commitment Martin Mari made regarding regional econc development was made under assumption that patents could rapidly assigned within the pri sector.

While Dingell's letter does not what changes, if any, the gressman wants, there is a sug tion that Dingell is concerned as Martin Marietta gets more of patents on inventions at ORNL will become more difficult for ot companies or firms to take adv tage of technology developed government laboratories.

Another thing that seems to be major concern to Dingell — it is first issue raised in his letter — that DOE seems to be downgrad its Office of Competition.

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Inside the Administration

An Inside Washington Publication

An exclusive report on the Reagan Administration's economic, regulatory and management policies

Vol. 4 No. 18 May 3, 1985

In 'power play' over OMB reg authority

TREASURY OBTAINS SECRET AGREEMENT TO LIMIT OMB REVIEW UNDER E.O. 12498

In what one reliable source described as "sheer power play" by former Treasury Secretary Donald Regan, sources say the Treasury Dept. and Office of Management & Budget worked out an agreement late last year that virtually exempts Treasury from most of the newly instituted regulatory review requirements of Executive Order 12498. Sources say the unique OMB-Treasury agreement is likely to become both the envy and complaint of virtually every other federal agency now striving to meet with OMB's exacting new reg review requirements under the executive order, and has been kept secret apparently to avoid stirring jealousy and controversy. The Memorandum of Understanding between Treasury and OMB dramatically narrows the scope of regulatory authority OMB has over Treasury,

(continued on page 6)

To avert clash with Administration on compensation issue

SENATE COMMERCE TO VOTE ON UNIFORM PRODUCT LIABILITY BILL

Senate Commerce Committee Chairman John Danforth (R-MO), in a move to avert a near-term policy clash on product liability legislation with the Reagan Administration and influential business groups, has reportedly decided to urge his committee to vote out uniform product liability legislation (S. 100) this month with the proviso that the bill will not be considered on the Senate floor until the committee has had an opportunity to hold hearings on "no-fault" compensation schemes that would provide economic relief to persons injured by commercial products. Reportedly, Danforth has struck a behind-the-scenes compromise with the two major Senate proponents of product liability compensation legislation — committee member Slade Gorton (R-WA) and Christopher Dodd (D-CT) — in which both have agreed not to attempt to amend S.100 in committee in exchange for a promise from Danforth that the bill won't

(continued on page 7)

Critics see 'caving in' to oil & gas interests

WHITE HOUSE, IN POLITICAL CONCESSION, EYES RETAINING SPECIAL TAX BREAKS

Conceding what one source described as "political reality," President Reagan and White House Chief of Staff Donald Regan reportedly are weighing a recommendation by Treasury Secretary James Baker that the Administration retain special tax breaks for the oil & gas industry, as well as continue the tax-exempt status of fringe benefits, in the final overhaul of the Treasury Dept.'s tax reform plan. Sources say the Administration is under particularly "strong pressure" from powerful southern and midwestern legislators to continue to permit write-offs for oil & gas exploration, as well as from Senate Finance Committee Chairman Bob Packwood (R-OR) not to change the tax treatment of fringe benefits. While some assert that Baker in urging these major exceptions to the tax reform plan is merely acknowledging the realities of "power politics," others warn that such major concessions may tarnish the

(continued on page 5)

Under pressure from U.S. grain dealers

REAGAN 'FLIP-FLOPS' POLICY STANCE ON CARGO PREFERENCE BILL

The Reagan Administration, under pressure from U.S. grain dealers who are losing business to foreign competitors, this week reversed its position on cargo preference legislation — telling Congress it will not fight legislation that would permit certain farm export programs to ship on commercial vessels, rather than comply with existing law and use more costly U.S. flag ships. The Administration's abrupt policy turnabout directly contradicts an earlier White House statement opposing the bill. A recent court decision effectively overturned a longstanding federal practice of permitting certain agriculture exports to be shipped on commercial vessels despite existing law that requires federally supported exports to be shipped on the more costly U.S. flag ships. The decision, which the Justice Dept. is appealing, resulted in im-

mediate suspension of several U.S. Dept. of Agriculture programs and a loss in business for U.S. grain exporters whose customers are choosing foreign grain suppliers with cheaper shipping costs.

The White House last month offered Congress opposing policy statements on the legislation with Agriculture Secretary John Block saying the Administration would support a bill to restore the exemptions for certain agriculture programs; at the same time Transportation Secretary Elizabeth Dole said the White House had decided to oppose a legislative remedy and would instead appeal the court decision. The White House later issued a formal position statement, supporting Dole's perception of a high level meeting at which it was decided to oppose the legislation, saying that the Justice Dept. would appeal the court ruling in an effort to preserve the exemption for agriculture exports. Administration officials said the White House feared a legislative remedy would provide an "uncontrollable rolling stone for expensive export subsidies" that the federal government simply cannot afford.

The Reagan Administration, faced with a growing loss of business to U.S. grain exporters, is now willing to run the risk associated with the legislation, according to a high level official who said "we'd better win on the floor [of Congress] cause we're sure as hell losing in the field."

The Reagan Administration has been divided over the cargo preference issue with DOT officials, concerned with supporting the domestic maritime industry, opposed to extending exemptions — beyond a limited number of agriculture programs — to the cargo preference law, which is intended to assure a livelihood for the U.S. shipping industry. The law requires that at least 50% of exports funded in part or in whole by U.S. subsidies be shipped on U.S. flag vessels. DOT wants to avoid a congressional opportunity for other interests to add their own exemptions.

DINGELL CHARGES COMMERCE INTERFERES IN DOE AFFAIRS, CONGRESSIONAL DEBATE

House Energy & Commerce Committee Chairman John Dingell (D-MI) has charged that the Commerce Dept. has interferred in Dept. of Energy management by improperly seeking to replace a DOE official with one more "friendly" to Commerce's view of government patent policy. Dingell, through his oversight & investigations subcommittee, claims Commerce has engaged in about half a dozen improper activities within the Administration and before Congress, and has asked Commerce Secretary Malcolm Baldrige to investigate the allegations. Dingell last week delivered a lengthy memorandum to Baldrige, a copy of which was obtained by *Inside the Administration*, charging that Commerce officials, seeking to develop a federal patent policy, have sought to improperly influence DOE management involved with forming that agency's policy on release of patents developed under DOE contracts. He also alleges that Commerce lobbied Congress without authorization. Baldrige's office this week had no comment on the allegations except to say they are being looked at. But other Commerce officials maintained the charges "are without merit and have no foundation in fact." A key Commerce official claimed Dingell's "preference for contentious issues has provided an easy route for those wanting to block" Commerce's efforts to develop a federal consensus on patent policy.

The allegations follow a longstanding dispute between DOE and Commerce's Office of Productivity, Innovation & Technology, which has taken the lead for developing Administration policy regarding release of patents developed with federal funds. (OPTI itself has been at the center of some Administration/congressional controversy — the Administration proposing, with Baldrige's assent, to terminate the office, but congressional budget committees voted to restore FY-86 funding for the program anyway.)

OPTI last year accused DOE of not complying with a Presidential directive to release the rights to as many federally funded patents as possible. DOE has opposed OPTI's efforts to reform uniform government-wide patent policy because it would eliminate an exemption the energy agency has had to existing law, which requires agencies to relinquish as many patents as "possible." The Commerce-DOE feud grew as each agency sought to influence the Administration's position on legislation, reportedly written by OPTI and introduced by Sen. Robert Dole (R-KS). The new law establishes a presumption of patent ownership in favor of private government contractors.

DOE officials, hoping to preserve the agency's exemption, had, without Administration approval, lobbied Congress last year to reject Dole's bill. Dole complained to the Office of Management & Budget that DOE's unauthorized lobbying contradicted the Administration's official support for the bill as had been presented in earlier Commerce Dept. testimony. OMB directed DOE to halt all unauthorized communications with Congress and Dingell called for a General Accounting Office investigation into DOE compliance with Reagan Administration patent policy procedures. GAO, in the course of the DOE inquiry, reviewed a number of Commerce documents that, Dingell claims, suggested improprieties and he subsequently asked GAO to examine internal Commerce documents.

Dingell has also attacked OPTI's efforts to win passage of another Dole patent bill that would strengthen government laboratories' rights to patents developed with federal funds. Dole, who introduced the measure last Congress, may drop his support (the bill has not yet been introduced this session) rather

than fight Dingell's charges that OPTI has improperly lobbied Congress on the bill. Dingell complained to Baldrige that OPTI's plan to lobby for the lab bill — to "influence the direction of congressional hearings" and "work the Hill and the private sector as we did last year" — is objectionable.

WEISS THREATENS TO SUBPOENA DRAFT REGULATORY PLANS FROM FOUR AGENCIES

House Government Operations intergovernmental relations & human resources subcommittee chairman Ted Weiss (D-NY) is threatening to subpoena draft regulatory planning documents from four Reagan agencies if they don't comply with his demand for the documents by Wednesday May 1. Administration sources claim that the four agencies — including the Depts. of Health & Human Services, Treasury, Agriculture, and the Veterans Administration — already submitted the documents Weiss and ranking subcommittee member Robert Walker (R-PA) originally requested on March 6, but subcommittee sources insist the Administration still has not fully complied with their demands. Weiss' ultimatum — delivered in an April 24 letter to each department — is the latest in a series of Executive-legislative confrontations over the Administration's new Executive Order 12498, and represents the most serious challenge thus far to the Administration's claim of Executive privilege over draft documents submitted to the Office of Management & Budget under the order.

Weiss in a representative letter to HHS Secretary Margaret Heckler cites his subcommittee's "oversight responsibilities" and asks her to provide copies of the department's regulatory planning documents "as well as all agency memoranda, correspondence, and draft reports" that support the documents. In what sources say is an implied threat to subpoena documents the subcommittee believes the Administration is withholding, Weiss warns that all documents should be supplied by close of business May 1 "to avoid unnecessary confrontation." Sources say Weiss is "reserving the right" to call for a subcommittee vote to subpoena documents if the Administration does not fully comply with the request.

OMB Director David Stockman recently directed agencies to respond to a similar request from House Energy & Commerce Committee Chairman John Dingell (D-MI) by releasing their draft regulatory plans, but Stockman's April 19 directive did not authorize release of draft documents leading up to and supporting the regulatory planning documents, as requested by Weiss. Nevertheless, Administration sources apparently were surprised at Weiss' continuing demands, and some were puzzled as to what further documents Weiss wanted to see. Unlike Dingell, Weiss is not asking OMB to compile and release telephone logs of conversations between OMB and department personnel, but rather is asking for background documents that shed light on regulatory plans made under the new executive order.

Also unlike Dingell, sources say Weiss sent his demands to the agencies directly under his subcommittee's jurisdiction, and has been "scrupulously avoiding" any contact with OMB. OMB Director Stockman personally negotiated the release of documents requested by Dingell's subcommittee, although OMB later insisted that the decision to release documents was left entirely up to individual agencies. Sources say Weiss believes as a matter of principle that the decision to release documents should be made by each individual agency, and not the more secretive budget office.

The subcommittee's threat to subpoena documents will put OMB's earlier claim of Executive privilege over interagency communications to its first real test. Sources say the subcommittee does not believe OMB can claim Executive privilege on behalf of the Administration, but rather the decision to withhold documents from Congress must be made by the President personally.

OMB STALLS AUTO THEFT REGS PENDING REAGAN WORD ON GREY MARKET CONTROLS

The Office of Management & Budget reportedly is withholding approval of proposed auto-theft-control regulations, implementing legislation passed last year, pending decisions on whether to restrict so-called "grey market" imports — brand names sold at discount prices in the U.S. without authorization from the U.S. trademark owner. The grey market decision may require deletion of brand names for certain imported products, and that in turn may affect the nature of the auto theft regulations. But congressional pressure is increasing for promulgation of the regs, which will define what foreign car parts are to carry identifiable numbers designed to help in tracking theft, and the auto industry also wants the regs issued as soon as possible.

An official of the National Highway Traffic Safety Administration, which submitted the regs for approval in mid-March, said OMB has given no indication as to when it will release the regs. But NHTSA Administrator Diane Steed told Congress this week she is confident NHTSA will make the statutory Sept. 15 deadline.

The Reagan Administration is expected to reject a Commerce Dept. recommendation that it move to impose restrictions on grey market imports (Inside the Administration, April 26 p1) but OMB sources say any change in current policy could redirect "the desired thrust" of the auto theft regs. President Reagan

Charting the Way the World Works

BY DONELLA H. MEADOWS

THE *Limits to Growth,* which I wrote with several co-authors in 1972 to provide a popular account of the first global computer model, created an uproar that still echoes. Much of the problem was and remains public confusion about global models. The media depicted our model, done by the Systems Dynamics Group at M.I.T.—and the models that followed and sometimes challenged ours—as crystal balls predicting the future of almost everything and upholding wildly pessimistic or optimistic views of the world.

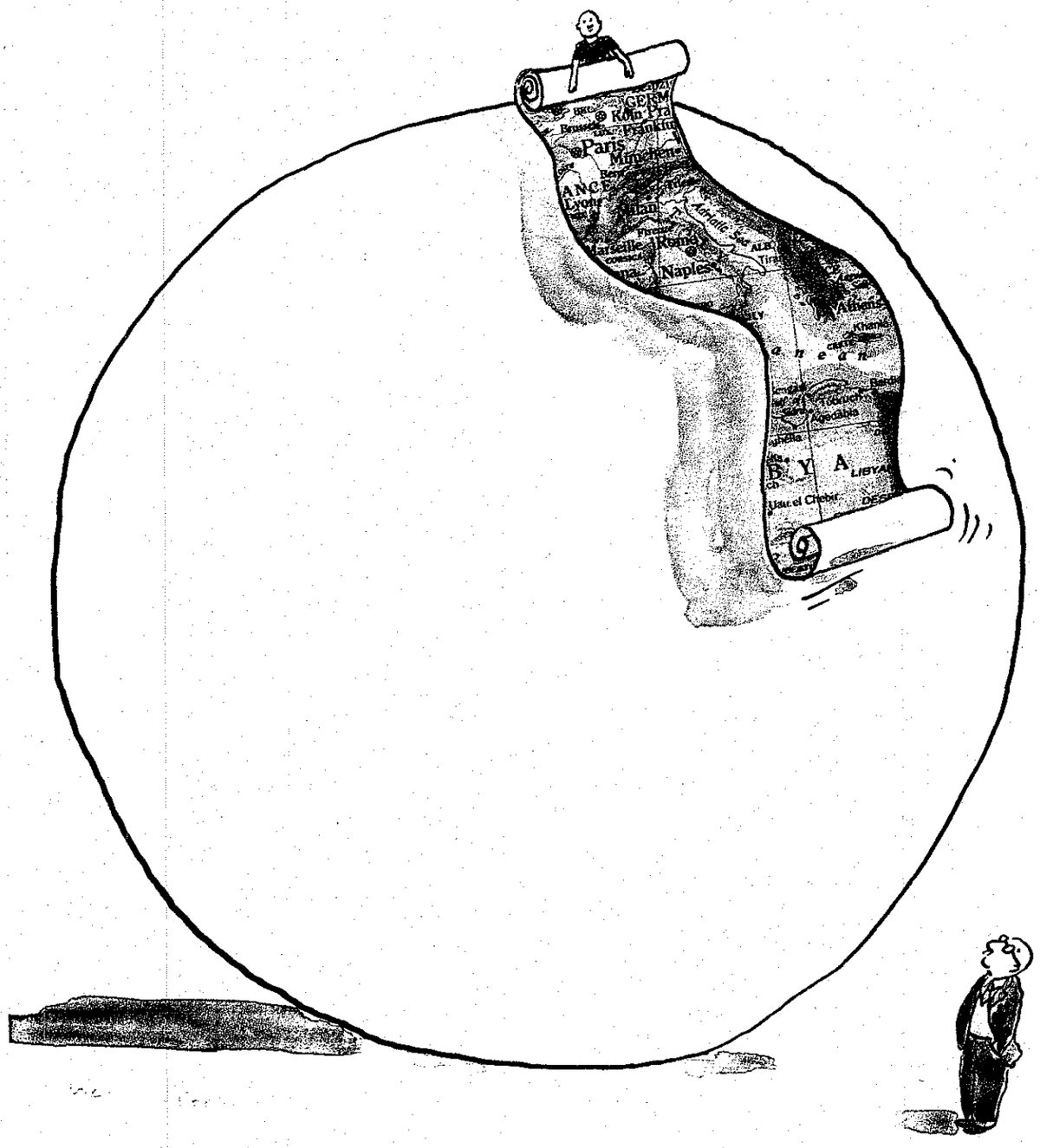
In fact, global models are not meant to predict, do not include every possible aspect of the world, and do not support either pure optimism or pure pessimism about the future. They represent mathematically assumptions about the interrelationships among global concerns such as population, industrial output, natural resources, and pollution. Global modelers investigate what might happen if policies continue along present lines, or if specific changes are instituted. For example, particular models have asked what would happen if growth continued at its present rate, if the European Common Market increased grain exports, or if infinite, free energy became available.

Since the first global model, the discipline has spread throughout the world. The Japanese have a global model. The Russians have, as far as I know, three of them. The World Bank and the United Nations have produced several models. To refute those coming from the rich countries, scientists in Latin America produced a model of their own. The U.S. Joint Chiefs of Staff commissioned a new version of a global model at a cost of $1.4 million. At a 1981 conference of the International Institute of Applied Systems Analysis (IIASA) in Vienna, representatives from 20 global-modeling groups made presentations. And no one knows how many other models exist within governments and corporations around the world.

Not surprisingly, the initial assumptions of these various global modelers are incredibly different. First, they disagree on methodology: Is it better to simulate the world as it exists, or to construct a model that optimizes it as it might be—if, for example, every government made basic human needs a first priority? Is it better to make guesses about "soft" factors such as political stability or to ignore them altogether?

Though they are made with conflicting ideologies in diverse nations, all global models basically agree on how to improve the state of the world.

ILLUSTRATIONS: MICHAEL CRAWFORD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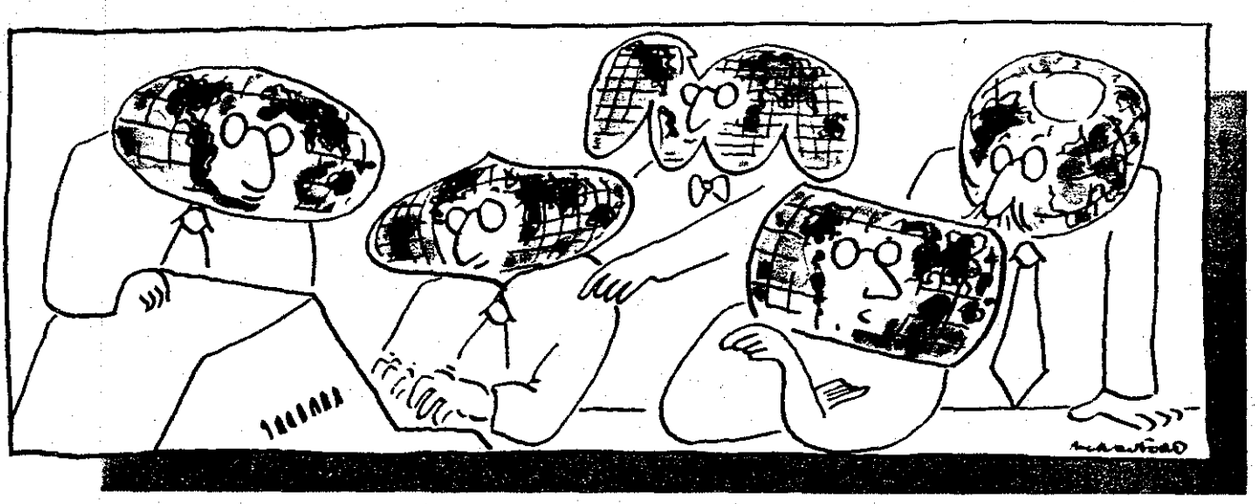
The substantive disagreements among global modelers form a catalog of the uncertainties of our era.



Then, there are substantive disagreements among the global modelers, which form a catalog of the uncertainties of our era. To what extent do free markets actually exist? How vulnerable, really, is the ecosystem? Does technology appear unexpectedly or as a result of social processes that can be controlled? Do governments act independently, and how much are they trapped by forces larger than themselves?

Above all, or perhaps I should say below all, because they are rarely addressed explicitly, are the divisive moral issues. Is man's inhumanity to man the primary global wrong, or is it destruction of the environment? What assumptions about human nature and political legitimacy do we who construct global models inadvertently build into them? What is our social responsibility: to serve a system or to challenge it, to raise questions or to provide answers, to redesign social systems or to empower others to do so?

The methods and philosophies of global modelers are so diverse that one would hesitate to call the models a single body of intellectual work, except that they are directed toward the same intertwined problems: population growth, poverty, resource scarcity, environmental deterioration, and international instability. Another point of commonality is that many of the models were made in response—sometimes heated response—to the ones that came before. Especially when the discipline first began, a major purpose of each model was to discredit the others and show how the whole exercise should be done. Thus, collectively the global models constitute a fascinating international debate. They reveal the world's knowledge, uncertainty, and opinion about global problems.

They do so in terms that are relatively precise and unemotional, adding a mathematical rigor to discussions of world issues. Every term must be defined precisely. Everything that is sold must be bought. The amounts of energy, labor, and capital allocated to various sectors of the economy cannot exceed the total amounts available. Such unremarkable and even simple-minded requirements allow more explicitness, complexity, and logical consistency than can ever be expected from the only other source of understanding about the world: the models in people's heads.

The world system is enforcing its regularities on the modelers. When the Japanese, the Soviets, the Americans, the Europeans, and the South Americans step back and attempt to integrate their most treasured assumptions about the planet, they find themselves in substantial agreement. Given the different starting points, the debate about global issues is leading to a surprising convergence of opinion.

Action and Reaction

The first global model was developed at the behest of the Club of Rome, a group of policymakers, academics, and managers who met in Bern, Switzerland, in 1970 to discuss 66 world problems such as hunger, pollution, and crime. The problems seemed interconnected, so Carroll Wilson of M.I.T., a mem-

ber of the club's executive committee, had invited someone he thought could draw the connections: his colleague Jay W. Forrester of M.I.T.'s Sloan School of Management. Forrester proposed constructing a global computer model. On the way home from the meeting, he worked out a rough model he called World1 on the back of an envelope, and then amplified it into the first detailed global model, called World2. A team headed by Dennis Meadows, then also at M.I.T., refined this model into World3, the basis for *The Limits to Growth*.

World2 and World3 are intended to answer a simple question that can be put this way: Population and capital growth are inherently exponential. The world's population is growing at such a rate that, if it were to continue, it would double in 40 years, quadruple in 80 years, and increase eightfold in 120 years. The physical growth of capital equipment, housing, and infrastructure is proceeding even more rapidly. Forrester asked what might ultimately limit population and physical growth on this finite planet, and how the world's adjustment to its limits might be smooth and controlled rather than unexpected and violent.

He concluded that no process exists that can reliably adjust today's exponential growth to the earth's limits, whatever they may be. Delays are too long, both in the process of making decisions and the time it takes for results. For example, so many children have already been born that even if each couple from now on averaged two offspring, population would continue growing for 70 years. Though industry might stop polluting, its toxic waste would linger in the environment for decades. The world's machines are too dependent on nonrenewable resources and too long-lived to be replaced quickly by machines that can use renewable resources. And the value of growth for its own sake is too deeply embedded in industrial culture for a different value to be quickly adopted.

Unless some deliberate process to slow growth is implemented, Forrester found, the most likely future will be "overshoot and collapse"—an irreversible destruction of the resource base followed by a decline in capital and population. However, if societies design a sustainable, equitable system instead of trying to correct problems caused by growth with still more growth, there are enough time and resources to provide a desirable standard of living for everyone.

The scientific community criticized World2 and World3 on several grounds, one being that they did not distinguish among different regions of the world. Thus, Mihaijlo Mesarovic at Case Western Reserve University, and Eduard Pestel at the Technical University in Hannover, West Germany, designed the World Integrated Model (WIM), to explore the same questions with more regional detail. These scientists reached similar conclusions, except that their warnings were expressed in even more urgent and dire language.

Over the years WIM has been modified, updated, and made more detailed at the behest of numerous clients, including several U.S. agencies and countries such as Mexico and Iran (during the shah's regime). This is the model that is being adapted for use by the U.S. Joint Chiefs of Staff.

Another criticism of World2 and World3 came from citizens of the Third World, who read into *The Limits to Growth* the implication that growth must stop in such a way as to freeze poor nations into an eternal state of poverty. They responded with the Latin American World Model, made at the Fundacion Bariloche in Argentina. This model is constructed around an explicit value: meeting basic human needs.

According to the model, the world could work well with that priority. Latin America and Africa could meet the basic needs of their entire populations through their own efforts by the year 2000. Asia would take longer and require outside aid. The rich countries would not collapse or even stagnate, and as human needs were met everywhere, the population would stabilize.

The Bariloche group did not explicitly model environmental and resource problems. But the modelers say that the planetary stresses of a just society would be much less than those of the greed-and-growth-oriented world of today. They estimate that decent living standards could be achieved for all with per capita economic outputs a third to a fifth as great as those needed if present inequities persist.

The modelers write that "the economically underdeveloped societies cannot leave their state of backwardness following the development patterns of the already industrialized—but not necessarily developed—societies. Even if it were possible, it is not desirable, as it would mean to follow the same road which led to the present situation of wasteful and irrational consumption, accelerated social deterio-

ration, and increasing alienation."

A coalition of agronomists from Wageningen University and economists from the Free University of Amsterdam constructed a model to see if adequate food could be produced for the expected doubling of the world population—up to 6 billion by the year 2000. They discovered quickly that there is already enough food for 6 billion people, so they changed the focus of their investigation to examine why it is that in a world with more than enough food, hunger persists.

The sophisticated model that emerged, called the Model of International Relations in Agriculture (MOIRA), represents food production, consumption, and trade for 106 nations. Each has 12 income classes and a government that may interfere with internal pricing and trade flows to satisfy political priorities. As each nation tries to maintain its domestic food supplies and prices at desired levels, it dumps its shortages or excesses onto the world market. The result is systematic amplification: a small fluctuation in wheat production in Kansas can become a major wave in consumption in Ghana. Large, rich countries can buffer their interface with the world market at considerable expense but small, poor countries cannot, and fluctuations in the world market sweep into their domestic markets. As the Dutch modelers say, "He who has the lowest dam gets the whole flood."

Hunger in this model results primarily from inequities in income distribution, both among families and among nations. These inequities are exacerbated by the impersonal workings of the world market. Measures such as food aid can have adverse effects, since they lower food prices in countries receiving the aid and discourage farming. However, two kinds of policies do help eliminate hunger: changes that give poor people the resources to earn a decent income, and efforts by the rich countries to keep food exports and imports constant so as to keep world prices stable and relatively high.

When President Carter asked Gerald O. Barney at the U.S. Council on Environmental Quality to study global prospects for the year 2000, Barney gathered existing models and forecasts of various government branches. These included population projections from the Census Bureau, food projections from the Department of Agriculture, and so forth. The result, called the Global 2000 model, was not only a rich collection of information about the world, but a fascinating comment on the state of global understanding of one of the world's most information-rich governments. The separate forecasts had never before been coordinated, and their makers often were not even aware that other projections existed. The assumptions and methods of these forecasts were not necessarily consistent. Indeed, the study concluded that "at present the executive agencies of the United States Government are not capable of presenting the President with internally consistent projections of world trends in population, resources, and the environment for the next two decades."

Even though these projections were not internally consistent, they were consistently gloomy. Global 2000 has become famous for that gloom, as if the study itself rather than separate government offices had produced the forecasts. The summary statement reads: "If present trends continue, the world in 2000 will be more crowded, more polluted, less stable ecologically, and more vulnerable to disruption than the world we live in now. Serious stresses involving population, resources, and the environment are clearly visible ahead. Despite greater material output, the world's people will be poorer in many ways than they are today.

"For hundreds of millions of the desperately poor, the outlook for food and other necessities of life will be no better. For many it will be worse. Barring revolutionary advances in technology, life for most people on earth will be more precarious in 2000 than it is now—unless the nations of the world act decisively to alter current trends."

The Global 2000 staff's own contribution to the bad news was to point out that the various forecasts are probably too optimistic because they were made independently. The energy forecasts assumed that enough capital would be available, the capital forecasts assumed that there would be enough energy, and the agriculture forecasts assumed that there would be enough of both. Because the sectors were not linked, as they are in most global models, they did not set up any of the truly difficult trade-offs that must be made in the real world.

These are but a few examples to illustrate the variety of the global models. Each model asks a particular question and focuses on one aspect of global complexity, each expresses the cultural and methodological viewpoint of its makers, yet each is constrained by mathematical rigor and the world database. However interesting the individual models

The media depicted the early global models as crystal balls predicting the future of almost everything.



are, I think their real value is in their juxtaposition. As each explicit representation of the world is added, the collection begins to hint at common insights into how the complex global system behaves and how it can be better managed.

The Common Ground

The common conclusions among the world models are both unsurprising and revolutionary. At some level nearly everyone understands how the world works, yet governments and people do not often operate in accordance with their understanding. While knowing that the world is an interdependent, richly varied system, we act daily as if it were made up of simple, separate pieces. Knowing that cooperation works better than competition, we continue to compete. Knowing that short-term results often differ from long-term ones, we go for the short-term payoff. Knowing that the environment flows through us with every breath, drink, and meal, we still think of nature as distinct from humanity.

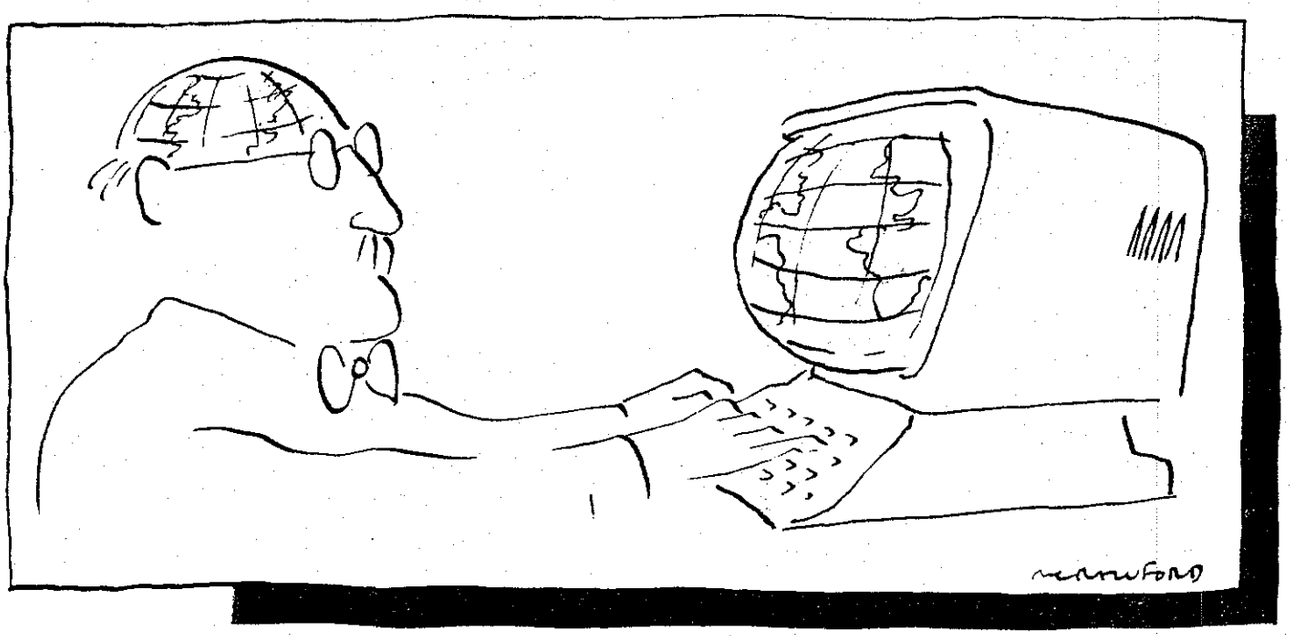
I have chosen common conclusions from the global models and have expressed them in my own words. But I believe each global modeler would agree that his or her work supports these conclusions, or at least does not contradict them:

☐ *Existing resources and known technologies can support all the needs of the world's people today and for some time to come.* People's needs are not being met and resources are being degraded because of inequities, wastefulness, and mismanagement, not because of any immediate physical scarcity.

The models illustrate this point with resounding unanimity. MOIRA shows how the world trade system transforms more than enough food for everyone into hunger for one in five. The IIASA Energy Model emphasizes how many technical options actually exist to supply energy. World3 shows how it is possible to make a transition to an economy that uses renewable resources to sustain high living standards for everyone.

The earth is a diverse, abundant planet. However, the assumption that most pervades decision making in our era is that there is scarcity. The reaction is to hoard and try to increase short-term production.

The world system is forcing its patterns on the modelers.



This reinforces the perception of scarcity in the short run and can create actual, though unnecessary, scarcity in the long run through wastefulness and degradation of resources.

☐ *Population and physical capital cannot grow forever on a finite planet.* Though overall scarcity does not now exist for the global society, it can be generated if rapid growth continues.

All the models recognize problems connected with population growth, even though some modelers began with strong reactions against the "anti-natalist bias" of World2 and World3. Agreement on the need to limit physical growth (of capital goods, infrastructure, and housing) is less unanimous, chiefly because some models represent the economy only as a flow of money rather than a stock of physical equipment. They do not account for the fact that physical equipment, like population, takes up space, requires a constant stream of energy and raw materials, and continually emits wastes.

A steady growth of electrical generating plants, factories, or any other capital equipment at 3.5 percent per year, a typical goal for industrial societies, implies a 32-fold multiplication in a century. It is not surprising that real growth rates rarely stay that high for that long. It is only surprising that so many people believe they should. The important questions are not how to promote all kinds of physical growth everywhere, but rather what kinds of growth should be encouraged in what places for how long to shape a sustainable and desirable way of life for everyone.

☐ *No reliable, complete information is available about the degree to which the earth's environment can absorb the wastes created to meet human needs.* The global models have mostly tried to quantify environmental stresses—such as how much carbon dioxide or sulfur pollution is dumped into the atmosphere—but they have not studied the ecosystem's reactions to those stresses. And even the effort to measure the stresses has shown that the data are totally inadequate. No reliable data exist on soil erosion, groundwater pollution, or disposal of radioactive waste. The makers of the U.N. World Model and WIM gave up on their environmental sectors for lack of information. Specific environmental effects, such as the death of forests in Europe, are only now beginning to be modeled seriously.

A conclusion of "we don't know" may not sound like much of a conclusion, but it is useful information in a world where policy is dominated by the belief that we do know, and that the limits to how much stress the environment can absorb are centuries away.

☐ *If continued, present policies will lead to an in-*

creasing gap between rich and poor. The world economic system is structured to behave exactly the way it is now behaving. Further operation of the system will not all of a sudden produce equity or eliminate poverty.

The models show that even fairly massive adjustments, such as vastly increased foreign aid, would not significantly redress global inequities. For example, in the IIASA Food and Agriculture Program model, 30 million tons of "free grain from outer space" were added to the world market annually. The result was that meat consumption in the rich countries rose, but hunger in the poor countries did not decline. The world system is replete with subtle mechanisms that capture any gains made in less-powerful parts and redistribute them to more-powerful parts. However, several models suggest that conscious policies to improve the lot of the poor can succeed without major sacrifice by the rich.

☐ *Technology can help but is not the answer.* No set of purely technical changes tested in any of the models was enough in itself to bring about a desirable future. This is epitomized by the finding that providing infinite, cheap energy, with no other change, simply exacerbates inequality, population growth, and environmental problems. Providing land or education for the rural poor in several models was much more beneficial to them than providing technologies that increase agricultural yields.

In the process of making a global model, one has to discard fuzzy mental-model concepts of technology as either the cost-free solution to all problems or the source of all evil. From a systems point of view, technology looks more like a tool to achieve goals. If a society's goals are to maximize material possessions, resolve conflicts through military aggression, and maintain hierarchies of power, its technologies—no matter how powerful—will not suddenly produce peace, justice, or environmental quality.

☐ *The interdependence among peoples and nations is much greater than commonly imagined.* Actions taken at one time and on one part of the globe have far-reaching and long-term consequences that are impossible to predict intuitively.

The models constantly surprise even their makers—as when MOIRA found that a small change in Kansas wheat production can undermine Nigerian food policy. A Japanese world model showed that that country's economy rises or falls with the welfare of its poorer Pacific-basin neighbors. When modelers simulated what would happen if all trade barriers were lifted, the results were very complex. Some nations benefited greatly while others lost badly, and it was surprising to see which nations fell into which groups. Free trade is neither the panacea nor the disaster that its advocates and opponents portray.

The results of economic shocks such as the 1973 oil price rise reverberate not only among all nations but also over decades of time. Some models indicate that the economic system still has not settled down from the turbulence caused by the first oil price shock, much less the later ones.

Most governments, especially of large nations, still assume that they can win while others lose. They believe they can act independently, without creating political, economic, or environmental repercussions outside their borders that will return to haunt them. When the repercussions come, they will continue to be surprised.

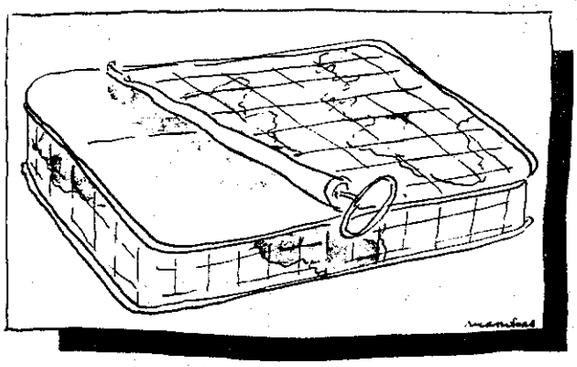
☐ *Policy changes made soon are likely to have more impact with less effort than the same changes made later.* By the time the need to face a problem becomes obvious, there may be no easy solution.

Resource pricing provides one of the classic examples of this principle. According to WIM, steady, slow oil price increases, well in advance of any actual physical depletion, benefit both producing and consuming countries. Gradually rising prices induce consumers to adopt alternatives to oil in a way that does not disrupt their economies, while producers' revenues are maintained. In contrast, the current battle between the oil cartel and the market produces disruptive price cycles in the short term and too-abrupt, too-late signals of scarcity in the long term.

Most kinds of environmental damage, such as desertification and contamination of groundwater, are thousands of time cheaper to prevent than repair. In India alone, bringing the birth rate down to two children per couple in 1995 instead of 2005 can make a difference of 300 million people. Creating equitable distribution systems is far less painful while there is still an abundance to distribute. But policymakers systematically postpone all such decisions as long as possible.

☐ *Many complex international programs and agreements are based on inconsistent assumptions.* Policymakers debate plans that are simply impossible to

Exponential growth cannot continue forever on a finite planet.



achieve while failing to notice real opportunities.

For example, several global-modeling teams have tried to find ways to meet the Lima targets developed by the U.N. Conference on Trade and Development, which specify what shares of world industrial output the Third World should provide by the year 2000. However, these targets were stated so vaguely that the teams could not represent them quantitatively without further interpretation. After representing them as best they could, the teams found the targets essentially unmeetable. And when they forced massive, unrealistic changes on the system so the goals could be met, the modelers found them not even desirable. For example, the Latin American World Model found that for Africa to produce the stipulated amount of manufactured exports, food production, education, and housing would have to decline.

If global models had no other use, they would be worth the price of making them just to impose clarity on the terms of international demands and agreements, and to save the trouble of arguing for conditions that are patently impossible to achieve. One case where a model has been used successfully for just such a purpose is in the Law of the Sea negotiations. Professor J. Daniel Nyhart of M.I.T. developed a model of the costs and returns of undersea mining that was used to debunk initial assumptions that this technology would yield a bonanza. The model enabled the negotiators to agree on international licensing and taxing systems.

A New World

Although something within us knows better, our mental models and those of our leaders cling desperately to the assumption that the future will not be very different from the present. Or that the future will be some smooth extrapolation of the present. Or at least that the future is to be predicted, not to be shaped by human decisions.

It is not possible to maintain those assumptions while contemplating the long-term trends of the world. Global models produce thousands of different simulated futures under thousands of possible sets of policies. None of those simulations proceeds far past the year 2000 without showing significant changes for better or worse. A smooth continuation of present trends can be ruled out as physically impossible.

One hardly needs a computer model to discover current trends that are far from sustainable. The world's use of nonrenewable resources such as petroleum cannot continue indefinitely. The amount of carbon dioxide in the atmosphere—up 30 percent since preindustrial times—cannot continue increasing without disrupting the global climate. Each year 20 million acres of tropical forest disappear, and there are 80 million more people to feed. Each minute the world spends $1 million on armaments and 24 people starve, most of them children.

The range of *real* possibilities includes some nearly unimaginable outcomes, including on the one hand nuclear winter and the end of everything, and on the other a world at peace in which everyone's physical needs are met sustainably. Both these futures are, as far as our present knowledge can tell, very possible, and the difference between them will be determined by the way the world's people understand their options and the way they act.

The global models have not given us the key to full understanding of our complex world. We will probably never have that key. What the global models have done, at least for those of us most closely involved with them, is to be what Stuart Bremer, director of a global-modeling group at Science Center Berlin, calls a "creative irritant." They have forced us to stand back and look at all the complexity, admit it, be humbled by it, and yet continue to keep confronting it. When we do, we see far too many negative trends to be complacent and far too many positive trends to be hopeless. We mainly see a lot of work to do.

DONELLA H. MEADOWS, adjunct professor of environmental and policy studies at Dartmouth College, worked in the System Dynamics Group at M.I.T. on the first global model. She is coauthor of Groping in the Dark *(Wiley & Sons, 1982), a description of the first seven global models, and is a research scholar of the International Institute of Applied Systems Analysis in Laxenburg, Austria.*

San Francisco Chronicle Thursday, April 25, 1985

Why Inventions Flee Overseas

By Michael Harris

A new musical computer invented at Stanford University is a wonderful money-maker for Japan.

The Yamaha DX7 synthesizer has proven so successful in its first 18 months on the market that demand for the instrument has outstripped production.

Draper's, a Palo Alto music store near the Stanford campus, has already sold "well over 100" for $1995 apiece. More than 25,000 have been sold around the country and 25,000 more worldwide.

The result is that an invention that could have produced export income for the United States has instead increased the nation's record trade deficit.

A second Stanford invention, an acoustical microscope, will come to the United States this year under German and Japanese sponsorship. The device already has won co-inventor Professor Calvin F. Quate a $55,000 award from the Rank Prize Fund of England.



By Vincent Maggiora

Niels Reimers, Stanford's technology licensing director

No numbers are kept nationally or at most invention-producing universities, but some ideas born on campuses in the United States are produced abroad because domestic manufacturers fail to accept the challenge to develop them.

"We always attempt to reach American companies first," said Niels J. Reimers, Stanford's director of technology licensing.

But Reimers and some other university patent officials said they found that American willingness to take risks diminished sharply in the 1970s. So some schools turned to foreign companies after exhausting domestic possibilities.

"An American company sent five engineers and executives to look at the synthesizer," said Reimers. "They liked it but finally decided it was more of a technical challenge than they

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Why U.S. Inventions Profit Foreigners

From Page 29

were willing to take on. Several other American companies also declined to participate."

The acoustical microscope, which relies on sound waves rather than light to operate, originally was licensed to American Optical Co., but remained undeveloped in the United States and ultimately went to German and Japanese interests.

Reimers said Stanford earns about $4 million a year by licensing patents under its control — with about one-third of its income coming from foreign companies willing to undertake projects that Americans rejected.

Stanford is not alone in licensing its patents to foreign firms. Last year, Washington University in St. Louis issued a license to a Japanese firm to manufacture a local area network — a system to link computers over phone lines.

"We tried every U.S. manufacturer first," said Duke Leahey, the school's director of industrial contracts and licensing.

"We have a situation where U.S. universities are the best in the world in both basic and applied research, and where European and Japanese companies are hungry for new technology and are willing to take a flyer," Leahey said.

"Fortunately there are signs that things are getting better now, and many U.S. companies are becoming aware that technology will pass them by unless they invest in new ideas."

Washington University issued a limited license permitting the equipment to be manufactured only for sale outside the United States. The school hopes it will find an American company willing to produce it here after the Japanese show it can be done.

The University of Wisconsin Alumni Foundation, which is ranked third in patent licensing revenue after Stanford and the University of California, has had similar experiences.

"We don't publicize our figures, but probably half our revenue comes from abroad," said Marvin Woerbel, the foundation's director of licensing. Many of the foundation's products are pharmaceuticals not yet licensed for sale in the United States.

If and when the U.S. licenses are granted, he said, the foreign companies will be free to sell their products in this country.

At the Massachusetts Institute of Technology, which received about $2 million in patent licensing income last year — enough to put it in fourth place — approximately 15 percent to 20 percent came from abroad.

Arthur Smith Jr., director of the program, said MIT has instituted what he calls "an aggressive marketing program" in Europe.

But there are exceptions to the trend.

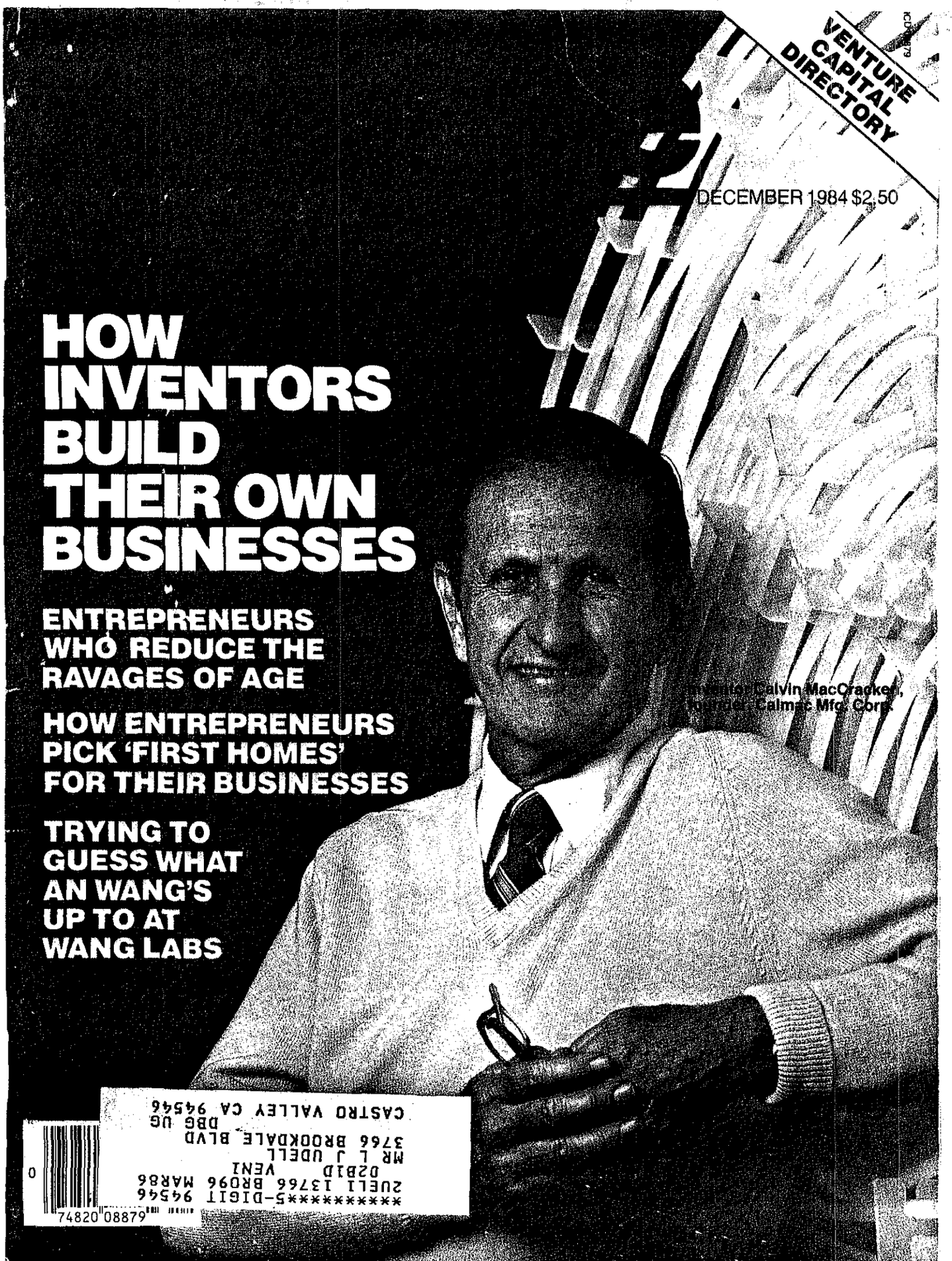
The University of California collected $2.6 million in patent payments during the 1983-84 fiscal year, almost all from domestic sources, said Roger G. Ditzel, director of the patent program for all UC campuses.

Spencer Blaylock of Iowa State University, serving a term as president of the Society of University Patent Administrators, said he thinks the Stanford synthesizer and microscope experiences are atypical.

He said he believes that about 25 percent of patent income received by American universities comes from abroad. But he added he "would be surprised if more than 1 percent" of the patent revenue is derived from products invented on American campuses, produced abroad and then sold in the United States.

Reimers said at Stanford that he sees signs that there may be greater willingness by American companies to license inventions that now go to foreigners by default. But he said some U.S. firms remain harder to deal with than foreign companies.

"We do sign most of our licenses with American companies," Reimers said. "But the guy who has to mobilize things may not have gotten all his ducks in a row, and the project may die."



VENTURE CAPITAL DIRECTORY

DECEMBER 1984 $2.50

HOW INVENTORS BUILD THEIR OWN BUSINESSES

ENTREPRENEURS WHO REDUCE THE RAVAGES OF AGE

HOW ENTREPRENEURS PICK 'FIRST HOMES' FOR THEIR BUSINESSES

TRYING TO GUESS WHAT AN WANG'S UP TO AT WANG LABS

Inventor Calvin MacCracken, founder, Calmac Mfg. Corp.

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Inventors

BY SABIN RUSSELL

Inventors are learning from entrepreneurs how to turn ideas into profits

In American mythology, independent inventors fit right in with apple pie, motherhood, and Old Glory. From garages and barns, back shops and basements, these lonely geniuses are said to build the stuff of the American Dream. So the story goes.



Caccavo

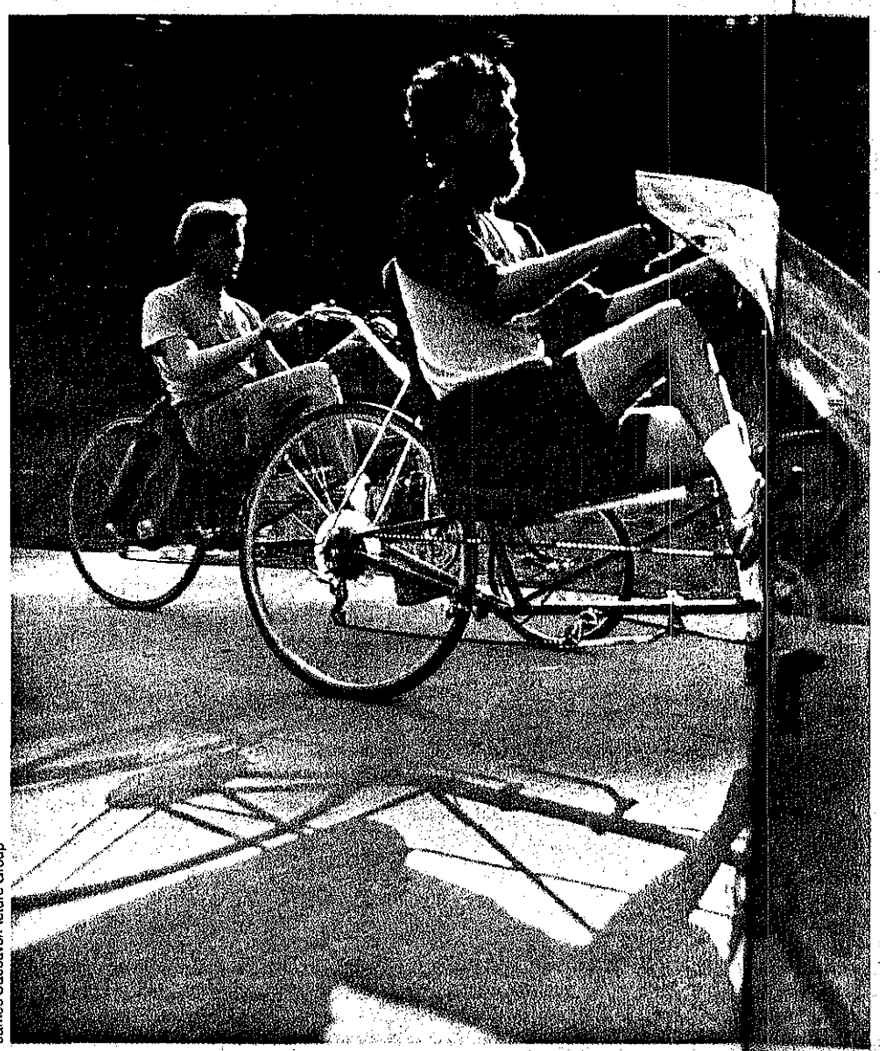
In reality, the American economy largely ignores the backyard inventor. Only 17% of patents issued this year will be assigned to individual inventors. In 1954 individuals accounted for 37%. "The notion of the individual inventor making it happen is increasingly more myth than fact," says O.J. Krasner, a professor of management at Pepperdine University in Malibu, Calif. "More and more, it takes an entrepreneurial team."

Increasingly, inventors are discovering that the entrepreneurial route—frequently in the company of a business partner—is not only potentially more lucrative than the traditional paths, but sometimes is the only option.

Robert Henry, the inventor of a new method of blood analysis, brought in a partner to turn his idea into an immunoassay business with projected sales of $500,000 its first year. Jerry Stubblefield, who designed a new athletic shoe, saw his company go from near bankruptcy to $8 million in sales when professional managers took over. R.M. "Rusty" Hammond, the inventor of a fold-away barbecue, is determined to run his business at arm's length. "Inventors are better off turning it over to someone else. They get too protective," he says.

The entrepreneurial route is not for every inventor. "It has always been the dream of the inventor that his idea be the nucleus of a business he runs himself," says Larry Udell, former president of the National Congress of Inventor Organizations. "Only one out of a thousand has the ability to be an inventor-entrepreneur. It's the intelligent inventor who recognizes his own limitations and starts to assemble a team."

As others who've started companies have discovered, entrepreneurship isn't an easy road. Like other entrepreneurs, inventor-entrepreneurs often have to take a back seat in management if the companies they found are to sustain their initial success beyond the first few years. But the transition may



James Caccavo/Picture Group

Partners Gardner Martin (foreground above) and Nathan Dean thought of their invention before they thought of starting a business. Without outside management help, sales of Easy Racers' recumbent bicycles have been slow

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Come of Age



take place even more quickly for the inventor than for the average entrepreneur. "That's a wrenching personal experience that a lot of inventors don't want to go through," says Herbert Keirulff, professor of entrepreneurship at Seattle-Pacific University. Like other entrepreneurs, the inventor-entrepreneur is likely to achieve big success only on the second—or later—try, sometimes with a completely different invention.

And inventors have found that the network of financiers and consultants that has grown up to help new businesses isn't always suited to their needs. Venture capital doors are usually closed to the independent inventor. As New York financial consultant Burt Alimansky observes: "Investors don't invest in inventions. They invest in businesses. It's the organization that is going to attract the money."

Holder of 81 patents, Calvin MacCracken qualifies as one of America's most prolific independent inventors. (His *A Handbook for Inventors*, Charles Scribner's Sons, 1983, tells how it's done.) In 1947 he founded Calmac Mfg., Englewood, N.J., after co-developing the jet engine at General Electric. Launched in business by a $150,000 stake from American Research & Development Corp., one of the nation's earliest venture capital firms, MacCracken has developed and sold eight major product lines, ranging from solar swimming pool heaters to the Roll-a-Grill, the hot dog cooker at sports arenas, which slowly spins the dogs as they cook on a bed of heated rollers. MacCracken collects royalties from exclusive licenses on product lines he's relinquished. But he tells inventors to consider entrepreneurship as a route to licensing. "You don't get very much for your invention unless you've made and marketed the product yourself," he advises.



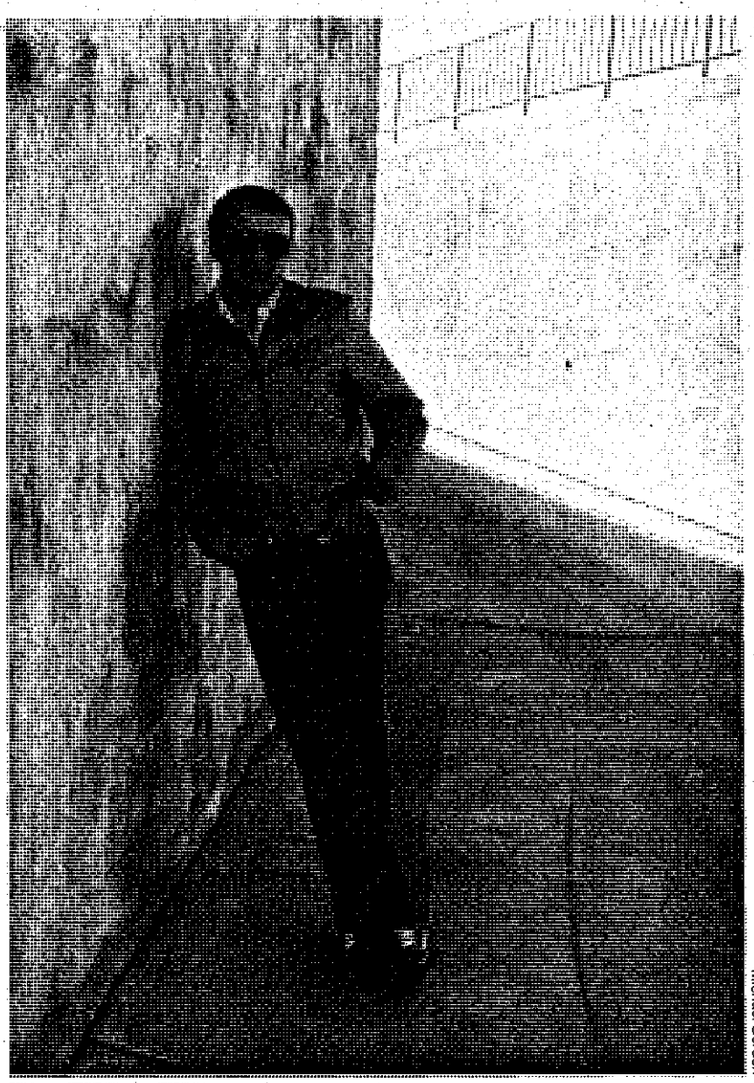
Bill Kelly

Holder of 81 patents, Calvin MacCracken (above) reaped $2 million in sales from Levload Ice Banks. "The big secret to starting a small business and having it succeed is hiring the right people"

Right now MacCracken is busy manufacturing his latest invention, which he is marketing in partnership with his 30-year-old son, Mark. Dubbed Levload Ice Banks, the system is designed to cut operating costs for commercial air conditioning in half. The device makes ice during night hours when electricity prices are lower, stores it, then uses it to cool buildings during the day when prices shoot up.

MacCracken anticipates earnings of about $300,000 on sales of $2.5 million for Calmac in 1984. About 80% of that comes from Ice Banks. The company has invested close to $1 million to bring Ice Banks to market, most of that from the sale in 1981 of his solar collectors to Besicorp for 1.2 million shares of Besicorp stock.

"Our barbecue is to other barbecues as the hide-



Michael Gordon

Even though he'd headed a corporate R&D effort, Bruce Vorhauer (above) knew no venture capitalist would back his idea for a contraceptive sponge. His company, VLI Corp., completed a $26 million public offering in 1983



Gordon



Gordon

a-bed is to a couch," says Rusty Hammond, a Fort Worth, Tex., inventor-entrepreneur. In 1982 Hammond revved up Leisure Mfg. in Des Plains, Ill., a company he'd mothballed from one of his earlier ventures, to produce the $995 folding grill. Despite a minimum of advertising, sales have reached $2 million, Hammond says. Unsatisfied, Hammond has enlisted the help of six "business angels" who are now preparing to invest $1.2 million in a plan to boost sales to $50 million in five years. Although Hammond is an experienced businessman, he wants to run Leisure Mfg. at a distance.

Jerry Stubblefield learned Hammond's lesson the hard way. A former high school physics teacher and basketball coach, he invented a radically different athletic shoe, featuring a shock-absorbing, "cantilevered" sole in 1977. After nearby Nike Inc. turned him down, he licensed the technology to Osaga, a shoe retailer backed by Japanese giant Mitsubishi. When Osaga foundered in 1980, he canceled the license, located a pair of business partners, and raised $850,000 in convertible debentures to launch Pensa Inc. in Tigard, Ore.

Eighteen months later, just as the firm was ready to ship its Avia basketball shoes, Stubblefield's partner announced the company was broke. "I understood what the athlete wanted in footwear, but I didn't understand business," he shrugs.

In September, 1982, Pensa was bailed out by a personal $250,000 infusion of funds from venture capitalist Henry Hillman, who took over the helm and recruited sales help from Nike. Stubblefield took a back seat as vice-president for R&D. With the aid of an additional $2.5 million in venture capital, Pensa's sales rose to $8 million this year from $1.8 million in 1982. The firm is now profitable, and Hillman expects sales of $20 million in 1985. Stubblefield keeps a 25% stake in Pensa. "Most inventors would like to become entrepreneurs," he says, "but what it takes is organization—marketing, sales, finance—and most inventors can't do it alone."

Robert Henry, the inventor of a new blood test, didn't try to do it alone. He got help from both a venture capital company and an outside partner. Henry was general manager of Union Carbide's European medical products division in France when the business was sold in 1981. He left and soon devised a technique to identify antibodies in the blood using dye polymers—giant molecules that can signal the presence of a disease by changing color in solution. Current techniques in the $400 million immunoassay business require use of mildly radioactive substances or costly enzymes to identify antibodies.

Once he had established the concept, Henry headed for the U.S. But he found that even an inventor with excellent credentials has a hard time getting a hearing from venture capitalists. After one year of pounding the pavement, he raised $750,000 in equity money from a team headed by CW Ventures in New York and an additional $800,000 through an R&D partnership in April, 1983. Henry's Photec Diagnostics Inc. of Little Falls, N.J., plans to release its first clinical product in the first quarter of 1985 and expects sales for the year to top $500,000.

Henry says he understood from the beginning that he would need a partner. Through CW Ventures, he found Jim Mongiardo, a 10-year veteran of

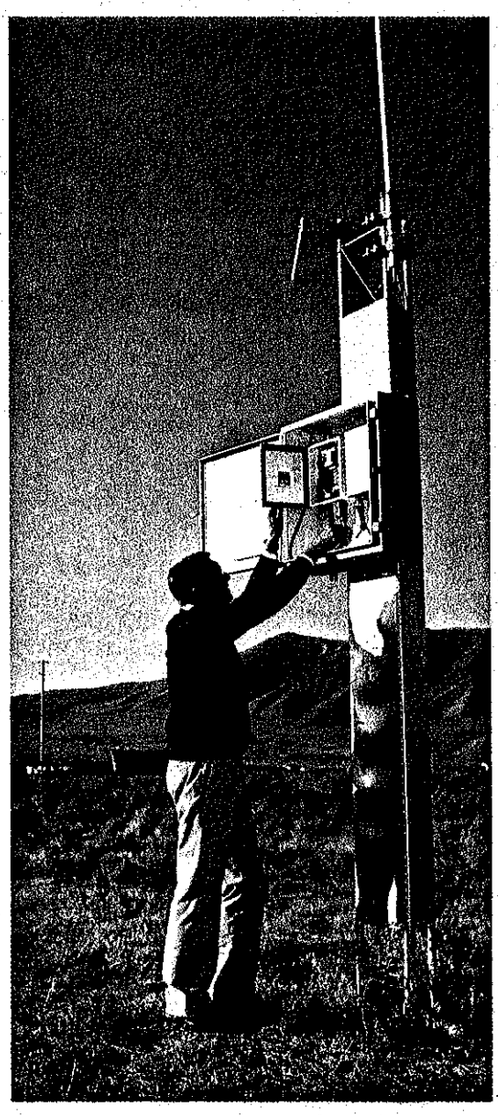
Schering-Plough Corp., who had been responsible for U.S. marketing. Since joining Photec as president last March, Mongiardo has assumed control of marketing and administration, freeing Henry to handle R&D and production.

CW Ventures is one of the rare venture firms that backs lone inventors. Crosspoint Venture Partners is another. The Palo Alto, Calif., firm manages $58 million in funds and nurses young startups in an 11,000-sq.-ft. incubator, where new companies can rent office space for one-tenth the going rate, according to partner John Mumford. One engineer, William Cargile, has been made a Crosspoint general partner. For a five year period, ending in 1979, Cargile had tried unsuccessfully to sell an electronic device that tested automobile shock absorbers, oblivious to a lack of demand for his product. "The big issue is marketing, not engineering," says Cargile. "That's what brought this inventor back to earth."

With $400,000 seed funding from Crosspoint, Cargile turned another idea into Software Security Corp. in November, 1983. The company manufactures an electronic lock designed to keep unauthorized users away from sensitive computer data. Without a $10 key that reads signals from the computer screen and translates them into a type-in access code, an information thief would have no chance to tamper with the software. Operation of the young company, recently renamed Gordian Systems Inc., has been passed to newly hired president Richard Otte. "The ideal situation for the inventor is to be in there for as long as he has to, and then to get the hell out before he fouls it up," says Cargile, who remains as chairman of the venture.

In the end, however, the independent inventor's most likely source of finance remains the small private investor who can be pursuaded to pony up $10,000 to $50,000.

These business angels, says William Wetzel, professor of finance at the Whittemore School of Business and Economics at the University of New Hampshire, are more likely than a venture capitalist to back an inventor because they tend to be willing to wait longer for a payback. In a 1981 Small Business Administration-backed study of business angels, Wetzel found that a quarter of a sample of 133 were willing to wait more than 10 years for a return or simply felt the length of time did not matter. (Venture funds, on the other hand, look for a return within 5 to 7 years.) With a small grant, Wetzel has launched a pilot program to identify business angels and match their investment interests with potential entrepreneurs. Entrepreneurs are charged $100 to sign up for this pilot computer matching service. Since the program was launched in May of this year, "the volume of activity has outstripped our expectations," Wetzel says.



Lance Iverson/Picture Group

Inventor John Kleppe (above) is using government contracts, a $750,000 private placement, and the sale of a prior business to get Scientific Engineering Instruments off the ground. Kleppe's invention bounces radio signals off the tails of meteors

Angel Echevarria borrowed $35,000 from relatives to launch a furniture ticking business 17 years ago. The business venture served as the springboard for his own invention, a waterbed mattress marketed as the Somma, which has boosted annual sales of privately held Angel Echevarria Co. Inc. to $36 million. Patented in 1978, the mattress contains seven water-filled cylinders that run from the head to the foot of the bed and use only three inches of water instead of the standard 10. The Los Angeles businessman was able to get his invention started with the help of a $250,000 SBA loan, but for the most part, Angel Echevarria has been his own angel.

Bruce Vorhauer, the inventor of a contraceptive polyurethane sponge, needed business angels to get his business off the ground and to rescue the company five years later. Vorhauer, a vice-president for research and development at American Hospital Supply, quit the company in 1975. It took $300,000 from a friend to launch VLI Corp. and two years of experimentation in a Newport Beach, Calif., kitchen before others began to take notice. The Ford Foundation backed initial clinical tests in Mexico City, and in late 1977, drug giant G.D. Searle loaned VLI $400,000 interest free in exchange for rights to buy the company. Beset with internal problems, Searle dropped the project, but in 1979 Schering-Plough signed a similar deal for a $180,000 loan. In early 1980, Schering-Plough dropped out.

"Two big drug companies had dropped me," recalls Vorhauer. "By the third quarter of 1980, things were grim." But in late 1980 a group of physician friends raised $500,000 in an R&D partnership in exchange for a 20% stake in the company. VLI's first round of venture capital financing, $2 million worth, followed in 1981 from Golder, Thoma & Cressey, Continental Illinois, and the Sprout Group. An additional $3 million came through in 1982, and after the

Inventors dream of running their own companies. It's hard for them to step aside

FDA approved Vorhauer's sponge in April, 1983, VLI completed a $10 million private placement. The firm netted another $26 million in a public offering underwritten by L.F. Rothschild, Unterberg & Towbin, N.Y., that October. VLI today is engaged in a major assault on the contraceptive market, having launched a $5 million national advertising campaign for its Today sponge. VLI showed a loss of $2.9 million on sales of $8 million through the first three quarters of 1984.

Not all inventors are ready to surrender control or take a back seat. Inventors interested in keeping control and willing to pass up fast growth are likely to turn to bootstrapping—generating capital from internal operations. Gardner Martin has bootstrapped the production of his recumbent bicycle, which retails for $850. Martin's idea for the Tour Easy developed out of his work with a cult of engineers who design aerodynamic shells for bicycles that race at Indianapolis and other speedways. Aided by his wife and a partner, Martin subcontracts manufacturing of the bicycle components and assembles them in a Watsonville, Calif., barn. Founded in 1980, Easy Racers Inc. earned $30,000 on sales of $100,000 in FY 1983, and Martin didn't pay himself a salary. In FY 1984, Easy Racers showed a small loss on sales of $110,000, and Martin did draw a paycheck. He's exploring the possibility of forming a limited partnership or securing an SBA loan to finance a plan aimed at quadrupling sales. "We're in a position now, that if we want to borrow some money, we probably can," he says. "I'm going to try to make $1 million in sales next year."

RELYING ON HUSTLE

For other inventors, like Boston's John Adams, bootstrapping is a way of life. Adams' career as an inventor began when he was a student at Harvard 15 years ago. Adams is the inventor of an array of products, including book holders for bathtubs, foldable luggage carts, and a plastic grabber to protect fingers from Brillo pads. Adams Products and Research Co. incorporated in 1975, generates revenues of "under $200,000" annually from the manufacture and sale of the inventions. Adams says that he has made hundreds of thousands of dollars on some of his ideas, but "if you love inventing, you find it gets eaten up with new projects."

No millionaire, Adams relys on hustle to finance his projects, cutting deals with banks, subcontractors, and business angels. He survives, he says, by constantly inventing new products and because of the good will of those "who do not call in their loans."

To sell his patent, John Yount, inventor of a method to chemically strip scrap fiberglass of its resins, had to get the attention of a prospective licensee, so he wound up starting his own company. Five years ago, Yount, now president of J.W. Yount Corp., a distributor of chemical degreasers and cleaners, in tiny Bullock, N.C., first tried to sell the idea to Owens-Corning Fiberglas, which buries 25,000 lbs. of scrap a day at a plant in Aiken, S.C. "They told me to take a flying leap," he says. Undaunted, he invested $25,000 of his own money and built a pilot plant himself. He began clearing $600 a day selling recycled fiber to such Owens-Corning customers as GAF. That brought Owens-Corning running. The company paid him $15,000 for an option on the patent and built a large pilot facility in Aiken for further testing.

Bootstrapping isn't necessarily either small or simple. John Kleppe's Scientific Engineering Instruments Inc. has supported its R&D phase through a combination of government contracts, corporate R&D work, and the proceeds from the sale of one of Kleppe's former companies. The Sparks, Nev., company builds components for a remote data acquisition network that relies on bouncing radio signals off meteorite trails. "Meteorburst" communications is, in fact, a little known but proven technology pioneered in the 1950s by military re-

PATENT HELP FOR INVENTORS

"A patent only gives you the right to go to court," notes Florida inventor Jerry Hawke. "The average cost of a patent infringement suit is $200K, and you usually lose."

Theoretically, a patent is a contract between an inventor and the federal government granting the inventor a 17-year monopoly on an idea in exchange for making it public. Unfortunately, in reality, the patent application process has become time-consuming and costly, and the patents themselves ambiguous and vulnerable.

But things are changing. An overhaul of the patent system began in October, 1982, set up a new federal Circuit Court of Appeals for patent cases. Since then, new patent attorneys, experts claim Judge Howard Markey has dramatically shifted the balance of decisions in favor of inventors. "The courts are now sustaining patents that would have been struck down in the past," says Boston patent attorney Martin O'Donnell. "The value of a patent today is stronger than at any time in the century." Markey's rulings are having the intended effect at the district court level.

Meanwhile, changes in patent office procedures are promised to improve patent protection by streamlining the application process. Commissioner of Patents & Trademarks Gerald Mossinghoff has doubled the budget to fund a $30 million program to computerize the office's massive filing system, with completion of the project slated for 1988.

—S.R.

Most venture capital funds don't welcome inventors. Investors don't put money in ideas, says one consultant, they invest in businesses

searchers. The earth's atmosphere is bathed in billions of dust-size meteors, whose fiery arrivals on earth leave ionized trails that can amplify a radio signal. In effect, meteor trails can do for free what a $150 million commmunication satellite is designed to do.

Crucial to Kleppe's network is a system of transmitters that fire signals at randomly timed intervals. Called Popcorns, they transmit data up to 100 miles from the sites of remote sensors to a central station that can then use meteorburst to send the information anywhere within a 1,200-mile radius. Sales of the five-year-old research firm were only $133,000, mostly from R&D contracts, in FY 1984, but Kleppe says he is angling for a $4.5 million contract with the Egyptian government to report water levels along the Nile River. In July, 1984, the company raised $750,000 in a private placement. "The problem with marketing this," Kleppe acknowledges, "is that it sounds so bizarre." Still, Kleppe expects sales to reach $21 million by 1987.

Increasingly inventors can go to Uncle Sam instead of near relations for funds. Several new government research programs have increased funding for independent inventors. But competition is intense and some of the programs are slanted toward inventors with established research facilities rather than backyard tinkerers. Here, too, it seems inventors are more likely to succeed in getting a grant if they're part of a company.

REPAVING HIGHWAYS

One government program sponsored by the National Bureau of Standards and the Dept. of Energy is aimed at lone inventors whose ideas might yield energy savings. Out of 20,000 applications screened by the NBS since 1975, 180 have received grants totaling $14 million, says George Lewett, NBS chief of the federal Office of Energy Related Inventions. A study by Mohawk Research Corp., Lake Forest, Ill., found that every dollar put into the program generated $17 in sales and follow-on private risk capital. The program has a budget of $5 million for FY 985.

Among the beneficiaries of the federal grants is Dick Jeppson, a Carmel, Calif., inventor and entrepreneur who has developed a vehicle to resurface highways by melting the pavement with microwaves, remixing the asphalt, and rolling it out again. "You can make a new highway with the materials already there," says Jeppson, who shares his patent with Micro Dry Corp., a microwave drying equipment maker he founded in 1962 and subsequently sold. Jeppson's Microwave Pavement Heating Systems Corp. has used two federal grants totaling $89,000 to refine the concept, and he is now seeking $3.3 million in venture capital to develop a full-scale prototype.

With passage of the Small Business Innovation and Development Act in July, 1982, the stage has been set for substantial increases in government funding of independent inventors. Small Business Innovation Research (SBIR) grants totaling $125 million were awarded through 12 government agencies in FY 1984, and the figures will rise to $450 million annually by FY 1987. A National Science Foundation SBIR pilot program, launched with $1 million in 1977, yielded $8 of private investment for every federal dollar spent. Initial grants of $50,000 are designed to fund proposals for six months. Second phase grants run up to $500,000. But program administrators look for an equal commitment of third-party money before awarding a second phase grant.

The government programs aren't designed for the backyard tinkerer. According to Roland Tibbetts, SBIR program manager at NSF, only 19% of his agency's grantees to date are one- or two-person firms. "If you don't have a good research facility, forget it," says Tibbets. "We're aiming at high risk, university-quality research."

The SBIR program helped former IBM engineer John Bates get his invention off the ground, but, again, it took outside management to turn the idea into a substantial business. A $30,000 grant in 1981 helped the Endicott, N.Y., engineer build a model of his voice recognition system, which he had developed at home for nearly a decade. The most significant contribution may have been the SBIR-sponsored seminar he attended in June, 1982, where he met the speaker, businessman Peter Vollers. Seven months later, Bates and Vollers founded Vois Inc. Through Vollers' connections, the company raised $100,000 with the sale of a nonexclusive license, and the firm expected to close a $2.5 million R&D partnership to bring the product to market in 1985. "Without strong professional and financial management help, he would still be in his basement," says consultant Burt Alimansky, who helped arrange the financing.

Today's entrepreneurial climate bodes well for the inventor, but it does not guarantee success. "The opportunities for an inventor to realize delivery into the marketplace have certainly increased," says Pepperdine's Krasner, "but the potential of that process contributing much more is great." "The greatest need in the process of innovation is practical education for inventors on how to get their idea to market," says the Bureau of Standards' George Lewett. "We can out-invent the rest of the world," says Udell, "but you've got to get people turned on—there's got to be incentive."

Will Russia Dare Clean Up Its Economic Mess?

By Seweryn Bialer

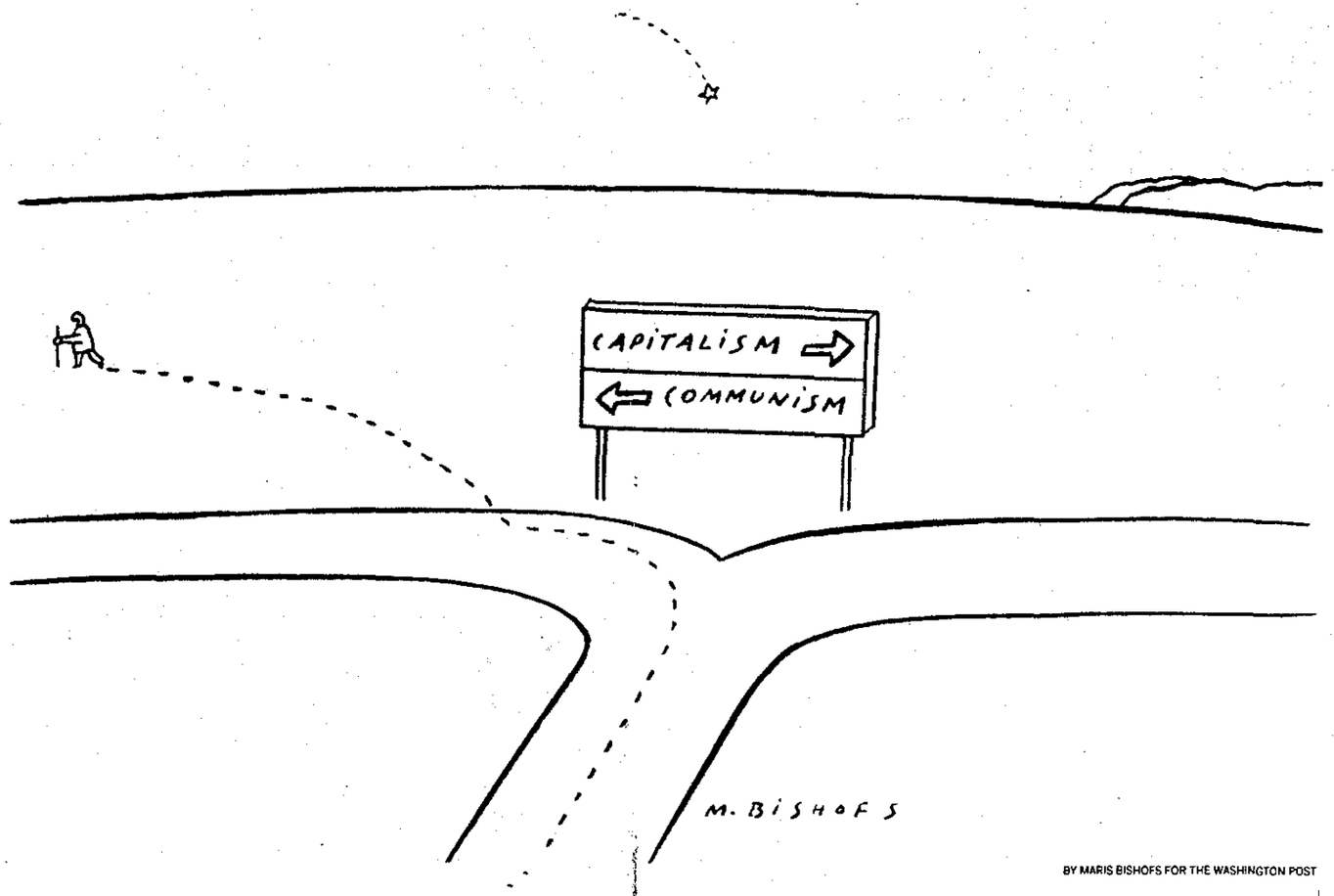
MIKHAIL GORBACHEV has come to power in Moscow at a time of grave crisis in the Soviet Union. The situation cries out for creative and forceful leadership. But will Gorbachev be able to provide it? Will a new Soviet leader really be able to make a difference?

Gorbachev has inherited a non-competitive Soviet economy that is in a terrible state. A cumbersome system of central planning produces shoddy goods, and discourages any sort of creativity or technological innovation. The Soviet economy is simply incapable of participating in the high-tech, electronic age.

The economic crisis is compounded by a social crisis, manifest in a catastrophic decline of the work ethic and of discipline among Soviet workers and managers. Corruption and drunkenness are rampant. Upward mobility for the children of the Soviet working classes, once a major stabilizing factor in society, is declining precipitously. Workers' children no longer can expect to get higher education and better jobs than their parents.

A political crisis has also been obvious in the paralysis of leadership of the last half dozen years, when old leaders have proven incapable of meeting the many challenges before them. Crisis is also evident in ideology. Marxism-Leninism has degenerated into familiar, but irrelevant, sloganeering. With rare exceptions, Soviet books, movies and plays are dreary representations of a make-believe world of heroic workers and selfless officials that few citizens even pretend to recognize as real.

The most intriguing option available to Gorbachev and his colleagues under these circumstances would be radical reform — a broad and thorough overhaul of the economy and political institutions that would change the fundamental operating principles of the Soviet system. It would involve not a change *in* the system but *of* the system.



BY MARIS BISHOFS FOR THE WASHINGTON POST

But logical as such an initiative might seem to Western eyes — and tempting as it may be for the new leadership in Moscow — such sweeping change would face formidable opposition from within the system. Radical reforms can be attempted only by a brave, self-confident leader who is ready to assume major risks, and can convince his coalition that these risks are necessary.

To enter on such a road Gorbachev would have to be as ruthless and single-minded as Joseph Stalin was with his "revolution from above" in the 1930s, and as adroit a politician as was Nikita Khrushchev in the first seven years of his anti-Stalin campaign. For while almost everyone in Russia speaks about the urgent need for reform, a radical reform program in fact lacks a constituency from below.

Nevertheless, the possibility that Gorbachev and his closest collaborators will attempt radical changes cannot be excluded.

In the event they do, their policies are likely to borrow from Hungary's successful "new economic mechanism" or Yugoslavia's "market socialism." Those countries are now ahead of other communist societies in overall economic performance, consumer satisfaction, ability to absorb Western technology and ability to adjust to changes in the international marketplace.

See GORBACHEV, K2, Col. 1

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Assuming that a radical reform is not in the cards for the 1980s, how much can the Soviet domestic system improve under Gorbachev? Gorbachev need not transform the Soviet Union to be a successful leader, at least in the short term. For the last seven or eight years, Russia has been muddling down. Gorbachev will be a success if he can merely get the Soviet behemoth to muddle up.

Outside of radical new policies, there are at least four other approaches that Gorbachev can consider.

The first is the easiest — to shake up the system by reinstituting strong, vigorous, demanding central leadership. This is already happening. The top decision-making and executive bodies, the politburo, the Communist Party secretariat and the council of ministers will be purged of the old or inefficient, who will be replaced by the younger and energetic of proven talent.

The authorities will crack down on lax work habits and appeal to patriotism and pride to cajole a better performance out of the workforce. They will revive the policy initiated in the short-lived regime of Yuri Andropov of prosecuting cases of brazen and large-scale corruption. And they will try to teach modern managerial techniques to many of the nation's managers.

The second option is to reorder national priorities and redistribute existing resources.

Tinkering of this kind could have a real impact, as one example — that of energy — suggests. The major thrust of the existing Soviet energy program is to increase (despite soaring costs) petroleum production in the forbidding conditions of western Siberia, and to convert Soviet industrial consumers from oil to gas.

But, as we have learned in the industrial West, the most promising and least costly way to deal with the energy problem is to promote conservation. In Russia, that would require rewarding managers of individual enterprises for using less energy. But such an incentive would be almost a contradiction in terms for the Soviets, for whom more has always meant better.

Changes in policy are also likely in agriculture. Chernenko announced an extensive program to reclaim



MIKHAIL GORBACHEV

vast areas of marginal farmland. But there is good reason to doubt the effectiveness of this policy, and Gorbachev could radically alter it in favor of intensifying production and improving efficiency on existing farmland.

As much as 20 percent of the average Soviet harvest is wasted for want of adequate roads, trucks, railroad facilities, grain silos and fertilizer storage. I expect Gorbachev to concentrate on this problem.

A third option would be to make changes in Soviet organizations and the bureaucracy. Near the end of his career, Khrushchev tried to radically reorganize the Communist Party's huge bureaucracy. Other party officials resisted, and Khrushchev's tinkering was used against him by those who removed him from power in 1964. Khrushcehv's "harebrained schemes" are now famous in the Soviet Union, and their bad reputation will discourage Gorbachev from doing much in this realm.

If Gorbachev does tinker, he might concentrate on the agencies and organizations that deal with new technology and foreign trade. The Soviets have never been able to get branches of the Academy of Science that are concerned with new technology to work closely with governments ministries concerned with running the economy.

As matters stand, an intelligent factory manager actually *resists* introducing new technology, because he can fulfill his quotas with the equipment and the introduction of new and more efficient technology or machinery would just mean higher quotas.

Gorbachev may also try to break down the the sharp divisions between the civilian and military economies, so the better-organized military sector can help the civilian side become more efficient. He could have military factories manufactureconsumer durables such as appliances. Or he could have the more talented military production managers help civilian factories.

In agriculture, Andropov sent agricultural contract brigades to many collective farms, particularly in the important farming areas of Georgia and Armenia. Relatively small groups of collective farmers are assigned plots of land and agricultural implements. They sign production contracts with the government and are guaranteed rewards when they exceed quotas. This system could be improved and expanded.

A fourth option is to allow a little private enterprise.

Inadequate services in cities, from plumbing to shoe repair to small restaurants, could use a dose of private initiative. The poor quality of these services, which has given rise to a large illegal (or semilegal) "second economy," contributes to inflationary pressures and frustrations in everyday life. Allowing private services would depart from traditional communist ideologically. But such businesses would only exist at the margins of the economy, and would not endanger the party and state's political control over the economy as a whole.

The timidity of Soviet leaders has prevented such reforms in the past. This failure is an example of the psychology of Soviet functionaries for whom the concept of "spontaneity" is still a taboo, and who are aghast at the idea that anything could exist in Russia which is not entirely under their control. Breaking out from these psychological restrictions is a necessary precondition for reform.

Nevertheless, I would not dismiss all the reform steps that the new leader may undertake as mere cosmetic changes. Their cumulative effect may improve the Soviet domestic situation and even arrest the declining performance.

To a decisive degree, their effectiveness will depend on the strength of will, persistence and vision of Gorbachev himself, and particularly on his ability to shape a coalition within the Soviet hierarchy that is committed to reforms, both because of its loyalty to Gorbachev and because of its conviction that change is what Russia needs.

The outcome of Gorbachev's battle with bureaucratic inertia, political conservatism, ideological exhaustion and the present mood of pessimism will define to a large degree not only the Soviet domestic situation but also its international standing and aspirations.

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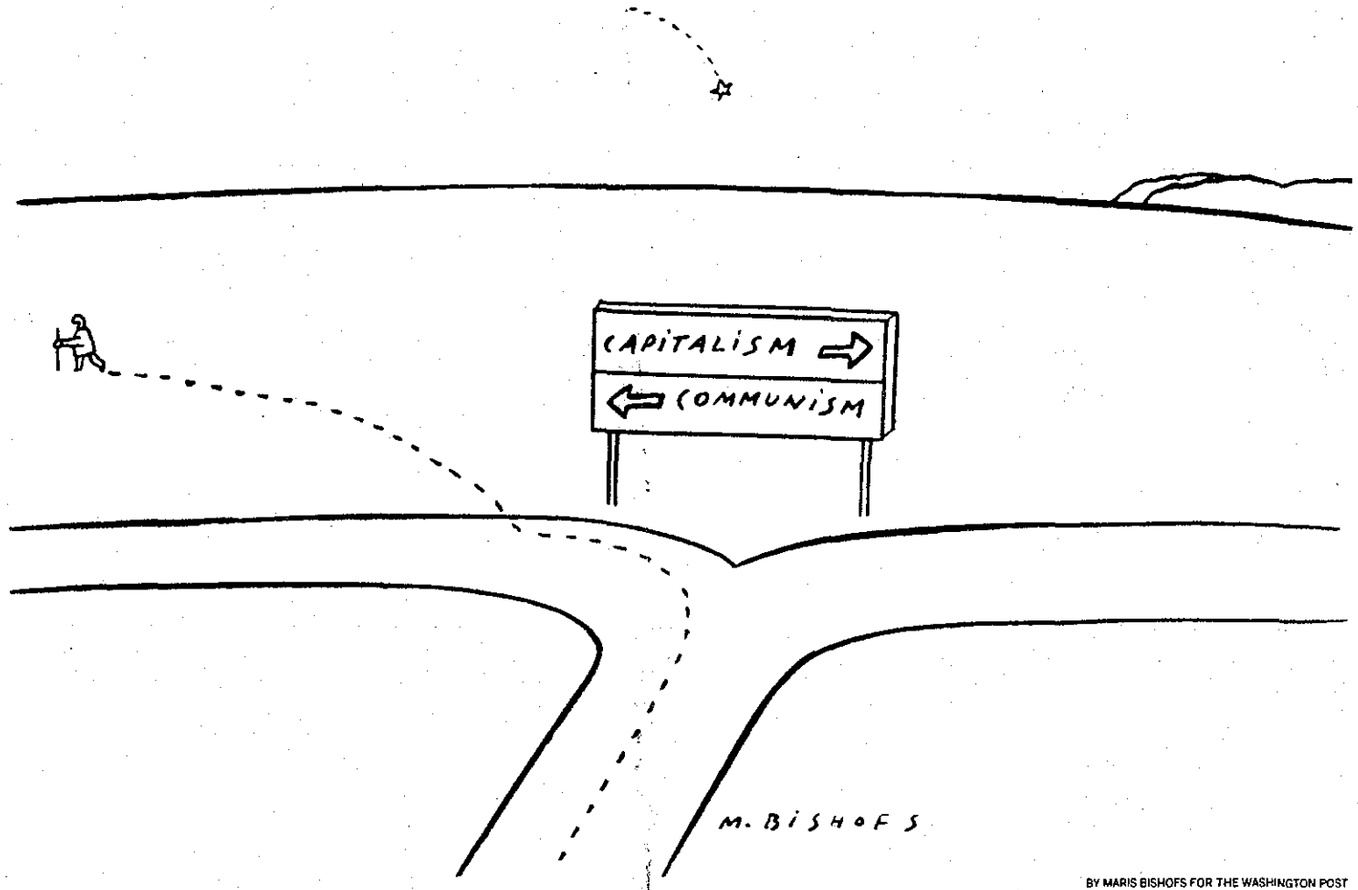

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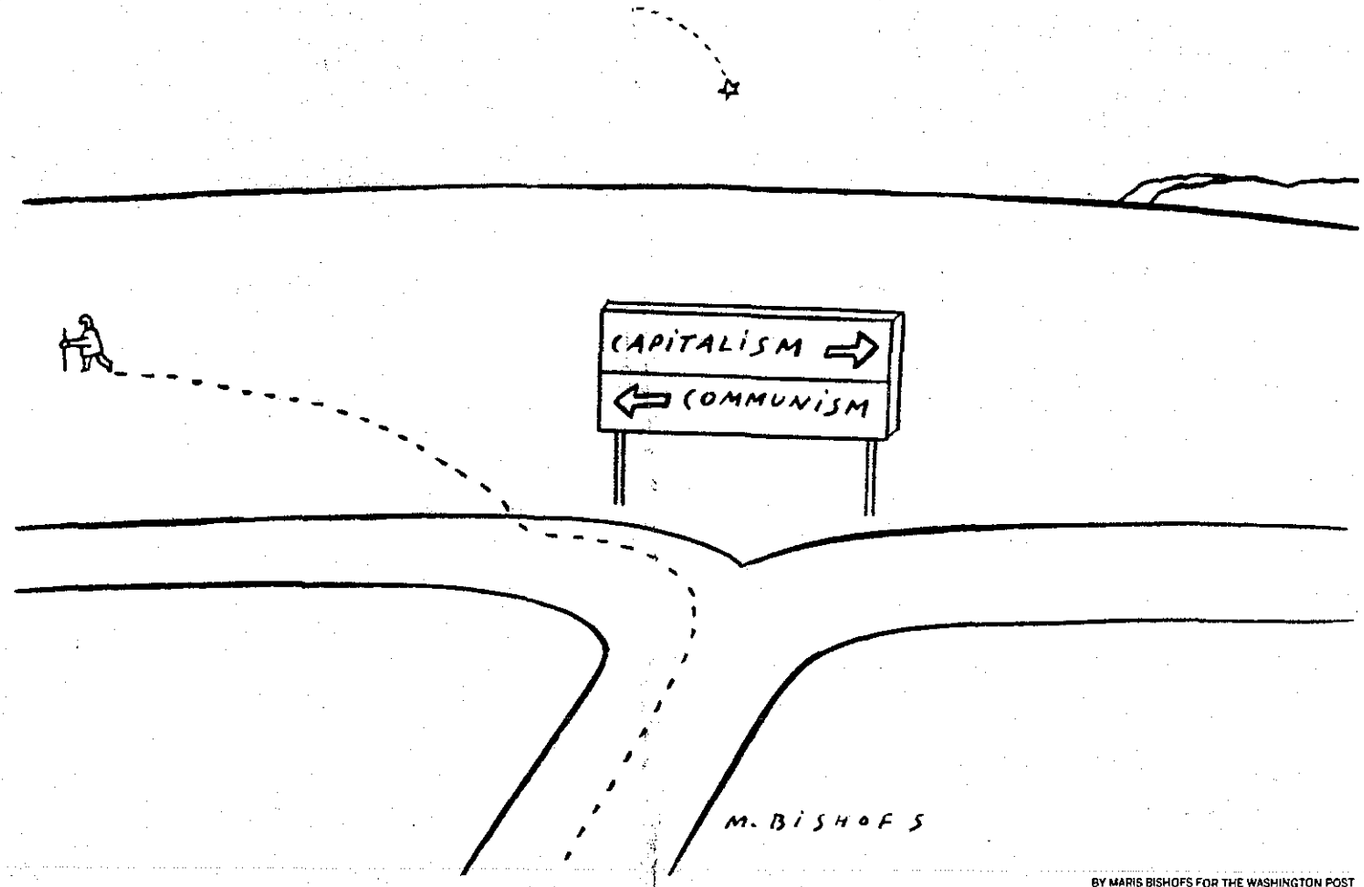

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GORBACHEV, From K1

The most recent, dramatic example of radical reform in progress is the People's Republic of China, where collective farms have been dissolved and peasants are working on their own farms, and where industry is being reformed to give more independence to factory managers, make prices more realistic, reduce government subsidies and accept more foreing investment.

However, domestic and international conditions in the Soviet Union are different from those in Hungary or China, where non-Hungarian or non-Chinese minorities compose only a small percentage of the population. The Soviet Union, by contrast, is a collection of diverse nationalities. Almost half the population is non-Russian and could be expected to take advantage of any economic decentralization to gain more political independence. The possibility of such loss of central control over the Soviet Union's non-Russian people raises risks few Russians are prepared to entertain.

Often in the West the foes of reform are identified as the top *apparatchiki*, the high-level party leaders, while the supporters of reform are identified as the managers of factories and collective farms, and the professionals within the system.

It is my opinion that such a picture is greatly distorted. As Gertrude Schroeder, a leading U.S. expert on the Soviet economic system, has remarked: "After 60 years of experience with the socialist economy run by government agencies . . . nearly everyone seems to have found ways to turn its shortcomings to individual advantage."

Soviet managers can hardly be described as supporters of radical reform. Their entire education, experience and expertise has prepared them to work within the system as it is and to exploit for personal benefit its loopholes and irrationalities. A change of the system would nullify their entire expertise and jeopardize their very jobs in favor of the younger, the better-educated and more adroit.

The government bureaucracies and their local units would lose their reason to exist and would shrink in size. They would be reduced to accounting rather than leading. The lower- and middle-level bureaucrats would see their power diminished in favor of the power of the "invisible hand" of the market.

Moreover, the experts who advocate economic reforms are divided about the kind of reform they would like to see, a fact that could neutralize their influence. If the professional groups continue to speak in a divided voice, both proponents and opponents of radical reform within the leadership will be able to find and mobilize experts for their respective positions.

The most serious obstacles to radical reform are political. To adjust the prices of goods and services to realistic levels, for example, the enormous state subsidies of basic food items, apartment rents and transportation will have to be abolished or cut drastically.

This would require the imposition of a harsh austerity regimen on the Soviet people long before any major beneficial results of the reform were tangible. The lessons of Poland and its free-trade union "Solidarity" movement — which arose when the government tried to raise prices of basic goods such as food to realistic levels — probably teach the Soviet leadership to be extremely wary of such changes.

Finally, radical reform could affect the stability of Eastern Europe. Radical changes in the Soviet Union would encourage all reformers and liberals there to press for greater (and politically more dangerous) changes in their own countries.

Even if he is determined to do something radical, Gorbachev could only act after painstaking and time-consuming preparations. Sweeping changes would be more likely in the 1990s than in the remainder of this decade.

Considering all these barriers, a revolution may well be easier than a reform — or a radical reform might become the equivalent of a revolution. Recognizing this, many in Russia and the West who are skeptical about the chances that even a new, young and energetic leadership will embark on such a potentially dangerous enterprise, often speak of a "partial" radical reform.

But a radical reform cannot be partial; it cannot be successful when introduced in small, gradual steps. The courage — and the wisdom — of the present Chinese leadership is reflected in their decision *not* to plan a piecemeal reform but to opt for comprehensive change of the economic system as a whole.

The magnitude and variety of domestic problems besieging the Soviet Union lead some Western commentators to proclaim, if not the imminent demise of the Soviet system, then at least the growing probability of a revolutionary crisis. But I am deeply convinced that their judgment about the nature of the Soviet domestic crisis is faulty.

The Soviet Union is not threatened with collapse. Soviet survival is not in doubt; Soviet *effectiveness* is. Decline can still be slowed or even reversed. This is a far cry from recapturing a new and lasting Soviet dynamism, but it is also far removed from any danger of disintegration.

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ment. The non-Russian nations of the Soviet Union will not rebel. The Soviet professional and middle classes will not endanger their careers by dissent. The Soviet party will not abdicate its dominant role. The Soviet military will not plot to take over power. Yet the crisis of the Soviet system is very real and if the trend is not reversed it may lead in the future to an authentic crisis of survival.

Assuming that a radical reform is not in the cards for the 1980s, how much can the Soviet domestic system improve under Gorbachev? Gorbachev need not transform the Soviet Union to be a successful leader, at least in the short term. For the last seven or eight years, Russia has been muddling down. Gorbachev will be a success if he can merely get the Soviet behemoth to muddle up.

Outside of radical new policies, there are at least four other approaches that Gorbachev can consider.

The first is the easiest — to shake up the system by reinstituting strong, vigorous, demanding central leadership. This is already happening. The top decision-making and executive bodies, the politburo, the Communist Party secretariat and the council of ministers will be purged of the old or inefficient, who will be replaced by the younger and energetic of proven talent.

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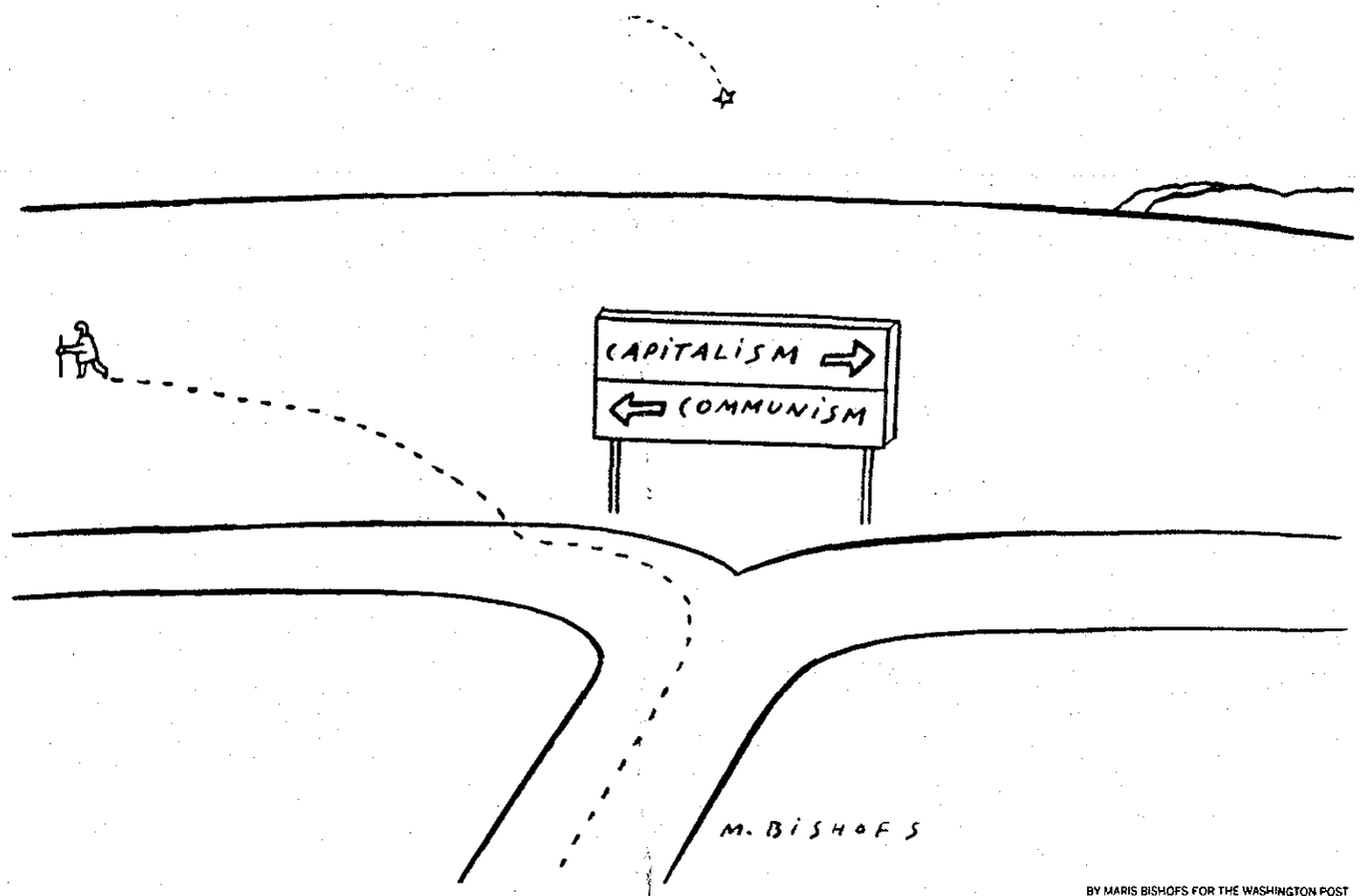

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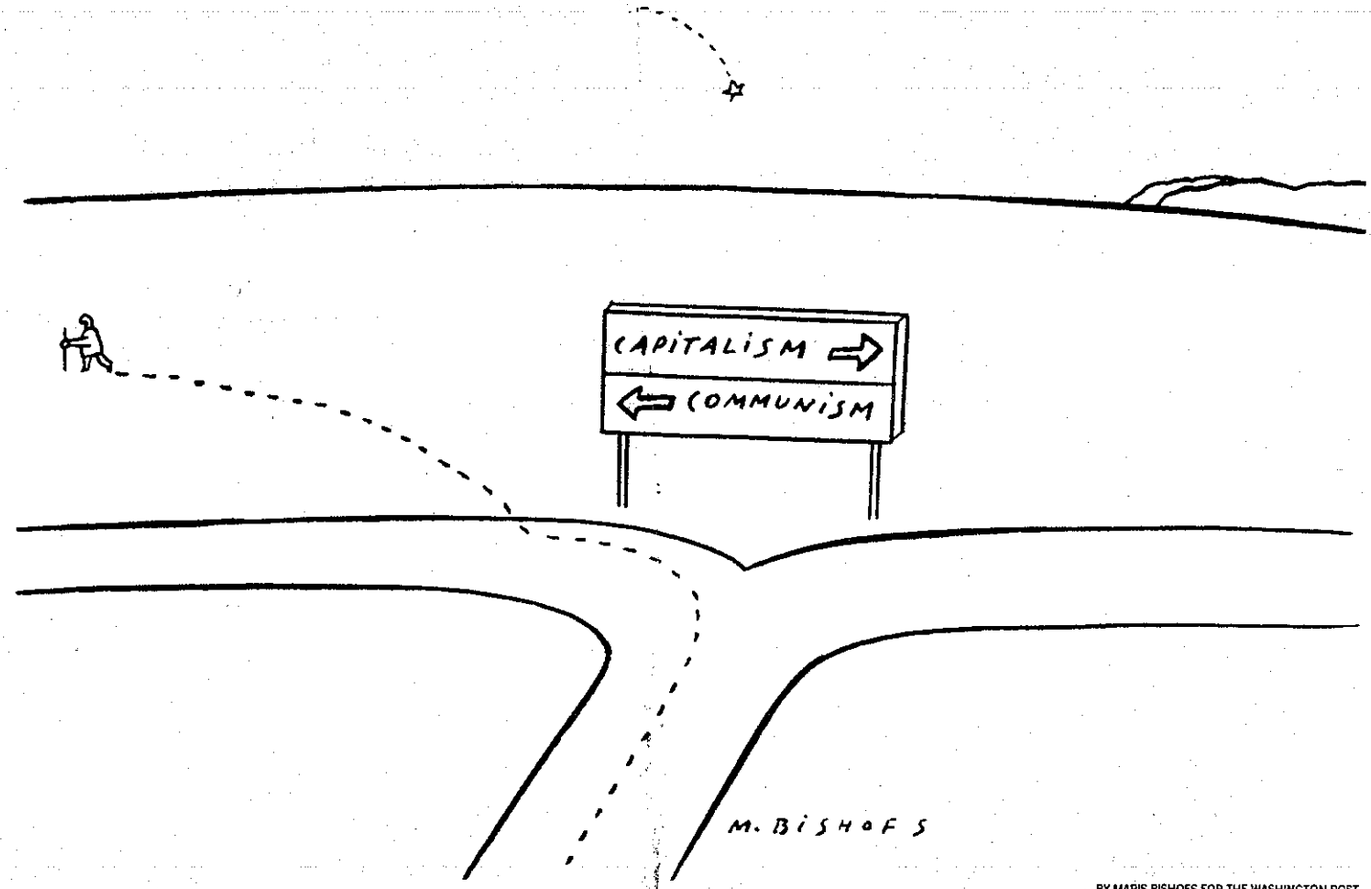

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GORBACHEV, From K1

The most recent, dramatic example of radical reform in progress is the People's Republic of China, where collective farms have been dissolved and peasants are working on their own farms, and where industry is being reformed to give more independence to factory managers, make prices more realistic, reduce government subsidies and accept more foreing investment.

However, domestic and international conditions in the Soviet Union are different from those in Hungary or China, where non-Hungarian or non-Chinese minorities compose only a small percentage of the population. The Soviet Union, by contrast, is a collection of diverse nationalities. Almost half the population is non-Russian and could be expected to take advantage of any economic decentralization to gain more political independence. The possibility of such loss of central control over the Soviet Union's non-Russian people raises risks few Russians are prepared to entertain.

Often in the West the foes of reform are identified as the top *apparatchiki*, the high-level party leaders, while the supporters of reform are identified as the managers of factories and collective farms, and the professionals within the system.

It is my opinion that such a picture is greatly distorted. As Gertrude Schroeder, a leading U.S. expert on the Soviet economic system, has remarked: "After 60 years of experience with the socialist economy run by government agencies . . . nearly everyone seems to have found ways to turn its shortcomings to individual advantage."

Soviet managers can hardly be described as supporters of radical reform. Their entire education, experience and expertise has prepared them to work within the system as it is and to exploit for personal benefit its loopholes and irrationalities. A change of the system would nullify their entire expertise and jeopardize their very jobs in favor of the younger, the better-educated and more adroit.

The government bureaucracies and their local units would lose their reason to exist and would shrink in size. They would be reduced to accounting rather than leading. The lower- and middle-level bureaucrats would see their power diminished in favor of the power of the "invisible hand" of the market.

Moreover, the experts who advocate economic reforms are divided about the kind of reform they would like to see, a fact that could neutralize their influence. If the professional groups continue to speak in a divided voice, both proponents and opponents of radical reform within the leadership will be able to find and mobilize experts for their respective positions.

The most serious obstacles to radical reform are political. To adjust the prices of goods and services to realistic levels, for example, the enormous state subsidies of basic food items, apartment rents and transportation will have to be abolished or cut drastically.

This would require the imposition of a harsh austerity regimen on the Soviet people long before any major beneficial results of the reform were tangible. The lessons of Poland and its free-trade union "Solidarity" movement — which arose when the government tried to raise prices of basic goods such as food to realistic levels — probably teach the Soviet leadership to be extremely wary of such changes.

Finally, radical reform could affect the stability of Eastern Europe. Radical changes in the Soviet Union would encourage all reformers and liberals there to press for greater (and politically more dangerous) changes in their own countries.

Even if he is determined to do something radical, Gorbachev could only act after painstaking and time-consuming preparations. Sweeping changes would be more likely in the 1990s than in the remainder of this decade.

Considering all these barriers, a revolution may well be easier than a reform — or a radical reform might become the equivalent of a revolution. Recognizing this, many in Russia and the West who are skeptical about the chances that even a new, young and energetic leadership will embark on such a potentially dangerous enterprise, often speak of a "partial" radical reform.

But a radical reform cannot be partial; it cannot be successful when introduced in small, gradual steps. The courage — and the wisdom — of the present Chinese leadership is reflected in their decision *not* to plan a piecemeal reform but to opt for comprehensive change of the economic system as a whole.

The magnitude and variety of domestic problems besieging the Soviet Union lead some Western commentators to proclaim, if not the imminent demise of the Soviet system, then at least the growing probability of a revolutionary crisis. But I am deeply convinced that their judgment about the nature of the Soviet domestic crisis is faulty.

The Soviet Union is not threatened with collapse. Soviet survival is not in doubt; Soviet *effectiveness* is. Decline can still be slowed or even reversed. This is a far cry from recapturing a new and lasting Soviet dynamism, but it is also far removed from any danger of disintegration.

The Soviet Union is not, and will not soon be, in a prerevolutionary situation. The Russian working class will not create a "Solidarity" move-

ment. The non-Russian nations of the Soviet Union will not rebel. The Soviet professional and middle classes will not endanger their careers by dissent. The Soviet party will not abdicate its dominant role. The Soviet military will not plot to take over power. Yet the crisis of the Soviet system is very real and if the trend is not reversed it may lead in the future to an authentic crisis of survival.

Assuming that a radical reform is not in the cards for the 1980s, how much can the Soviet domestic system improve under Gorbachev? Gorbachev need not transform the Soviet Union to be a successful leader, at least in the short term. For the last seven or eight years, Russia has been muddling down. Gorbachev will be a success if he can merely get the Soviet behemoth to muddle up.

Outside of radical new policies, there are at least four other approaches that Gorbachev can consider.

The first is the easiest — to shake up the system by reinstituting strong, vigorous, demanding central leadership. This is already happening. The top decision-making and executive bodies, the politburo, the Communist Party secretariat and the council of ministers will be purged of the old or inefficient, who will be replaced by the younger and energetic of proven talent.

The authorities will crack down on lax work habits and appeal to patriotism and pride to cajole a better performance out of the workforce. They will revive the policy initiated in the short-lived regime of Yuri Andropov of prosecuting cases of brazen and large-scale corruption. And they will try to teach modern managerial techniques to many of the nation's managers.

The second option is to reorder national priorities and redistribute existing resources.

Tinkering of this kind could have a real impact, as one example — that of energy — suggests. The major thrust of the existing Soviet energy program is to increase (despite soaring costs) petroleum production in the forbidding conditions of western Siberia, and to convert Soviet industrial consumers from oil to gas.

But, as we have learned in the industrial West, the most promising and least costly way to deal with the energy problem is to promote conservation. In Russia, that would require rewarding managers of individual enterprises for using less energy. But such an incentive would be almost a contradiction in terms for the Soviets, for whom more has always meant better.

Changes in policy are also likely in agriculture. Chernenko announced an extensive program to reclaim



MIKHAIL GORBACHEV

vast areas of marginal farmland. But there is good reason to doubt the effectiveness of this policy, and Gorbachev could radically alter it in favor of intensifying production and improving efficiency on existing farmland.

As much as 20 percent of the average Soviet harvest is wasted for want of adequate roads, trucks, railroad facilities, grain silos and fertilizer storage. I expect Gorbachev to concentrate on this problem.

A third option would be to make changes in Soviet organizations and the bureaucracy. Near the end of his career, Khrushchev tried to radically reorganize the Communist Party's huge bureaucracy. Other party officials resisted, and Khrushchev's tinkering was used against him by those who removed him from power in 1964. Khrushcehv's "harebrained schemes" are now famous in the Soviet Union, and their bad reputation will discourage Gorbachev from doing much in this realm.

If Gorbachev does tinker, he might concentrate on the agencies and organizations that deal with new technology and foreign trade. The Soviets have never been able to get branches of the Academy of Science that are concerned with new technology to work closely with governments ministries concerned with running the economy.

As matters stand, an intelligent factory manager actually *resists* introducing new technology, because he can fulfill his quotas with the equipment and the introduction of new and more efficient technology or machinery would just mean higher quotas.

Gorbachev may also try to break down the the sharp divisions between the civilian and military economies, so the better-organized military sector can help the civilian side become more efficient. He could have military factories manufactureconsumer durables such as appliances. Or he could have the more talented military production managers help civilian factories.

In agriculture, Andropov sent agricultural contract brigades to many collective farms, particularly in the important farming areas of Georgia and Armenia. Relatively small groups of collective farmers are assigned plots of land and agricultural implements. They sign production contracts with the government and are guaranteed rewards when they exceed quotas. This system could be improved and expanded.

A fourth option is to allow a little private enterprise.

Inadequate services in cities, from plumbing to shoe repair to small restaurants, could use a dose of private initiative. The poor quality of these services, which has given rise to a large illegal (or semilegal) "second economy," contributes to inflationary pressures and frustrations in everyday life. Allowing private services would depart from traditional communist ideologically. But such businesses would only exist at the margins of the economy, and would not endanger the party and state's political control over the economy as a whole.

The timidity of Soviet leaders has prevented such reforms in the past. This failure is an example of the psychology of Soviet functionaries for whom the concept of "spontaneity" is still a taboo, and who are aghast at the idea that anything could exist in Russia which is not entirely under their control. Breaking out from these psychological restrictions is a necessary precondition for reform.

Nevertheless, I would not dismiss all the reform steps that the new leader may undertake as mere cosmetic changes. Their cumulative effect may improve the Soviet domestic situation and even arrest the declining performance.

To a decisive degree, their effectiveness will depend on the strength of will, persistence and vision of Gorbachev himself, and particularly on his ability to shape a coalition within the Soviet hierarchy that is committed to reforms, both because of its loyalty to Gorbachev and because of its conviction that change is what Russia needs.

The outcome of Gorbachev's battle with bureaucratic inertia, political conservatism, ideological exhaustion and the present mood of pessimism will define to a large degree not only the Soviet domestic situation but also its international standing and aspirations.

engineering disciplines, and in a covering letter to the report, Robert M. White, president of the engineering academy, noted that "Without a complementary move to provide such support, cross-disciplinary research would be sapped at its roots."

Suh says the fears are groundless. "The rumor mill is churning out lots of wrong information," he says. It is true that new initiatives are claiming a growing share of the engineering directorate's budget, but even so, support for individual researchers has risen from $82.9 million in fiscal year 1983 to $95.4 million in 1985, he notes. "So far it hasn't been the case [that individual research awards have been squeezed], and I don't intend to make it the case."

Members of the fluid mechanics delegation say they came away from their 17 December meeting with Suh greatly reassured. In essence, he told them that the engineering centers program would not be allowed to grow at the expense of existing programs, and that he hoped to secure sufficient growth in the engineering directorate's overall budget to accommodate the new initiative.

Indeed, securing major growth in the directorate's budget is Suh's chief priority. The foundation's expenditure on engineering is "totally inadequate," Suh told *Science*, noting that it has sufficient funds to produce, on average, only one Ph.D. per engineering field per state per year. He says he hopes to see the total budget climb to $500 million by the end of the decade, a level that he still regards as "peanuts," but which would provide room for the centers and other initiatives he is planning. Those are the kinds of projections that make NSF's clients in the basic sciences nervous about their slice of the foundation's pie.

In particular, Suh says he would like to increase support for projects involving multiple investigators, expand the Presidential Young Investigator Awards program—a program begun last year that provides a flexible support to young researchers—and encourage more research in fields such as design that do not now have a strong science base.

He has already begun to put his stamp on the engineering directorate by withholding 10 percent of the directorate's budget for this year for possible reprogramming into priority areas. He has told program managers that the money will be available for high-risk, high-return projects.

As for the grumbling in the community, Suh says "It is what you expect when you do things differently."

—COLIN NORMAN

Europeans Adopt R&D Plan

Brussels. Research ministers from the ten member countries of the European Economic Community (EEC) agreed on 19 December to a major shift in the focus of their joint research efforts away from topics such as nuclear power and radiation protection—which have dominated these efforts since the community was established in the 1950's—toward technological fields that are likely to strengthen Europe's ability to compete commercially with the United States and Japan.

The shift is embodied in a 5-year, $1-billion package of research projects which was approved by the ministers largely at the urging of the outspoken commissioner for industry and research, Etienne Davignon, who has just reached the end of his 4-year term of office.

Davignon was largely responsible for one of the most significant developments in European technology policy in recent years, the EEC's strategic program in information technology (ESPRIT). The program, which will cost $1.3 billion over 5 years, will be jointly financed by the commission and European companies and is a direct response to the challenge from U.S. and Japanese computer industries. Full funding for the second year's operation of ESPRIT was approved at last week's meeting.

The broader research package represents an attempt to apply the same approach to a variety of precompetitive research projects in fields ranging from materials processing to biotechnology. The biggest new element in the package, for example, is a program known as basic research in industrial technologies for Europe (BRITE), which aims to get research workers together from universities, research institutes, and industrial laboratories to work on topics of industrial interest in more than one EEC member country.

The ministers agreed to allocate $100 million of the community's research budget to BRITE over the next 4 years. Fields in which joint research projects will be sponsored include laser technology, catalysis and particle technology, membrane science, polymer chemistry, and computer-aided design. According to Cyril Silver, head of the EEC's new technology division who is responsible for the BRITE program, the aim is to adapt to a European setting many of the ideas that have been explored in the United States in the past few years on ways of stimulating innovation in strategically important fields without requiring massive government-directed intervention.

Other new initiatives included in the package are a $45-million 4-year program to support efforts in biotechnology, primarily for research and training activities in national institutions, and a $50-million program aimed at stimulating greater cooperation between research groups in different EEC countries.

Working within severe budgetary limitations, the ministers were forced to cut back on some of their existing research activities to make way for the new programs. Research into the safety of nuclear reactors, for example, which was previously a separate project, is now to be made the responsibility of the EEC's Joint Research Center at Ispra in Italy, but without any extra funding being provided to the center.

The largest single cut will come in the fusion program, by far the biggest item in the total package. The commission had asked for $790 million over the next 5 years, but the ministers cut this back to $690 million, which will mean a reduction in the EEC's overall fusion effort. About half of this sum will be spent in the next 2 years alone, allowing full operation of the Joint European Torus (JET) at Culham in the United Kingdom. The cuts will be absorbed by stretching out the technology research programs that are directed by the next step after JET.

The overall package of $1 billion over a 4- to 5-year period was considerably smaller than the commission of the EEC had originally asked for, largely as a result of pressure from the British and German governments. However, the ministers agreed that almost half of this sum will be spent in the first 2 years; a review will be carried out at the end of this period to assess whether increased support is justified.—DAVID DICKSON

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THE FEDERAL REPORT

Bureaucracy Baffles Inventors

'Better Mousetraps' Snare Little U.S. Marketing Support

By Keith B. Richburg
Washington Post Staff Writer

Stephen Austin thought he had hit upon a pretty good invention: the world's first permanent waterway-dredging system. It was an idea that the St. Louis engineer figured would save the federal government billions of dollars because it would make routine dredging obsolete and equipment last longer. At a time when Washington politicians were committed to reducing budget deficits, Austin assumed that he would find an eager buyer here.

But five years of trying to peddle his idea to the U.S. Army Corps of Engineers has left him broke and frustrated. He's had two cars repossessed, his phone bills run $300 a month, and he says he can't get anyone in the corps to return his calls.

"There are thousands of people out there like myself who have what they consider the better mousetrap, but can't do anything with it," Austin explained. "I've gone broke. I've gone bankrupt—it's a sad story. "I've gone through every penny I've got . . . . I mean, I don't have anything."

Most recently, Austin contacted the Office of Management and Budget, where staff member Joyce Morrison promised to at least find someone to return his calls. But Austin's tale is a familiar one to scores of citizens who think that they have a way to save taxpayers' money—only to encounter what to them is a nameless, faceless stone wall known only as "The Bureaucracy."

"We get a batch of letters every day from frustrated Americans who have good ideas, but no one will listen to them," said J.P. Bolduc, chief operating officer of the Grace Commission who now heads Citizens Against Waste. Bolduc said the group, an outgrowth of the commission, encourages phone calls from the public and receives about 1,000 each day, many of them serious, well-researched proposals.

"When these suggestions come in from American citizens," he said, "there is really nothing in government today that provides incentives for federal employes to pick it up and run with it. For the federal employe, it means nothing but additional aggravation and frustration, especially trying to convince superiors. And you're not going to get anything in the way of additional pay or a bonus, so your reaction to a new idea is to kill it."

Several government agencies say they are receptive to citizen-generated ideas. Also, several programs are aimed specifically at helping small businesses and individuals develop ideas.

The General Accounting Office has a 24-hour, toll-free "fraud hotline" for citizens to report waste. The hotline has received 53,000 calls over the last five years, and a GAO spokesman said that about $24 million has been saved as a result. But the GAO is better equipped to deal with reports of waste than with new ideas or inventions, although, the spokesman said, those suggestions are forwarded to the appropriate agency.

The Energy Department, for one, has an Office of Energy-Related Invention Programs that supports inventors—such as a California engineer who recently invented a microwave pothole paver. Jack Vitullo, the office's director, said that in the program's 10 years, 195 inventors have received support, and 70 more are waiting. The catch is that the inventions must first be energy-related, and the inventors must be having financial trouble getting their inventions developed.

Vitullo said he sympathizes with the problems of people such as Austin. "We have in both government and industry the so-called 'Not Invented Here' syndrome. They figure they've got a lot of important people who are paid a lot of money to come up with things themselves."

In 1983, Congress created a Small Business Innovative Research program, requiring agencies to set aside a small percentage of their research budgets for small companies. Agencies will first publish a list of potential research subjects, then small firms get to bid on them. A winner receives $50,000 to develop his idea, and more later if the agency likes it. But in these cases, the agency and inventor work closely from the beginning on a specific project.

That still leaves many people who feel that they have no place to go.

Some have turned to the OMB because of its high profile in the budget-cutting process. As Austin said, "I finally went to OMB. If anybody can shake 'em loose, they can."

"We're kind of the place of last resort for people when they've gotten the run-around from all the other agencies," said OMB's Morrison. "You, of course, have the cranks out there, but there are people out there with good ideas."

Among those who think they have a good idea are Norman and Beverly Halem of Cocoa, Fla. The Halems patented a gadget called the "Pass Master" that disconnects a car's air conditioner when its engine is accelerated, thus saving gasoline. Since 1978, the Halems have been negotiating with the General Services Administration, trying to get Pass Masters installed on government vehicles.

Although the Environmental Protection Agency tested the Pass Master and reported that it was an effective gas-saving device, GSA wanted more tests performed. In the meantime, it began converting its fleet to smaller, more efficient four-cylinder cars, that, it says, make the Pass Master less effective than it is on larger-engine models. Also, the GSA noted, the large auto makers were already developing a similar device.

"Frankly, we're fed up," said Norman Halem, who testified in 1979 at congressional hearings on the resistance encountered by small businesses. "I'm ready to drop the whole thing . . . . How many times can we go to Washington and stand up on a soapbox? We cannot afford to advertise. We have decided that in 1985 we cannot afford to push it anymore, we're going to just let it take its course."

The Halems see theirs as a case of a small firm competing with Detroit's giant auto makers, vying for a sympathetic ear in an atmosphere of which they say, "If it wasn't invented in Detroit, forget it."

But to the Halems and Austin, the larger concern is for the future of individual creativity in America.

"The fact that we will probably end up going out of business is not the issue," said Beverly Halem. "The issue is, what is happening to the inventiveness of this country if you're always considered too small, and all ideas have to come out of IBM? We've lost what America was founded on."

Said Austin: "I don't have what they call credibility because I'm small and I'm new. The stifling of creativity is so evident."

"It's a big problem, it really is a big problem," said Bolduc. "Maybe we need a [national] ombudsman, or maybe we need a built-in incentive system for employes who take these ideas and run with them."



"We get a batch of letters every day from frustrated Americans who have good ideas, but no one will listen...."

—J.P. Bolduc