

Technology Review

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"Japan was already defeated....
It wasn't necessary to hit
them with that awful thing"
-Dwight D. Eisenhower

Did we need to drop the bomb?

A HISTORIAN
WEIGHS THE EVIDENCE

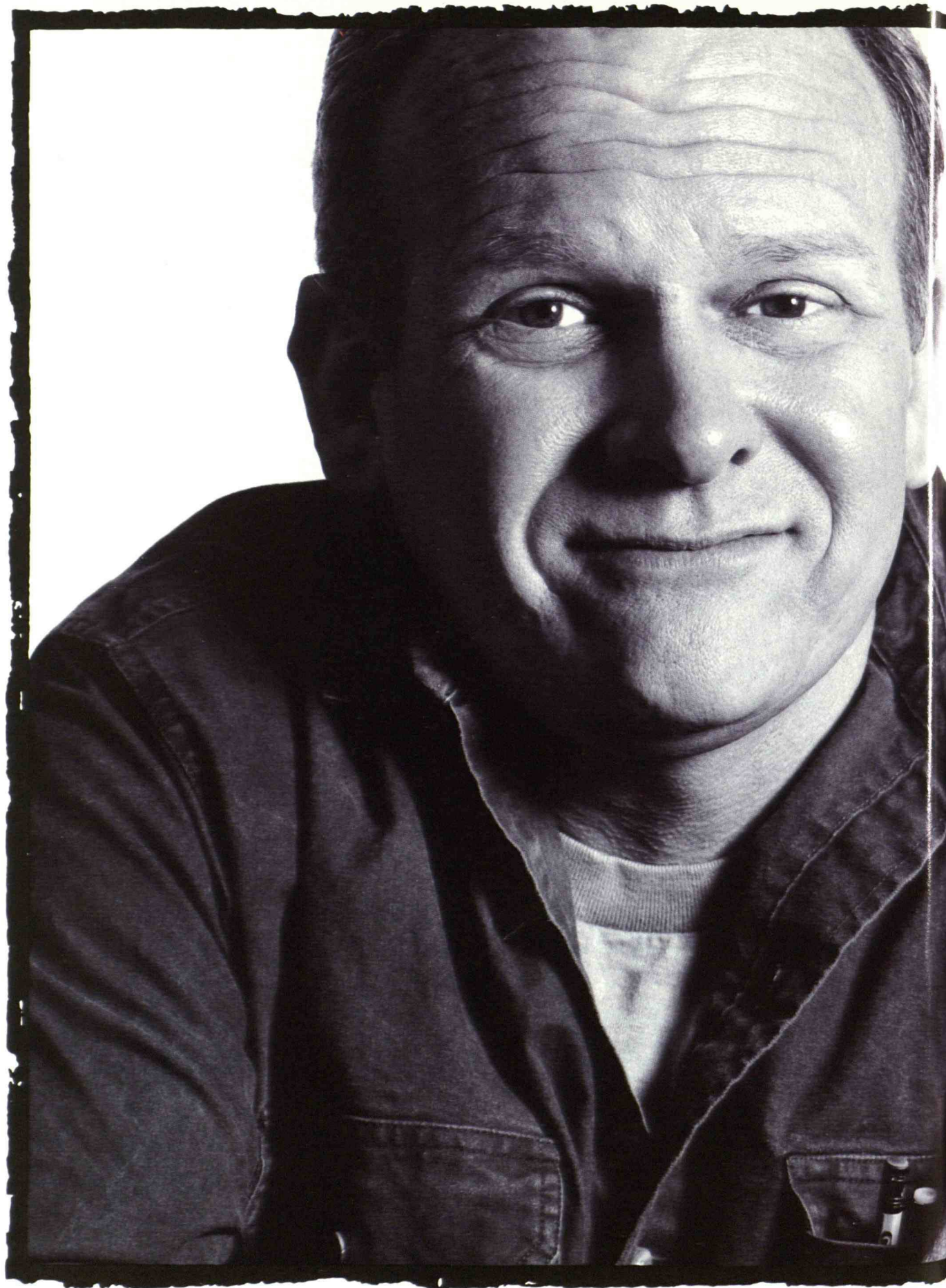
ALSO IN THIS ISSUE:


GETTING TOUGH WITH MEDICAL WASTE

NEURAL NETS GO TO WORK MINING WITH MICROORGANISMS

RADICALLY RECYCLED CAMERAS







**“The idea of computers in
the factory used to
scare the daylights out of me.
Now I run one.”**

“I figured I’d get burned either way—computers show up and I get fired, or computers don’t show up and the plant closes down.

“But what happened is, they retooled the plant and while that was going on they sent me to school, to an IBM-sponsored course at the community college.

“Here are two things I learned. I learned a new job that’s better than my old one. And I learned that our plant won’t be boarded up any time soon.”

Yes, you can teach old factories new tricks, and CIM (Computer Integrated Manufacturing) is one of them. CIM coordinates the manufacturing process, from design to distribution, as a single system. Needless to say, it can make our economy more competitive.

And yes, we’ll have to teach people some new tricks, too. That’s why IBM sponsors CIM education for students and workers at over 70 colleges and universities across America.

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Syringes washing up on beaches belie the real health problem with medical waste: unregulated incinerators run by individual hospitals. The United States can look to European countries for more effective ways of handling medical refuse.

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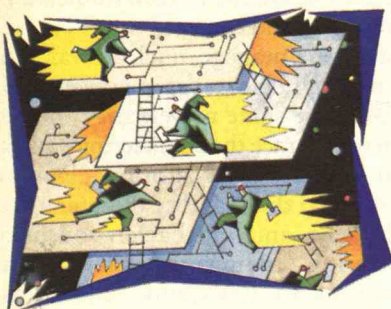
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FirstLine

How Star Wars Helped

A couple of years ago, the Strategic Defense Initiative (SDI), President Reagan's call to render nuclear weapons "impotent and obsolete" by building a shield against missiles, was the central arms-control issue. Now Presidents Gorbachev and Bush have agreed to proceed with START, seeking significant reductions of strategic weapons while leaving missile defense as a footnote to be dealt with later. Yet the meteoric career of Star Wars, as it came to be known, produced a legacy worth remembering. By at once promising protection from the terrors of the arms race and seeking to extend that race to the ultimate frontier, Star Wars helped illuminate the insane trap we were in.

Looking back, it is hard to tell when Star Wars was really finished. Was it only recently, when Edward Teller, the physicist who gained Reagan's ear with visions of an x-ray laser that could destroy 100,000 targets in one blast, lost confidence in that technology? Was it last year, when Gorbachev realized he could proceed with START because Congress itself would prevent serious SDI testing? Was it when Reagan left office, or when Gen. James A. Abrahamson, the visionary leader of SDI, was replaced by a bureaucrat? Was it in 1987, when the American Physical Society declared it would be at least a decade before scientists could determine if directed-energy weapons were practical? Was it the day after Reagan's Star Wars speech, when Deputy Secretary of Defense Paul Thayer gathered Pentagon officials and said, "What are we going to do with this mess?"

Dating Star Wars' demise is problematic because it was always the engineering equivalent of a perpetual motion machine. Critics emphasized this from the start. Any shield to protect the public against nuclear weapons must be "leakproof": one explosion could kill a million people. But as Gerold Yonas, the chief scientist of the

SDI program, admitted to *Los Angeles Times* reporter Robert Sheer in 1985, "Nobody believes in 100 percent leak-proof defense. Nobody believes in 100 percent anything that's ever worked on military systems." Engineers could be reasonably confident of overcoming gravity to reach the moon but could never be certain of outwitting an intelligent human adversary.

If this was obvious, why was the Star Wars debate so protracted? Reporters have no litmus test for truth but do have generally agreed lists of authoritative sources, and one of these is the president of the United States. If he says perpetual

*In promising
to stop the arms race
by extending it to space,
Star Wars illuminated
the insane trap
we were in.*

motion is possible, reporters may quote members of the American Physical Society who disagree, but cannot ignore the statement. In fact, the statement is so controversial that it will repeatedly make the front page.

Moreover, though the essential problems with Star Wars were simple, the debate grew complex. There was a kind of inevitable logic to this development. In a familiar form of mathematical proof, you posit a statement, use it to deduce something absurd, and thus prove the original statement false. In this case, the assumption that engineers can defend the nation against nuclear weapons led to numerous, intricate contradictions. One was that programmers can be sure that the most complex software ever written will work the first time. (There can be no test of thousands of nuclear warheads streaming toward the U.S.) Even new versions of word-processing programs have bugs that make them "crash," for example, dis-

playing exclamation marks all over the screen and destroying a document.

But as a fairy tale, SDI did yield a valuable insight. Before 1983 the arms-control community had come to accept deterrence—the notion of preventing nuclear war by threatening a retaliation that would destroy civilization. This frightful logic had produced its own chain of absurdities, such as the notion that the United States needs to continually improve technologies of nuclear destruction to deter the Soviets "at every level of conflict." The entire arms-control community agreed on the need to strengthen "communication, command, and control," or "C-cubed," systems to manage nuclear war. But managing nuclear war is nonsensical.

With the same naivete that allowed him to embrace the engineering equivalent of perpetual motion, Reagan challenged the morality of deterrence. When he and Gorbachev outlined sweeping reductions of nuclear weapons in Reykjavik, the arms-controllers shuddered for the stability of deterrence and made it clear that the doctrine requires a minimum of thousands of nuclear warheads. The two heads of state had to pull back, but the arms race never looked quite so sensible again.

Ultimately, Star Wars illuminated the essential illogic of that race. When President Truman and other U.S. leaders knew they had the atomic bomb in 1945, they apparently saw it as a guarantor of peace. With American innocence in control of the ultimate technology—we have long thought of ourselves as untainted by the evil and intrigue of foreign peoples—the world could rest at ease. Of course, events did not and could not work out that way. In the 1980s Star Wars revived the vision of an all-powerful America as global benefactor. This time critics were more swift and merciless about the contradictions of the vision, and that contributed to a somewhat safer world. ■

JONATHAN SCHLEFER

What if there
were
an aerospace
all-star team?




There is—the engineers and scientists just named Technical Fellows of The Boeing Company. They are individuals who have earned reputations for exceptional judgment and competence in their disciplines, and for practical, yet innovative reasoning. (Front Row, L-R) **Richard B. Hall**—precision measurements and laser applications, Boeing Aerospace & Electronics, Seattle; **Wayne E. Woodmansee**—nondestructive testing, Boeing Commercial Airplanes, Seattle; **Coe E. Wescott**—electronic design, Boeing Military Airplanes, Seattle; **Nicholas Albion**—flight control systems, Boeing Helicopters, Philadelphia;



(Back Row) **Weightstill William Woods**—sensors, Boeing Aerospace & Electronics, Seattle; **Mervin C. Vincent**—
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