Technology Review

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THE INTERNET

Is the Free Ride Over?

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MAY/JUNE 1995

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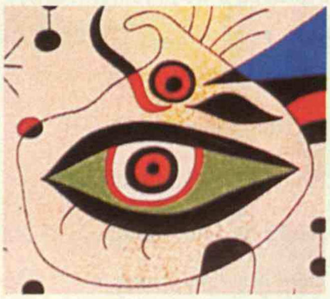
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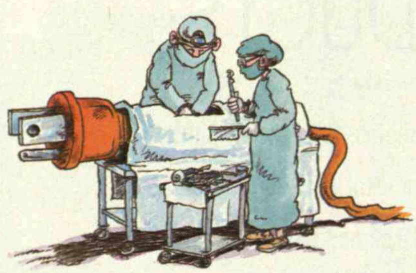
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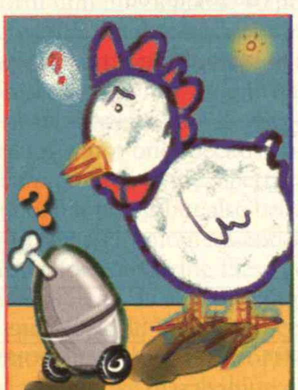

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BPA INTERNATIONAL

First Line

Transforming a Superpower

SOME years ago, TV's *Saturday Night Live* presented a comedy sketch based on the following proposition: What if the infant Superman, who came to earth during the 1930s and touched down in heartland America, had instead landed in Nazi Germany? In place of the kindly superhero we all knew and loved—who had grown up to serve "truth, justice, and the American way"—viewers were presented with "Übermann," a strutting villain who used his powerful gifts only in pursuit of Hitler's misbegotten designs.

Why was this grim scenario funny? Because of its absurdity: Superman was a quintessentially American creation, a symbol of might tempered with a sense of right, a tireless and invincible doer of good deeds—in short, an embodiment of the way most Americans have traditionally regarded the United States of America. Superman as a national of any other country was unthinkable, and laughable; to transform him into a goose-stepping fascist only took the displacement to its most ridiculous extreme.

The United States has long been regarded by its citizens as a Superman among nations, not only because of its ironclad commitment to life, liberty, and the pursuit of happiness but also because of its awesome technological and economic means for converting these goals into realities. Recall, in this fiftieth year since the end of World War II, the country's extraordinary mobilization—the rapid and productive marshalling of its industrial and intellectual resources—to win that war.

How the country accomplished these feats—specifically with regard to inspiring its scientific and engineering talent to near-superheroic levels of productivity—together with the effects of these wartime achievements over the ensuing decades, are the subjects of "The Legacies of World War II: A Roundtable Discussion," in this issue. A distinguished group of scientists, engineers, and historians who know the era well (often from direct personal experience) describe some of the "magic ingredients" in the country's successful wartime efforts.

But what works in wartime is not necessarily applicable to peacetime, and can be downright harmful. Our "super power," in other words, can backfire. "The only point of government is to safeguard and foster life," observed Nobel laureate George Wald, a professor of biology at Harvard University, in a memorable speech at MIT in 1969. "Our government has become preoccupied with death, with the business of killing and being killed." The result, he asserted, is that the military establishment "is corrupting the life of the whole country [by] buying up everything in sight: industries, banks, investors, workers, universities."

> *Dear Uncle Sam:*
> *The war is over.*

By contrast, our former enemies Germany and Japan restructured their institutions for peacetime and a new economic era. They directed their resources and investments to civilian applications, and flourished as their growing world-class industries served global markets. One might even say that they ultimately won World War II, moving on to more meaningful campaigns while we were still rattling our swords.

Military institutions, Supermanlike imagery, and narrowly defined crash programs, of which the ultimate example has been the Manhattan Project, are of course highly appropriate for fighting wars, where there is usually a well-defined enemy whose containment we can envision if we take particular sequences of specific actions. Winning a war isn't easy—in fact, it's "hell"—but at least it's a quantifiable problem that sooner or later produces unambiguous results.

No wonder, then, that we use martial metaphors for nonmilitary problems—Lyndon Johnson's War on Poverty, Richard Nixon's war on cancer, Jimmy Carter's "moral equivalent of war"—in the wishful belief that they, too, will be quickly and thoroughly resolved. The country's space exploits, many of which were themselves a direct consequence of warlike competition with the Soviet Union, have inspired a related metaphor: "If we can get people to the Moon, why can't we [solve this or that social problem]?" But such comparisons are usually faulty because the phenomena involved are far more complex, long-term, and ill-defined.

The fundamental contradiction here may be that our institutional structures are a little too "male." That is, the model of competitiveness, battle, dominance, and well-defined movement toward singular solutions may be totally inappropriate for dealing with so many of today's social, political, economic, even technological problems. Because these situations lend themselves more to nurturing than to conquest, we need to employ the "female" model: collaboration, emphasis on process and growth, and a gentle, patient, and flexible approach to what is complicated, imprecise, and slowly changing.

Where there is no "enemy," it makes more sense to treat people as friends and colleagues, all working together to address mutual problems. "The thought that we're in competition with the Russians or with the Chinese is all a mistake, and trivial," said Professor Wald in his farsighted 1969 speech. "We are one species, with a world to win. Our business is with life, not death. Our challenge is to give what account we can of this corner of the universe that is our home—what becomes of humanity, all human beings of all nations, colors, and creeds. It has to become one world, a world for all people, the only such world that can offer us life and the chance to go on."

For the United States, at least, the basic task here may be conceptually simple after all: to switch its can-do image from Superman to Superwoman. ■

—STEVEN J. MARCUS

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Letters

Cooperating on New Materials

In "Bringing New Materials to Market" (*TR February/March 1995*), Thomas Eagar suggests that cooperative ventures will help commercialize new materials in the future by enabling companies to rise above line-of-sight economic planning to recognize the big picture. Eagar refers to a partnership between AT&T and Corning to produce optical fibers as the kind of cooperation that will lead to success. Although such vertical partnerships clearly offer opportunities, they are not risk-free, especially for small competitors in an advancing field for whom the choice of the wrong partner may be fatal.

We may be able to learn how to reduce this risk from Japan. As one who has done business in that country for many years, I have been impressed with the power of the Ministry of International Trade and Industry to organize patent pools by identifying a technology of national importance, allocating seed money, and providing administrative guidance to firms in a consortium. The member firms are then free to use technology developed and commercialized cooperatively under common license.

Perhaps a similar approach could work in the United States. The National Institute of Standards and Technology could develop a consensus on the goals of materials research and target funds to specific projects. A national patent pool could then be made available to the participants. With too few examples of previous successes of this type, we will need strong leadership to overcome our inertia.

David C. Hill
President
Performance Materials
AlliedSignal
Morristown, N.J.

I support Eagar's general argument with an additional observation. New materials are adopted when they offer unique properties or incrementally enhance existing products.

The former are rather rare, exciting, and influential and fall outside of the scope of Eagar's article. Examples include silicon as the staple of solid state electronics and low-temperature superconductors enabling magnetic resonance imaging. The latter are much more common and find their worth in their ability to reduce costs or increase performance.

In either case, manufacturers have to provide customers with enough enhancements to justify the additional investment. As a materials scientist, I may be fascinated, but as a consumer, I am not interested in the materials from which my purchase is made. Rather, I select a product from options based on performance, styling, and cost. As manufacturers become increasingly aware that their performance depends on differentiating their products, they may be more willing to work together in materials development to reduce the risk for each individual partner.

Eagar correctly points to the Department of Commerce's Advanced Technology Program as "evidence of a shifting emphasis toward process development." This program requires a commercialization plan—one that is oriented to manufacturing—as a major component of its award criteria. However, Eagar did not note that the development of these business plans is leading to just the joint ventures necessary to shorten the 20-year interval between materials development and commercialization.

L.H. Schwartz
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and Technology
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Eagar is right on target in identifying most of the problems in getting new materials to market and the need to change from a competitive environment to a cooperative one. However, in analyzing the 20-year interval it takes to bring new materials to market, he overlooks one of the main causes: the mission and policy of the company that developed the new material.

During the past 30 years, materials have been developed primarily by relatively conservative companies whose main product line was firmly established. Top management defined success as the continued and growing sales of existing products, not the introduction of novel materials. Even if new products were developed, there was little incentive for marketing groups to find a place for them. Without pressure from sales, the manufacturing group was never pushed to make the product at a lower cost. Unless a company decides that its commercial success absolutely depends on the continuous introduction of new products, the 20-year cycle will not shorten. (The computer hardware industry best exemplifies the success of companies that do follow such a principle.)

Another factor Eagar mentions–difficulty in building trust among various companies–merits illustration. My com-

pany, Crucible, manufactures and sells steel bar to manufacturers of cutting tools. Those manufacturers fabricate the materials into the finished parts and sell them to end users. Although each of the three parties involved has information that is potentially useful to the other, frank and open communication is virtually nonexistent because that information is often considered proprietary. The toolmaker may want to sell an improved, more costly product that will last longer but may not be able to find a market without a cost-benefit analysis by the end user. Similarly, the materials supplier may want to sell a new or improved product but does not know which products to improve. Teamwork would enable all three companies to win.

Without instilling a company culture that explicitly supports the continuous introduction of new products and creation of vertically integrated teams, we will continue to face the unnecessarily long interval between the development of new materials and their commercialization.

WILLIAM B. EISEN
President
Crucible Research
Pittsburgh, Pa.

To Eagar's list of hindrances to the commercialization of new materials I add the explosion in litigation in recent years. Whereas little credit is given for advances that benefit society, criticism awaits any result that is less than perfect. This has not only adversely affected the posture of approving agencies, but has forced companies to abandon many ideas that could have resulted in substantial public benefit.

The materials profession itself is also a barrier to bringing new materials to market. Materials engineers have traditionally been taught that structure determines properties. Emphasis has shifted only recently to an understanding of how processing creates or inadvertently modifies the structure from which these desired properties are obtained. The modern technological university must educate materials engineers on the critical role played by processing in creating new materials.

MICHAEL J. CIESLAK
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RECYCLING FACTS

After reading "From Villain to Hero" (*TR January 1995*), I realized that we at IMCO Recycling, Inc., where I am a director, have publicized our work poorly.

The authors, Julian Szekely and Gerardo Trapaga, state, "Today, the companies that recycle aluminum are the same as those that make aluminum from ore." IMCO does not make any primary aluminum (aluminum from ore); instead, we make secondary aluminum (recycled from scrap and dross) along with a small amount of secondary magnesium and zinc.

The authors also state, "Right now, almost all the 3.7 million tons of aluminum made annually in the United States is produced by the electrolytic decomposition of alumina, a substance found in naturally occurring bauxite ore." In 1993, the U.S. production of primary aluminum was 3.7 million metric tons. However, this was augmented by more than 2.9 million metric tons of secondary aluminum, and 1.85 million metric tons of imported primary. While 42 percent of the secondary material was supplied by the primary producers, 58 percent came from independent secondary smelters.

JACK C. PAGE
Dallas, Tex.

DETERRING COUNTERFEITERS

"Desktop Counterfeiting" (*TR February/March 1995*) is the best treatment of this threat that I have read. As McClellan notes, most of the existing and even proposed deterrence features are two-dimensional and can be easily foiled with artistic talent or easily attainable equipment. However, three-dimensional patterns can better thwart would-be counterfeiters.

To implement this concept, each document must contain a unique identifier consisting of a randomly generated three-dimensional pattern. The identifier could consist of natural features such as the pattern of paper fibers in the document, or of special materials introduced into the paper during manufacturing. When the document is printed, an imaging device would generate a numerical description of the identifier's three-dimensional properties. This description is encrypted and printed on the document in a bar code or other pattern readable by machines.

Authenticating a document would entail using a device that reads the unique identifier pattern, recognizes and decrypts the authenticator, and compares the two. A match would validate the document.

Actually, careful selection of the nature of the random pattern might permit counterfeit detection without the use of special equipment. For example, if the unique identifier consisted of a random