Technology Review

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BY SEYMOUR PAPERT

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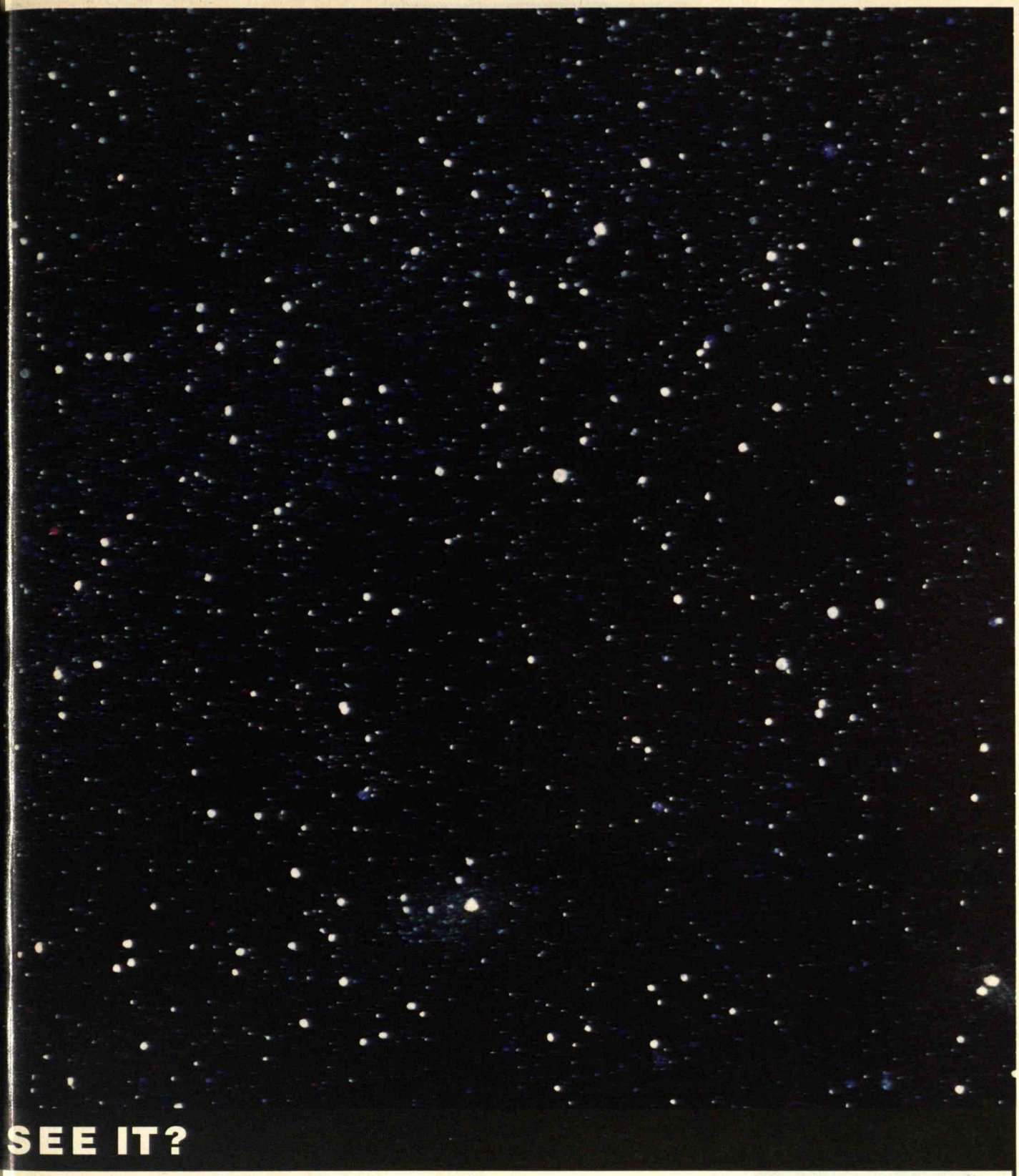

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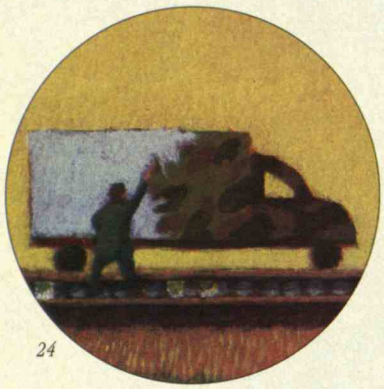
TECHNOLOGY REVIEW
JULY 1993

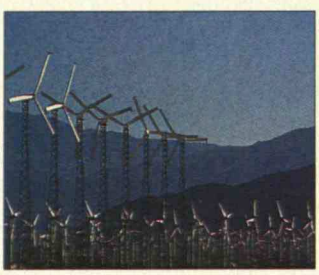
Contents

FEATURES



24

28



38

54

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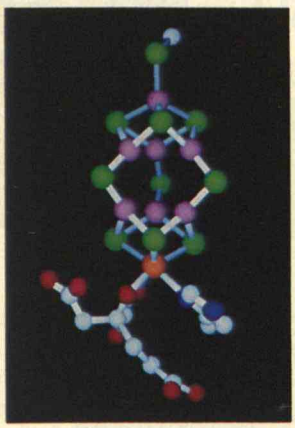
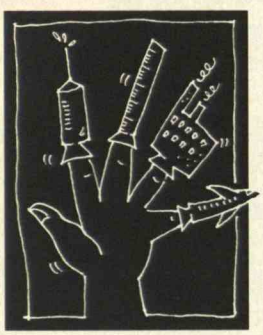
TECHNOLOGY REVIEW
VOL. 96/NO. 5

DEPARTMENTS


10


16


66

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First Line

Challenges Ahead for White-Collar Workers

CORPORATIONS' investments in employees have traditionally focused on cultivating a sophisticated and increasingly specialized work force of professionals. The U.S. service sector, for example, has enhanced these staffs during the last several decades through enormous expenditures on training, computers, databases, and a wide range of support systems both technological and otherwise.

For a long time, professional employees were largely exempt from the vicissitudes of the market and corporate restructuring, as blue-collar and other nonprofessional labor—especially in manufacturing—was usually the target of layoffs. But in the current round of corporate downsizing, companies are cutting dramatically into their professional staffs.

The loosening of the traditional corporate commitment to professional employees is not just the result of short-term competitive and financial pressures. It reflects a dramatic restructuring of professional work. Companies may now simply retain a core professional competence and seek the remainder of traditionally in-house skills, including research and development, design, and even manufacturing and marketing, among people outside the conventional corporate boundaries. With boards of directors taking on a more activist role, even the powers—and jobs—of CEOs are being redefined.

Individuals and organizations have weathered periods of change before by reinventing themselves and anticipating the new and more effective shape of the future. General Motors once pioneered the corporate model that features competition for customers between rival divisions coupled with strong centralized staffs and financial controls. Companies such as Royal Dutch Shell have been successful in transforming large multinational organizations into what most host countries think of as locally run, responsive national enterprises. More recently, the Japanese trading company has established another model that capitalizes on preferential access to domestic sources of capital and governmental involvement.

Each of these structures strengthened the role of professional employees. But given the global competitive forces now operating, where low-wage and nonprofessional workers frequently have access to world-class manufacturing capability with a minimum of managerial assistance, none of the previous models seems predictive of the future.

Professional employees such as engineers, no longer secure in the corporations of the "new economic order," must seek alternative arrangements.

What might the new business models look like? Some analysts posit that we may see alliances involving groups of skilled professionals, tied to a corporate core, undertaking short- to medium-term projects. Small groups with special expertise in engineering design have already formed for just this purpose. Software firms, for example, often rely heavily on specialist contractors to create subsystem architectures. And consultants often provide continuing services, such as benefits and executive search, to client companies.

Meanwhile, because corporations are investing heavily in administrative reforms such as total quality management (which, in order to minimize product defects, operates through diverse work teams) and employee empowerment (which broadens individuals' roles), those who do remain on the corporate roster must adopt a different view of their jobs and rewards. Professionals will be less able to retreat behind expertise, must learn to collaborate with other professionals and nonprofessionals, and must thoroughly understand the overall business.

Companies as well as skilled professionals attempting to adapt to such changes would therefore do well to keep several admonitions in mind:

First, each of us as individuals will have to invest in ourselves more steadily, broadening as well as deepening our skills and keeping an eye on an array of disciplines previously seen as outside our spheres of interest. Learning to use computers and speak a foreign language, for example, are skills that have become prerequisites for many important business positions.

Second, corporate investments in human capital are crucial to maintain the flexibility of the leaner but meaner work force.

Third, as companies downsize they will be able to offer fewer promotions and thus will have to find new ways of measuring people's worth and capturing their commitments. Broadened work roles and greater control of work, which imply increased knowledge, power, and personal growth for individuals, are major steps in that direction.

Fourth, ease of communication between employee and employer, and between professionals and their networks of colleagues, will determine the kind of training that is mutually rewarding and will enable more productive interaction.

Finally, the societies that foster broad professional and personal growth among their citizens are more likely to build stable, productive work forces and consequently enjoy world-class economies. The new administration in Washington has a rare opportunity to build such a work force if it can succeed in its intention to massively shift resources—from defense to civilian work, for example, or by streamlining and improving education. ■

—WILLIAM J. HECHT

Letters

CHEMICAL ARMS CONTROL

"Ending the Scourge of Chemical Weapons" by Jay Brin (*TR April 1993*) is an excellent examination of the Chemical Weapons Convention. The CWC signing ceremony in January signaled the end of a long, arduous negotiation process. Much credit for this achievement belongs to former president George Bush, and President Clinton must exercise similar leadership to ensure the value of the convention.

For now, the focus has shifted to the Hague, where the Preparatory Commission is establishing the means by which the CWC will be monitored and enforced. The PrepCom's accomplishments over the next two years will determine the viability of the CWC as an arms control agreement. But during this same period, a separate, equally important process will occur as the U.S. Congress considers legislation to implement the treaty. Unfortunately, Congress has remained largely removed from the chemical weapons negotiations. Few of my colleagues have demonstrated interest in chemical arms control, and it has long been my belief that Congress would not pay attention to the CWC until it arrived on Capitol Hill for action.

Perhaps the greater visibility of chemical weapons issues will lead to more interest in ensuring the adequacy of our chemical defensive equipment and training. We might also address the problems associated with destroying chemical weapons. And finally, we might recognize the need to incorporate CWC-style verification measures into an important treaty that so far has no teeth—the Biological Weapons Convention of 1972; absent any inspection regime, the BWC has amounted to little more than the paper on which it is printed. One clear and welcome sign of leadership from President Clinton would be support for such measures.

REP. H. MARTIN LANCASTER (D-N.C.)
House Armed Services Committee
Washington, D.C.

Jay Brin fails to acknowledge the dangers inherent in the CWC. In agreeing to this treaty, the United States is willingly committing itself to a chemical weapons "ban" that is neither global nor verifiable and that in effect requires us to unilaterally disarm.

The history of attempts to limit chemical warfare does not bode well for the CWC. The Geneva Protocol of 1925, which banned the use of chemical weapons, was proven over and over to be ineffective. The CWC attempts to go beyond the protocol by banning not only the use of chemical weapons but also the development of new ones, and by providing for the destruction of existing stockpiles. Yet the reason the 1925 treaty did not attempt this in the first place was that it recognized compliance to be unverifiable, and in fact compliance is still unverifiable today. Supporters of the CWC argue that the specified inspection regime is likely to detect any violation of military significance while allowing countries to protect legitimate military and commercial secrets, but more realistic observers point to historical examples that cast doubt on such an assertion. To see that detection is impossible even with extremely intrusive inspection, one need only consider Iraq's success in hiding its nuclear weapons program.

Virtually any nation can retain or acquire the ability to conduct militarily significant chemical warfare, and the CWC—like prohibitions on first use of chemical weapons, on production and stockpiling of biological weapons, and on proliferation of nuclear arms—is certain to be ignored by some states that choose not to become signatories, and to be honored in the breach by only some of those who do. Mr. Brin places great stock in export controls as a means to limit the spread of chemical weapons, but such controls have consistently proven inadequate, unenforceable, and susceptible to circumvention and disregard. Just last month, the State Department announced that despite a U.N. embargo and worldwide recognition as a renegade state, Libya was constructing another chemical weapons plant with assistance from firms in Western Europe and Japan.

Ironically, too, the technological abilities of the United States put us at a disadvantage. The CWC requires the elimination within ten years of all chemical arms, but signatories that lack the technology to meet that deadline can have it extended. Thus vast quantities of chemical arms will be legally retained by others for at least five years after all U.S. deterrent weapons have been destroyed. For instance, the former Soviet Union holds the world's largest arsenal of chemical weapons, and it clearly cannot be eliminated within ten years.

Another dangerous aspect of the CWC is that it could discourage efforts to redress the current inadequacies of U.S. chemical defenses. All arms control treaties have been followed by political pressure to limit research, development, and deployment of defenses against the weapons that have purportedly been controlled. Witness the pressure that is already mounting to close Fort McClellan, the only live-agent defense training facility in the Western world. The consequences could be serious: operations Desert Shield and Desert Storm demonstrated that despite the assurances of the Department of Defense, our protective equipment against chemical and biological attack has numerous deficiencies.

While the goal of ridding the world of chemical weapons is admirable, it is reckless to base national security policy on hope rather than experience. President Clinton should insist that the arms control activities of his team not fall prey to the same wishful thinking that led to our current position. He should ensure that the Senate ratification process be open and critical, even to the point of seriously considering non-ratification, and he should support the programs the United States needs to maintain adequate chemical and biological defenses and improve intelligence and verification.

AMORETTA M. HOEBER
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SUPERSONIC COMMERCE

In "The Rebirth of Supersonic Transport" (*TR February/March 1993*), Robert Rosen and Louis Williams provide a comprehensive overview of the technologies that must be developed to make supersonic commercial transport feasible and environmentally acceptable. But a focused technology-development program sponsored by the government will be needed to achieve this goal. Otherwise, U.S. industry will not risk the billions of dollars required.

A fleet of supersonic transports could produce an increase in productivity comparable to that seen with the introduction of jet propulsion 35 years ago. Moreover, the global nature of commerce today and the anticipated increase in long-range international travel makes the development of a high-speed airliner inevitable. Companies and governments in Europe, Russia, and Japan recognize as much, and the country whose industry masters the relevant technologies will secure the leading role in the commercial aviation market. So far, U.S. leadership in aerospace technologies provides exports that are second only to agriculture and first within manufacturing. But maintaining that leadership requires aggressive research and development by a partnership of U.S. companies, academia, and government agencies, with the NASA High-Speed Research Program as the centerpiece.

BRUCE L. BUNIN
Program Manager for High-Speed
Civil Transport
McDonnell Douglas Corp.
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TEENY TECHNOLOGY

In "The Really Little Engines That Might" (*TR February/March 1993*), Fred Hapgood does not fully convey the central importance of molecular nanotechnology. The ability to build materials molecule by molecule is a fundamental goal for manufacturing. The arrangement of atoms determines the properties of everything we make, and with precise, mechanical control of molecular motion and placement, products can be made far stronger, lighter, cleaner, and more efficient. Precisely structured materials made of carbon can have 70 times the strength-to-density ratio of common engineering alloys, and precisely structured computer devices can store a billion bytes of data in the same amount of space present chips use to store a single bit. Further, exact control of molecular motions means that such items could be manufactured without by-products.

Because we lack the necessary tools, we are far from such feats today. Yet computer modeling can already describe the key devices and processes. Chemists are building ever-larger molecules, including molecules that can actually assemble themselves, and physicists are now using machines to move individual atoms—an IBM research group wrote "IBM" on a nickel crystal with 35 precisely placed xenon atoms. As these abilities develop, they can be used to build better molecular tools, and these to build still better tools, accelerating progress toward molecular manufacturing and a broad range of applications.

In Japan, the Ministry of International Trade and Industry has announced a 10-year project to develop atomic- and molecular-level manipulation technologies, aimed at learning to build with individual molecules. At its center is a consortium of 46 companies that will be seeded with $200 million in government funds. It is time for the United States to join in a serious program along these lines. In the short term the payoffs will be substantial, and in the long term the foundations of our industrial civilization could be transformed.

K. ERIC DREXLER
Chairman
Foresight Institute
Palo Alto, Calif.

COLLABORATIVE LEARNING

Edward Barrett's grasp of the importance of collaboration in learning to write is exceptional (*"Collaboration in the Electronic Classroom," TR February/March 1993*). One aspect of his work that distinguishes it from similar educational experiments is its tendency

to combine electronic collaboration with the ordinary face-to-face kind. Computer-aided collaborative learning is likely to be most effective if students are also engaged in nontechnological interactions such as group work, peer evaluation, and peer tutoring. These are not just something to turn to when the system is down: they enhance technologically mediated collaborative learning because they are more direct and warm-blooded. They are also more efficient: they require no maintenance, no special equipment, and no capital investment.

But Mr. Barrett might want to reconsider his claim that he and his students become collaborators. Students can really collaborate only with their peers. To regard teachers and students as collaborators masks the unavoidable power imbalance between them. Teachers organize collaborative learning, whereas students (normally) do what teachers ask them to do. Mr. Barrett yields to a temptation many of us feel—confusing peership with apprenticeship.

Fortunately, however, the test of software designed for collaborative learning is not whether it subverts the inevitable social asymmetries between teacher and student. The test is whether it empowers students—whether it helps them learn the skill of interdependence among themselves. That Mr. Barrett's program seems to do very well indeed.

KENNETH A. BRUFFEE
Director
The Scholars Program
City University of New York

RISKS FROM LOW-LEVEL RADIATION

In "Radiation Risks Revisited" (*TR February/March 1993*), Len Ackland has plunged into quicksand where even angels fear to tread. But in the process, he has brought to the controversy surrounding low-level radiation the kind of balanced treatment that is often woefully lacking.

The issue of low-level radiation reminds us how frequently human health and the environment are found near the bottom of the hierarchy of society's values. In most of the industrialized world, the preoccupation has been production, not health, and now nations are confronted with the insoluble problem of how to handle the radioactive waste from power and military reactors, as well as the plutonium and highly enriched uranium from dismantled weapons.

Records that could shed light on the health effects of radiation are frequently kept under wraps. But now, at long last, some of them are becoming available. In an area south of Leipzig, hundreds of thousands of workers in uranium mining and processing centers were exposed to low-level radiation for decades. Thorough medical records on 450,000 of these workers were maintained in secrecy until 1989, when the East German regime collapsed. This treasure trove of information on cancer and other illnesses has been retrieved and is now being computerized with an eye to continuing follow-up on as many exposed individuals as possible. There are also records on workers in our own weapons complex, and on thousands of people in Chalyabinsk, in the former Soviet Union, who drank water grossly contaminated by radioactive sludge.

Taken together, these data may provide a critical mass of epidemiologic information that could resolve much of the controversy over low-level radiation. But until then, we would do well to respect the approach of the American Medical Association's advisory panel on the matter: "While controversy exists, the present conservative assumption is that any dose of radiation has a deleterious effect even if it cannot be identified."

HERBERT L. ABRAMS
Professor of Radiology
Stanford University School of Medicine

Editor's note: For more on the database in former East Germany, see the Trend "A Treasure Trove of Data" by Seth Shulman in the February/March issue.