


DEMYSTIFYING MEDIA TECHNOLOGY

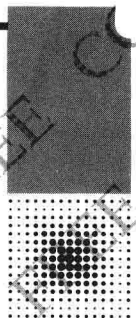


John V. Pavlik

Everette E. Dennis



READINGS FROM THE FREEDOM FORUM CENTER



DEMYSTIFYING MEDIA TECHNOLOGY

Readings from the Freedom Forum Center

Edited by

John V. Pavlik

Everette E. Dennis

*Freedom Forum Media Studies Center
Columbia University*



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PREFACE

New technology can mystify, dazzle and confuse. At the 1939 World's Fair in New York City, visitors marveled at the new radio with pictures, the medium of television. (Although television was invented in the 1920s, its public debut was at the 1939 World's Fair.) A half century later, conferees at the annual technical exposition of the American Newspaper Publishers Association in New Orleans held in their hands a single erasable optical disk capable of storing 5,000 electronic images in compressed form. What awaits us in the next half century is the province of science fiction writers, but in the meantime, what has already occurred and what is just beginning to occur raises important questions about the impact of technological change on the media and society.

Perhaps the most important trend in the years ahead will be the rapid convergence of media technology. Convergence is a complex notion stated eloquently by journalism professor John Wicklein in his 1981 book *Electronic Nightmare*. He wrote, "All forms of communication we humans have devised since the beginnings of humanity are coming together in a single electronic form, driven by computers."

This convergence is seen now in full force in the new "hypermedia," blending computers, full-motion video and stereo sound into a single environment. It also is evident in more subtle ways in the traditional media, where mass communication and telecommunication are melding, as is illus-

trated by facsimile newspapers or videotex, or where the boundaries between print and broadcast media are blurred, as is reflected in the increasing use of digital image processing at newspapers, newsmagazines and television news operations.

Beyond technology, convergence is reflected in the development of a single body of law affecting communications, where once clearly separate bodies of law governed the print and broadcast media and the field of telecommunications. Further, we see convergence in the increasing concentration of ownership of the media, with single corporations owning chains of newspapers, broadcast and cable television operations, magazine and book publishing and film operations. The late British media baron Robert Maxwell projected that by 2000 there would be just eight major media companies throughout the world; his goal was to be one of them.

The purpose of this book is to help unravel the mystique of media technology, to make sense of the increasing convergence of electronic technology. From rejuvenated 19th-century technologies, such as the well-accepted facsimile machine, to more controversial modes of delivery, such as high-definition television, the following chapters attempt to outline the key issues and problems that define these electronic devices.

Each of the new technologies has the potential to influence the relationship between the media and society. Sometimes the impact is forceful and

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immediate; other times it takes place over the long term and incrementally, becoming apparent only with hindsight. Robotic cameras, for instance, produce immediate effects in a television newsroom, eliminating the need for human camera operators and reducing production costs. On a quieter level, the digitization of text and data is producing profound challenges for society in the equitable distribution of and access to information.

Relying on experts from industry and the academy, each chapter examines the important consequences of the new technologies. Most of the chapters were gleaned from presentations made as part of The Freedom Forum Media Studies Center Technology Studies seminars. These seminars are organized for journalism educators and for newsroom managers, and they treat the consequences of new technology in each of four areas: (1) the communications product itself, (2) the way communication workers perform their jobs, (3) the structure of the media industry and (4) the audience, or society as a whole. The seminars for educators offer a more global and analytical assessment of these issues, while those for newsroom managers are concerned with direct applications of new machines and software on such matters as improving news coverage and delivering the news product to the audience.

This book is organized largely along these lines. It begins with a broad, analytical look at media technology, drawing a conceptual map of settled and unsettled technology issues of an enduring nature. Next, there are snapshots of current and continuing controversies, with testimony from industry and scholarly experts. Finally, the applications of electronic technology in the information society are examined.

In Part One, the editors explore the consequences of technological convergence. William F. Miller, a former head of Stanford Research Institute and professor of public and private management and of computer science at Stanford University, challenges readers to consider the potential impact of new technologies on restructuring a global economy. Anthony Smith, president of Magdalen College, Oxford, and longtime director of the British Film Institute, contends that the technology of the information society is reshaping our value system. Political scientist Alan F. Westin, an expert on

privacy issues, analyzes two contrasting views of information technology, one Orwellian, the other utopian. Sherry Turkle, author and psychologist, examines the manner in which computers have changed the way humans think. Political scientist Marion R. Just uncovers evidence about how people learn from the new electronic media. Telecommunications expert John Carey looks back to the future to explain how new communications technologies enter the American home. Benjamin M. Compaine, an information society specialist, provides a conceptual map of the information technology business. Communication attorney and scholar Anne Wells Branscomb considers ownership of information, exploring the legal status of information, economic principles and the individual's rights of privacy and access.

Divided into two sections, Part Two brings together voices concerned about the state of the art of new technology in the media. First are views from the newsroom, opening with a discussion of new technology and television networks. Reporter and commentator Jeff Greenfield of ABC News steps back from day-to-day work to discuss news applications—both positive and negative. The late Burton Benjamin (d. 1989) of CBS News offers a producer's view of technology and network news. Technology guru Julius Barnathan, longtime senior vice president of technology and strategic planning at Capital Cities/ABC, argues that information technology must be simultaneously decentralized and integrated if it is to meet all the needs of the newsroom. Adam Clayton Powell III, producer for Quincy Jones Entertainment and longtime television news executive, reveals the hidden consequences of electronic news gathering, from the satellite to the video camera. Newspaper editor Eric Wolferman examines the psychological consequences of introducing electronic pagination into the newsroom. Chris Pederson, director of Information Services at the Associated Press, describes how portable computers quietly revolutionized the wire services.

In the second half of Part Two, contributors envision the next generation of media technology. Roger Fidler, director of new media development for Knight-Ridder, Inc., imagines the newspaper of the future and sees an expanding role for informational graphics, online graphics networks and even

animated electronic newspaper graphics. Joe Flaherty, senior vice president, technology, for CBS, Inc., details the technical and political issues framing the high-definition television (HDTV) debate. Brian Winston, former dean of the School of Communications at the Pennsylvania State University, provides a critical examination of HDTV in Hollywood. The impact of fiber optics on traditional distribution channels is reviewed by Walter S. Baer, deputy vice president, domestic research, RAND. Adam Clayton Powell III illuminates the hidden consequences of fiber optics in the newsroom both in the United States and abroad. Satellite visionary Michael Alpert forecasts the future of direct-broadcast satellite to the home while ABC News' Pentagon producer Mark Brender probes the First Amendment implications of remote sensing, the picture-taking satellites in orbit around the Earth.

In the first half of Part Three, the role of information in the electronic age is on the agenda as we examine data bases and then look at alternative electronic delivery systems. Timothy Miller, electronic publishing agent for Ziff Communications, presents trends in the "data base revolution." Pulitzer Prize-winning investigative reporter Elliot Jaspin of Cox Newspapers describes how he uses computers in investigative reporting. Charles Brady, vice president, technology, for the information services division of Dow Jones & Co., explores artificial intelligence in relation to massive electronic news data bases.

In the second half of Part Three, interactive media expert David Shefrin traces the history of one of the world's oldest "new" technologies: the facsimile machine. Bill Williams, of the *Hartford Courant*, reveals the strategy and tactics behind *FaxPaper*, the *Courant's* experiment in the resurgent facsimile newspaper market. Finally, telecommunications commentator John Carey and one of the editors critique the origins and future of videotex. Also included is a glossary of more than 250 media technology terms and an annotated bibliography of key books on media technology.

While any book on new technology runs the risk of being outdated before it is published, this one tries to minimize that danger. Toward this end *Demystifying Media Technology* is the first college textbook in the media studies field to be published

simultaneously in both print and electronic forms. The electronic edition of the book is made up of chapters based on Technology Studies seminars held quite recently at The Freedom Forum Media Studies Center. This insures readers the most up-to-date commentary and research on new technology and the media. In addition, the electronic edition on computer disk allows readers the opportunity to search each chapter electronically by key word, as well as to print any page or chapter desired.

More important, this approach minimizes the problem of becoming outdated by concentrating on the long-term implications of technological change and the media. Throughout the 28 chapters that follow, there is an attempt to define the important issues raised by new media technology, maintaining the long view whenever possible. This critical lens tries to debunk misleading myths about technology. Still, we remain optimistic that technology offers at least a partial solution to some enduring media problems.

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More than 300 journalism and mass communication educators and more than 200 newsroom managers who have participated in the Technology Studies program of The Freedom Forum Media Studies Center, formerly the Gannett Center for Media Studies at Columbia University, were also helpful. Without their contribution as seminar speakers and participants, *Demystifying Media Technology* could never have happened.

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THE COMING OF CONVERGENCE AND ITS CONSEQUENCES

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John V. Pavlik

Everette E. Dennis is the executive director of The Freedom Forum Media Studies Center and is a vice president of The Freedom Forum. Formerly he was dean of the School of Journalism at the University of Oregon and professor of journalism and director of graduate studies at the University of Minnesota. A past president of the Association for Education in Journalism and Mass Communication and director of the Project on the Future of Journalism Education, he is author, co-author or editor of numerous articles and 23 books, including *Reshaping the Media*, *The Cost of Libel*, *The Media Society* and *Understanding Mass Communication*. He has also held fellowships at the Harvard Law School, the Nieman Foundation and John F. Kennedy School of Government, all at Harvard University.

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When observers try to capture the nature, processes and current state of what has been called the information society, they frequently employ the word *convergence*. Thus, we hear about the convergence of media technology, the convergence of ownership, the convergence of media functions and the convergence of messages as well as processing and delivery systems.

It is not clear just when the term was first used to characterize the revolution in communication technology that swept across American society in the 1970s and 1980s, but by the 1990s, even editors at *The New York Times* were telling visitors that convergence was one of the most important technological and managerial issues in their newsroom. It's likely that the term was used early on by people in the computing industry and was later picked

up by media executives and scholars looking for convenient ways to describe the phenomenal changes that were occurring in the communications industry.

Generally speaking, the verb *converge* means to approach the same point from different directions, or to tend to meet or intersect. *Convergence* also suggests a movement toward union or a common conclusion. When the term was adopted by the communications industry, however, it most often was used to mean a coming together, an integration or interface between and among different media systems or organizations. One part of the coming together embodied in the term was the ease with which electronic devices, including those involved in the media industries, came into homes, offices, cars, schools, libraries and communities. These new technologies were more portable than the old, with laptop computers even traveling with their owners on airplanes. A second, especially important aspect of convergence was the merger of telephone, data transmission and computer technologies, resulting in an integration of telecommunications, which also included broadcast and cable television. Harvard's Anthony Oettinger suggested that the merger of communications and computing ought to be called "comunications," but the term never quite caught on. And, third, from the high-tech world, *convergence* was used to describe a process wherein integrated storage and retrieval of text, data, sound and image was occurring.

Although data communications technologies and telecommunications were once separate and distinct, they converged in the 1980s. Soon the telephone and electronic data base had much in common with newspapers, broadcasting and cable, not to mention magazines, book publishing, newsletters, business information, messages delivered by fax, electronic mail and other media services that grew up in the early years of the information and communications revolution. As videotape recorders made inroads into the home (74 percent had them by 1990) and people acquired personal computers, the communications capability of the average person in the average home became powerful indeed. A flurry of newsletters or other publications emerged as a result of desktop publishing

done on modest home computers. Ironically, one of the results of convergence was the increasing use of television sets for activities other than watching broadcast or cable television; sets were used in conjunction with videocassette recorders (VCRs) to watch movies or home videos and in conjunction with videogame units to play arcade-style electronic games.

As communications devices and systems grew more and more sophisticated, artificial intelligence established a foothold when expert systems were developed to take on some quantitative and clerical functions once carried out by people. Such systems promised to grow increasingly sophisticated, even simulating various forms of human decision making, from selecting news stories to editing. At some television stations and networks, robotic cameras reduced the number of human operators needed.

By the 1990s, the idea of convergence seems almost commonplace, but not many years ago, it was regarded as visionary and sometimes fanciful. The reason: technological factors often outstrip the human factors that actually determine the pace of technological growth and integration. In the early 1970s much was written about the "wiring" of America, which involved cable television, then still a distant dream. With cable, the futurists said, we would almost instantly have more than 100 cable channels available in the home, with all sorts of diverse and specialized programming. We would have sophisticated home shopping, home security devices and bill-paying ability right in the television set. Although many of these promises were technically possible, there was little enthusiasm among consumers; government regulations and objections from traditional media, especially broadcasters, slowed the process of change. So, for years, most Americans had three or four channels of television in the home, while the promise of cable and the wired home, city and nation was sidetracked. Futurists were similarly excited about videotex and teletext services, which were originally going to give the consumer electronic data riches—news-papers, travel services, specialized information, and so on—right in the home. A few notable experiments did provide these services in pilot projects for a limited number of subscribers. But

consumers didn't respond, and the experiments were canceled to wait for a better day. In several cities, again on a pilot basis, interactive television systems allowed viewers to "talk back" to their television sets. In Columbus, Ohio, for example, an interactive system allowed viewers to select programs, respond to questionnaires, place shopping orders and respond to other importunities from the media. In time, this system also died for lack of financial nourishment.

But it would be shortsighted to count out any technology, even when it seems to be a failure. In the 1930s and 1940s experiments with facsimile newspapers, which could be sent electronically into the home, failed because there was little market demand; and this innovative service, decades ahead of its time, waited for a better day. That day came with the fax revolution of the 1980s when fax machines were installed by the millions in offices and home. And newspapers again began to publish limited, highly targeted fax editions for readers willing to pay the cost.

Although the average citizen in the 1980s may have thought that convergence was an idea whose time had not yet come, media companies were acting otherwise. They began to buy up newspapers, magazines, book publishing firms, radio and television stations, market research companies, outdoor advertising firms and other "media" outlets. This convergence at the ownership level was happening not only in the United States, but elsewhere in the world as well, as Australian, British, Japanese, French, Italian, German and other multinational firms emerged. In time, convergence at the ownership level was increasingly giant and global.

These enormous companies and others practicing ownership convergence used market research to develop their plans and more effectively sell their product to both the public and advertisers. Some of them, large companies like Dow Jones and Gannett, for example, began to repackage much of their material so that stories in newspapers and magazines would also be sold to television and to online data bases.

As media companies integrated different kinds of communication enterprises, they also drew on the tools of modern technology to do their work. From text editing in newsrooms, to electronic

darkrooms and electronically sophisticated press (at newspapers) and transmission equipment (at broadcast stations and cable headends), the media relied on electronic connections to do their work. Also vital to convergence was the communications satellite, which not only aided television with its international coverage but also allowed newspapers like *The Wall Street Journal* and *USA Today* to "go national," beaming material to distant printing plants that printed and distributed these and other papers.

For media managers, convergence meant a whole array of convenient work-saving devices that allowed reporters to use computers for research, analysis and writing; editors to edit and paginate electronically; and the advertising departments to create ads and do billings with dispatch, thanks again to the computer.

Over the last decade, there has also been much talk of global convergence, meaning the breakdown of national boundaries and some of the traditional formulations of the nation-state, due to large-scale communications. Newspapers have traditionally been viewed as very much nation-bound, and indeed they rarely move across borders. Exceptions are the *International Herald Tribune*, *Financial Times*, *Wall Street Journal* and *USA Today*. Nationhood has largely been reinforced by communication systems that were at first essentially parochial because they had to be, but increasingly challenged by newly available technology to move outside their once-constraining strictures. Increasingly, however, media, whether in the print or electronic form, that remained within the boundaries of a given nation have started moving across them. The movement to full implementation of the European Community in 1992 is one stimulus for various multinational enterprises linking British, French, Italian and German efforts, for example. Rupert Murdoch's Sky Channel is betting on a convergence of communication and the ability to marshall an audience from several countries. Such an enterprise would not have been possible without the satellite and the computer.

The larger question concerns not how, when and where, but rather the consequences of this global convergence. The question of what it will mean to media economies, regulatory systems and

technological transfer has generated volumes of comment and criticism.

At an abstract level, although there were immediately practical applications, came the merging and blurring of the various media's functions, due in large part to the electronic tools of convergence. In the 1970s and 1980s, information services and online data bases challenged the supremacy of news delivered by newspapers, television and radio. News and entertainment sometimes were blurred together, especially in television, where the pyrotechnics of computer graphics, news recreations and simulations and other tools raised questions about media roles and ethics. People used the term *entertainmentization* in describing the news and also worried that news and opinion were being blurred as a result of electronic wizardry. And all the while, as media grew more market-oriented and were increasingly driven by computer data, media analysts argued that advertising values were influencing news. For individuals working in the media, convergence was evident in all of the same ways it was evident to the general populace, but its pertinence to their careers was not always immediately apparent. Still, writers, editors, television journalists and others moved from one medium to another, and certainly some of their work was often used in more than one medium at a time. Magazine writers, for example, found that their work was sold to data bases and used by a number of other media. Some of these people were interviewed on radio and television about the material that appeared in the magazine or on the data base.

In the nation's journalism and communication schools, media studies embracing a single medium became increasingly irrelevant. It made much

sense to study the history of communications, less sense to focus on the history of journalism or broadcasting. Communications law, once broken conveniently into print and broadcast segments, also merged and blurred. Libel, privacy, copyright and other legal concepts now applied equally to print and broadcast media, and sometimes a broadcast case decision would very quickly be applied to a newspaper dilemma. The economics of individual media like a newspaper could be understood fully only in a media economics context, not in terms of newspapers alone. By the same token, technology had applications in every sector of the communications industry. And the print and broadcasting professions could, in fact, learn a great deal from each other. As a result, critics questioned whether the lines between many academic sequences were still relevant in an age of convergence and speed.

For the consumer, convergence has meant choice; but having more of everything requires, of course, more money to pay for these choices. The multiple television channels now readily available, not to mention services available over the phone, on television and through modems, is phenomenal. Convergence has liberated some people, but cruelly denied others access to its riches. Convergence has ushered in an era of information abundance for anyone who can pay for it and caused privacy problems for others. There are few ideas more powerful in the 1990s than convergence. It has given us a united state of media, powerful for its integrative force, but confusing because it blurs old distinctions. The process of convergence is in its formative stages, but serious students will want to watch it carefully if they hope to understand and participate in the information society.



Chapter 2

THE IMPACT OF TECHNOLOGY ON A GLOBAL ECONOMY

William F. Miller

William F. Miller is professor of public and private management and of computer science at Stanford University. Formerly, he was president and chief executive officer of SRI International and chairman and chief executive officer of its two subsidiaries, the David Sarnoff Research Center and the SRI Development Company, Inc. Miller is a member of the National Academy of Engineering and a Fellow of the American Academy of Arts and Sciences, the Institute of Electrical and Electronics Engineers, and the American Association for the Advancement of Science. He serves on a number of boards of directors of businesses and of non-profit institutions. He serves on the Telecommunications and Computer Applications Board of the National Research Council, the Commerce Department Advisory Committee on Advanced Television and the Board of Assessment of the National Institute of Standards and Technology.

In our society the press offers a forum for live and lively debate on critical issues while also providing the background communication that permits more rapid and deeper understanding. Such debate permits the audience and the participants to test

ideas. That testing enables us to change, reinforce or add to our conceptual understanding of the world.

I would like to present two main thoughts for testing. First, changes in technology and changes in societal values are moving us into a new era, an era I call the *economy of choice*. Second, worldwide communication, transportation and business competition have accelerated these changes and caused the world economy to be dramatically restructured.

Let's look at these ideas in turn. What is this economy of choice? Let's take both macro and micro views. If we go back in history before the industrial revolution, back to the 17th century, the world economy would be described as an *economy of despair*, at least for the masses. Existence was a hand-to-mouth affair for most of humanity.

The industrial revolution brought about what we might call the *economy of need*. For the first time in history, Western societies could provide food, shelter, amenities and improved health care

in sufficient amounts for most of the population. Human beings were able to satisfy their major material needs for the first time.

Today we are in a post-industrial revolution (which goes by many different names). It has come forth from a vast array of new technologies and is, simultaneously, being powered by new social values and social change. In other words, the new technologies are the supply side, the enabling side for this new economy. They provide the “push.” Social change and value change are the demand side. They “pull” on the new technologies. Today, as never before, the “push” and the “pull” sides are mutually reinforcing.

This post-industrial revolution is not well recognized or understood. For instance, in the 1960s the Club of Rome predicted the failure of world society, saying that we were bound by the limits of growth and, in particular, by the limits of natural resources, agriculture and energy. These predictions were based on an industrial revolution model. They did not take into account the technological changes of the post-industrial revolution. [*Editors' note:* The Club of Rome refers to a group of industrialized countries, including those of Western Europe and North America, that developed a number of economic treaties out of meetings in Rome during the post-World War II period.]

What do these new technologies do for us? I am not going to discuss why we have them, how we got them or how they were developed, but rather to describe the impact they are having. Let me describe them in terms of three broad categories: information and automation technologies, new materials and biotechnologies.

The technologies of the industrial revolution were mechanical. We harnessed power, learned to use energy and later mastered the electrical technologies—as opposed to the current electronic technologies. Mechanical technologies brought about a revolution characterized by mass production, standardization and centralization. We organized our society around those concepts. Urban society, business structures and our educational system developed around and focused on the industrial technologies.

The post-industrial revolution is very different. It allows decentralization, customization and small-

batch production; in short, individuation. Biotechnology, for example, can produce a great deal more variation in our plant and, for that matter, animal forms. We can develop plants that will be suited for specific regions and climatic conditions. Through biotechnology we can develop drugs that not only deal with very specific diseases but could also, in principle, be designed for an individual. It is not economical today, but it is technically feasible. For instance, we have drug design programs that not only can calculate the disease-fighting characteristics of a drug but also can exclude certain effects. In other words, pharmacologists could design drugs that would treat the disease but avoid an individual's allergies. The reality is a long way off, but other technologies coupled with the capability we now have will make it economically feasible in the future.

Information and automation technologies permit concepts like flexible manufacturing, which can be used in heavy industry such as automobiles and also in low-volume facilities—such as those where electronic parts are manufactured—and even in process industries, such as the chemical and pharmacological industries. Adding computer technology—another kind of intelligence—to the manufacturing system makes customization of the product possible. Small batches can be made at unit costs equivalent to those in mass production. The computer and communications technologies also permit decentralization in management. Industry today needs fewer layers, a smaller hierarchy, because of the ability to keep in closer touch from top to bottom, to more quickly digest reports and disseminate strategic and tactical decisions.

A quiet revolution is also going on in materials. Developments range from electronic materials, like gallium arsenide, to the structural materials, like new polymers. Some of today's polymers, used in critical parts of aircraft and land-based vehicles, are lighter than aluminum and stronger than steel. Because fiber-optic materials are cheaper to manufacture, use less energy and provide higher density communication, they are replacing copper in communications cables. And more exotic materials are being developed every day.

For example, some very promising research indicates that polymer materials have the lightness

and strength to replace bone. More important, they have the porosity to permit capillaries to grow into the replacement material. With that quality, artificial bones could truly connect body parts and allow appropriate muscle and nerve growth within the artificial material. Because we also have advanced the technologies involved with immunology, we can control body reactions to such new materials.

In short, these new technologies permit decentralization, customization and individuation for both organizations and individuals. They lift the constraints of the old industrial revolution.

But there is more to the post-industrial revolution than new technologies. There has also been a very noticeable shift in societal values, especially in the developed nations of the world; and it is at least as pronounced as the shift in values that occurred in the early part of the Renaissance. Lewis Mumford illustrated the magnitude of the shift from the Middle Ages to the Renaissance when he pointed out that the seven deadly sins of the Middle Ages—avarice, envy, gluttony, lust, pride, rage and sloth—all became virtues during the Renaissance. Those new values powered the Renaissance, and later the industrial revolution, giving rise to the desire to act, to achieve, to acquire. The technologies of the industrial revolution satisfied that value set. A reasonably large number of people could have material possessions, adequate food and improved personal resources. There was mutual reinforcement of desire and ability.

The change in social values today is toward more attractive values. There is an increase in the population of the group SRI International's researchers call the "inner directed," as opposed to Riesman's so-called "outer directed." These inner-directed people are more interested in personal development, more interested in societal issues, more interested in experiences and learning. They want to see themselves as individuals. Interestingly enough, while seeing themselves as individuals, they also want to feel they are part of something bigger than themselves; they are interested in issues.

People holding these new values constitute somewhere between 20 and 25 percent of the population. They are trendsetters; they know how

to work the system, and, interestingly enough, they have a strong work ethic. They get a great deal of satisfaction out of their work; in fact, their work ethic is so strong that job satisfaction becomes a major value, even more important than sheer financial reward. Perhaps the highest need in their hierarchy of values is personal productivity, their need to do something to make a difference.

To illustrate, these are the people for whom Merrill-Lynch changed their ad from the herd of bulls, the very strong, powerful symbol that had been the mainstay of their ads, to a single bull—a breed apart.

These value changes are pointing toward a new, distinctly American response to global competition. It will be based on the values of individualism, diversity and choice, which are behind the increase in entrepreneurship and grass-roots initiatives of all kinds. They provide the United States with an important source of strength in meeting the challenge of global competition.

On the consumer side, the growing diversity of values and lifestyles has led to a breakup of mass markets and an increasing demand for more customized products and services, which is being met by the new technologies. I refer to these new markets as *stiletto* markets, too small to be a niche.

Global competition, new technologies and changing values combine to create the economy of choice. This economy is based on higher quality, individual taste and a desire for personal experience, as opposed to economies based solely on lower costs. The economic choices available to consumers have increased immensely. Today we can purchase products made anywhere in the world; it is a changing and a global marketplace. The shift from the old to the new economy could be characterized as a shift from materialism to experience, from quantity to quality, from uniformity to diversity, from centralization to decentralization and, organizationally, from hierarchies to problem-solving units.

As society organizes around these new values and technologies, we will not simply extend from the past but instead will see new primary modes, with new organizational forms, with different capital, material and human-resource requirements.

Let's look now at the second key thought, the

restructured world economy. First of all, we must realize that we are truly part of a world economy. No nation, city, region, company or union can shield itself from the effects of this world economy.

We cannot escape, so we must compete, unless we want to be left behind. We can always compete by lowering our standard of living, but that is clearly not desirable. For instance, Bangladesh competes with its particular products—unlike the United States, it has a trade surplus—but its people have an impoverished standard of living.

One of the realities of the global economy today is that we do not need as much in the way of primary products. The world as a whole produces enough food for its population, although there are still terrible distribution problems.

The downsizing of automobiles and the miniaturization of other products, coupled with substitution of new materials and the drive to greater energy efficiencies, have reduced the need for primary commodities. As a consequence, commodity prices are at historic lows. This is the first time in world economic history that a collapse in commodity prices has not had serious consequences for the world economy. Commodities simply do not have the great importance they did in the industrial revolution.

Why have these changes come upon us so rapidly? Why did we not anticipate them? We have never been very good at predicting the impact of technology. In the early days of railroads, people felt that they would just be feeders for the canal system; no one envisioned that the railroad would become a primary mode of transportation. Twenty years ago we were worried about greater food production and feared the coming materials and energy shortage.

First, we tend to overestimate the short-term impacts of technologies and underestimate the long-term impact. Neither most economists nor the public expected the conservation programs leading toward more energy efficiency to have much impact. In the short term, the control capabilities, the new production processes—all of which use less energy—did not have an impact. In fact, the capital investment required to make those changes led to lower production costs and the lowest use of energy per unit of GNP in recent economic history.

Second, we seldom see the impact of combined technologies. In agriculture, we focused on increases in production but did not focus on the impact of preservation and improved transportation systems. For example, in India, efficiency in getting the food from the field to the consumer has improved more than has production per acre. In the 1960s, due to poor preservation and transportation, only about 20 percent of the food produced in the field got to market; today nearly 80 percent gets to market. India is now a net exporter of food.

In the areas of new materials and medical advances, for example, we could foresee that research in organic and inorganic chemistry might lead to new materials and to a new understanding of physiology and drug development. What we did not expect was that the addition of computers and computer modeling would permit a more rapid testing of these design concepts.

Third, we did not foresee new technologies becoming a primary mode of industry, as opposed to simply being a substitute for existing products. Fiber optics does not simply substitute for copper but also provides an entirely different kind of communication system. Satellite communication is not simply a substitute for normal broadcast communication but also provides the opportunity for various kinds of remote sensing, surveying and other activities that we would normally not associate with communications. Computer-controlled manufacturing does not simply make mass production more efficient, but also permits flexible manufacturing and a different organizational approach.

But let's return to the world economy. Every country is having to find new ways to compete in the midst of rapid change.

Basically, we can adopt any of four strategies: We might call the first strategy the *smart strategy*. It would emphasize higher value-added products—with more intelligence to them, more sophistication in their design and higher quality. The second strategy could be called the *commodity strategy*. Companies adopting it will try to compete on price by improving processes of production as well as using modern technology for a more efficient distribution system. For example, Metallgesellschaften, a major metals acquisition and production company in Frankfurt, Germany, no